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*"To the solid ground
Of nature trusts the Mind that builds for aye."*—WORDSWORTH.

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International Co-operation in Social and Economic Problems

AT a time when confidence in the League of Nations is being sadly shaken, the progress of the International Labour Organization, as shown by the recently issued annual report, is a welcome reminder of the realities of international co-operation. The emphasis which the tragic events of the last few years has laid upon the necessity of social justice as a condition of peace, both internal and external, has brought the aims and the potentialities of the Organization into stronger relief.

Beyond question the Organization has emerged stronger, and not weaker, from the slump. Its advisory and information services have been increasingly recognized by countries all over the globe. Its activity has been more than sustained, and there was never a time when a wider prospect of constructive work could be discussed; even in membership, the withdrawal of Germany in 1933 has been offset by the entry of the United States, the U.S.S.R. and Egypt.

The outstanding features of the past year have been the success of the American Labour Conference at Santiago, which has stimulated the publication of a series of valuable monographs on economic and social conditions in South America, the Maritime Conference dealing with hours of work at sea and the World Textile Conference convened at Washington at the end of the year.

Despite all political and ideological differences which impede international relations at the present time, the good will necessary for international agreement is still to be found in the social field. The technical aspects of migration problems are once again receiving attention, and a fresh start is being made in dealing with the social problems of the countryside.

What gives especial interest to the annual report prepared by Mr. H. B. Butler, director of the International Labour Office, however, is the admirable survey which he presents of the international situation as a whole. Avoiding the snare of excessive occupation with the details of the progress of the International Labour Organization itself, he gives us a balanced and impartial discussion of many of the national tendencies and policies, upon the integration of which the future of our economic and social order depends. In the present report, for example, he reviews the extent of recovery from the slump, seeks to indicate certain lessons to be learnt and to emphasize some of the main problems and tendencies at the present moment.

To-day there can be no doubt that a large measure of recovery has been accomplished, but there are widespread doubts as to the attainment of any real stability or equilibrium. Moreover, the recovery has been achieved mainly by the

positive action of Governments and peoples, and this in itself affords an excellent reason for learning from experience of a slump to build barriers against the recurrence of similar catastrophes.

The evidence of recovery afforded by charts of production and unemployment is decisive. It is less convincing in statistics of world trade, and freer international trade remains one of the prime necessities if any real confidence about stability or permanence of recovery is to be felt. Only a beginning has been made in stabilizing currencies and in reducing trade barriers, and in the meantime the growth of armaments and the uneconomic activity which it represents constitute a serious threat to such recovery as has been achieved, all the more in a period of rising prosperity. Mr. Butler's survey should leave no one in doubt as to the menace which recent developments in this field present to economic and social progress until a peace system guaranteed by an effective League of Nations has been organized.

It is, however, in his discussion of the lessons of the slump and of current problems and tendencies that Mr. Butler is most suggestive. Against the uncomfortable realization that prosperity does not of itself move along a straight and even course but is inclined to proceed by upward and downward waves, he sets a firm conviction that the experience of the slump has demonstrated that man is capable of exerting a degree of control over his economic destiny. This is the more important because the buffets of economic misfortune are no longer accepted with the same docility as in the past. In fact, the demand for a national economic policy may become as insistent as was the demand for a public health policy fifty years ago.

The experience of the slump has already revolutionized the traditional view of the unemployment problem. It has disposed of the old fetish that there is no such thing as involuntary idleness, and that efforts to provide work or sustenance for the unemployed are an unjustifiable interference with the law of supply and demand. The positive value of State aid to the unemployed has been demonstrated beyond question, independently of its economic value.

Sir Josiah Stamp's recent plea for investigation of population questions finds further support in some of Mr. Butler's comments on population changes in relation to unemployment. The greater difficulty of reabsorbing displaced workers is not due entirely to the greater impact of technical change on the volume of employment; the decline

in the rate of population increase in all Western countries is a much more serious factor, which aggravates the effect of technological unemployment. Moreover, technical changes mean now not merely new vocations for the younger workers or entrants to industry, but also actual displacement of those already at work. Vocational training to an increasing extent involves the training and re-adaptation of the older workers. This situation is the more serious because, while the changing age distribution in population is increasing the supply of older and decreasing that of younger persons, the accelerating tempo of industry is constantly reducing the age of maximum efficiency and consequent demand for older workers.

The difficulty of finding employment for middle-aged workers of all types is enhanced by the natural prejudice in favour of young men and women, even in the newer and growing occupations for which middle-aged men are quite suitable, and one of the gravest dangers at the present time is that the 'hard core' of elderly unemployed will continue to grow, with serious consequences to the whole economy of social services. Fortunately, the experience of the slump provides welcome evidence of the ability of social insurance as an institution to meet the exceptional and unprecedented demands upon it and even to extend its operations. This fact, however, stresses the necessity for close attention to the effect of the changing technique of industry on the character of the insured population and to the biological changes in the composition of almost all Western populations. Only by careful investigation of the problems thus presented can we hope to secure the stability of our social insurance systems under growing pressure.

It is remarkable, in some ways, that the depression has led to increasing recognition of the value of the minimum wage, and that the dogma that the most effective way of combating depression lay in the reduction of wages has largely been refuted. At the same time, it is increasingly recognized that incomes, not wage rates, form the foundation of living standards, and considerable progress has been made in raising the standard of civilization by supplementary methods such as family allowances, educational allowances or social insurance. Equally remarkable is the fact that the problem of leisure has been accentuated, not retarded by the slump. The tendency has been towards shortening the working week and not lengthening it, as in previous slumps. The problem of leisure, whether from the point of view of

holidays with pay or education, forms part of a general demand for a better and wider life which is the present trend of social progress.

Mr. Butler makes pertinent comments upon the importance of monetary policy in its international aspects, but even here he can point to evidence of the beginnings of a new monetary technique, which may assist in dealing with some of these social and economic problems in accordance with the ideal of social practice. Moreover, in the extension of Government intervention in the economic world he sees further possibilities of progress, if only the horizons of thought are widened and not limited to nationalist boundaries. He recognizes that it is almost inevitable for nations to attempt some degree of national self-sufficiency, clearly as he recognizes the dangers and disturbance to progress caused by the voluntary isolation of so large an economic unit as Germany. He reiterates the importance of foresight and planning in connexion with armaments and avoiding another depression,

and the necessity for developing an adequate technique for this purpose in time.

No reader of this report can be in any doubt as to the seriousness of the consequences of certain tendencies in national policies in economic and social affairs at the present time, or to the imperative need for thorough scientific investigation of population and allied questions. Nor does Mr. Butler leave us in any reasonable doubt as to the efficiency of existing international co-operation in social and economic questions. Even the few examples he cites of recent experiments at control within national boundaries indicate how hopeful the future might be if public opinion could be stirred to demand the necessary investigation and co-operate planning. This latest report gives us a most encouraging prospect of the possibilities of social control at the very time when scientific workers have come to consider, on a scale more widely than ever, just what might be done to elaborate an adequate programme and technique.

Offence and Defence in Gas Warfare

Chemicals in War :

a Treatise on Chemical Warfare. By Dr. Augustin M. Prentiss. With Chapters on the Protection of Civil Populations and International Situation, by Major George J. B. Fisher. Pp. xviii + 739. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 45s.

THE author's intention in the publication of this comprehensive work is to present to the public an authentic account of a much misrepresented and misunderstood subject, to give the American point of view on chemical warfare and to trace its development from its beginning in the World War to the present time. He is well qualified to undertake such a task, as he served in the War as assistant to General Fries, who was chief of the Chemical Warfare Service of the American Expeditionary Forces, and he has been on continuous duty in the American Chemical Warfare Service ever since.

Colonel Prentiss describes in full detail all the chemical agents that were used by each of the nations engaged, and also their method of manufacture and their comparative success, and he discusses the probabilities of their future employment as well as post-War developments. He refers to the sensational articles which appear from time to time about some new super-gas, a few hundred

pounds of which, dropped from aeroplanes, could destroy New York. These, he says, are invariably the figments of the imagination of writers who have neither technical nor professional knowledge, and they are found to be, when analysed, without the slightest foundation of fact. But this does not mean that there may not be much more effective chemical agents in the future, though there is little to be gained in finding them while the full possibilities of those already known remain unexploited. For example, an average of only 33 casualties resulted in the War from the use in battle of 1 ton of mustard gas, whereas it has been proved experimentally that there is enough potential poison in this quantity to kill 45 million men !

The evolution of the tactics employed in discharging gas clouds and artillery and trench mortar gas projectiles is traced, and the opinion is expressed that gas troops were more highly developed and more extensively employed by the British (the Special Brigade) than by any other nation. He also confirms the opinion held in Great Britain that the use by the French of prussic acid gas in their shells (of which four millions were filled with the substance) and by the Germans of their Blue Cross shells (of which fourteen millions were filled) were two of the major errors in the gas war. Far too many chemical agents were used in the field, and there were long delays in their

production; and gas was filled into shells designed for high explosive, which, with the fuses supplied, were quite unsuitable for the purpose. In fact, a heavy price was paid for lack of pre-war preparation, and the wonder is now how the amazing results achieved were ever accomplished.

The author has some interesting remarks to offer on the gassing of cities, and he considers that the effects of volatile gases, such as phosgene, can be largely avoided by taking refuge in buildings, closing the windows and doors and seeking the upper floors. Mustard gas sprayed from aeroplanes would be much more effective, and if it reached the target aimed at, it might result in serious non-fatal casualties to all unprotected persons exposed to the vapours for a period of half an hour.

Major Fisher, also of the U.S. Chemical Warfare Service, who has written the chapter on the protection of civilian populations, is of the same opinion. He thinks that the spraying of liquid chemicals from aircraft necessitates flying at altitudes of not more than 300 ft. and the deposit of spray directly on exposed personnel; but that this task would be so difficult that the employment of such liquids in aerial attacks would be limited to the dropping of vesicant-filled containers. "All military experience with chemical warfare,"

he says, "shows that gas may be countered by organized protection. Careful planning and preparation to this end must, therefore, appeal to and elicit the co-operation of every public-spirited citizen." It is interesting to note that the measures he advocates are precisely those recommended in the Air Raid Precautions handbooks published by the British Home Office, namely, the utilization of designated rooms within homes or residential or commercial buildings, and sealing them as gas refuges.

There are very complete chapters on chemical defence, and in summarizing the effectiveness of chemical warfare in the field the author tabulates a great deal of information collected from all available sources to show the increasing use that was made of gas in the War and its relative value to other weapons in casualty production: gas was four to five times more effective. Each casualty required 500 lb. of high explosive or 5,000 rounds of rifle and machine-gun ammunition, whereas a casualty resulted from the firing of every 22½ mustard gas shells.

This volume contains more than seven hundred pages, and is well illustrated. It comprises a very complete and impartial study of chemical warfare in all its phases, and is therefore a valuable book of reference.

C. H. FOULKES.

Organic Chemistry of Nitrogen

The Organic Chemistry of Nitrogen

By Prof. N. V. Sidgwick. New edition, revised and rewritten by T. W. J. Taylor and Dr. Wilson Baker. Pp. xix + 590. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 25s. net.

IT is refreshing to find a book which not only is thoroughly interesting to read on account of the way in which the subject-matter is presented, but is also sufficiently comprehensive to serve, for ordinary purposes, as a reference book for the range of material treated. The second edition of N. V. Sidgwick's "Organic Chemistry of Nitrogen", which has been entirely rewritten by T. W. J. Taylor and Wilson Baker, preserves that balance between interest and comprehensiveness which made the original so valuable. These authors have, in fact, adhered closely to the plan of the first edition in dealing only with the simpler organic compounds of nitrogen, although necessarily the newer book is longer, as it presents much material only discovered since 1910, the date of the first edition. For the most part the actual chapter headings of the two books are the same: the new

edition omits the chapter on derivatives of uric acid, only heterocyclic compounds which contain one nitrogen atom being treated; it omits also the subsection on the simpler alkaloids; it replaces the subsections on amino-acids and on aliphatic diazo-compounds and hydrazoic acid by separate chapters; and it treats all the carbonic acid derivatives together in one instead of two chapters.

Much of fundamental theoretical importance has happened in the twenty-seven years which have elapsed since the publication of the first edition. An old controversy in the chemistry of organic nitrogen centred around the question as to whether nitrogen could exert five valencies. The electronic theory of valency has since provided an answer to this question, leading to the formulation of nitro- and azoxy-compounds, the nitrile and amine oxides, and compounds of the type NR_4 as derivatives of quadri-covalent nitrogen.

In the introduction, Prof. Sidgwick stresses his belief that the conception of resonance is the most important development which structural chemistry has had since its extension to three dimensions by

van't Hoff. Use has been made of this idea throughout the book to explain the remarkable stability of certain compounds (for example, aromatic compounds), the notable modifications often exerted by one group on the properties of another (for example, the amino- on the carbonyl group and vice versa in an amide), and generally the absence of isomers to be expected from the older structural formulæ.

As in the original book, questions of structure are treated very fully, and physical as well as chemical methods of determining configuration are discussed. Here the new edition contains much fresh matter, owing to the development of physical methods. Among these may be mentioned the use of (a) Raman spectra, for example, to prove the presence of traces of $\text{HN}:\text{C}$ in $\text{HC}:\text{N}$, and to elucidate the structure of the isocyanides, the cyanogen halides and the thiocyanate ion; (b) the electron diffraction method, to prove that diazomethane has an open-chain structure; (c) X-ray

analysis, to show that the azide ion is linear; (d) dipole moments, to distinguish between *syn*- and *anti*-*N*-ethers of oximes, to fix the structure of azobenzene as *trans*- and to confirm the structure of the isocyanides; (e) heats of formation of links from atoms, to prove the structure of the cyanogen halides.

The book should be of great value to students: for whereas, under the present system of short intensive courses, it would scarcely be possible for a science degree student to master the whole contents, yet the greater part of it may be said to be useful examination knowledge; whilst to read the whole book cannot but be interesting and stimulating, since it shows how problems are attacked, and indicates, to some extent, further subjects requiring elucidation. To more senior people, no longer students in the technical sense, the new volume will be welcome as an old and valued friend, after long absence returned with added charm and strength.

E. H. I.

Coronation Ceremonial

A History of the English Coronation

By Prof. P. E. Schramm. Translated by Leopold G. Wickham Legg. Pp. xv+283. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 12s. 6d. net.

NOW that the coronation of His Majesty King George VI is a thing of the past, it is possible to take stock of the more immediate results which have emerged. Among these not the least impressive is the manner in which it has been emphasized on all sides, as never before, that this ceremonial has a living meaning for the peoples of the British Empire. It has been, in fact, from first to last, and not merely on one day and within the Abbey walls, a solemn act of mutual dedication between king and people. In this unprecedented appreciation of the solemnity of the occasion, science has played no small part by the application of its resources to meet the needs of the occasion, especially in methods of record and transmission of news, and more particularly by the manner in which the general public has been enabled to participate in the varied ceremonial and pageantry through the development of wireless telephony and the cinematograph.

This expansion beyond the immediate scene of action in essence breaks no new ground. It follows tradition in incorporating the coronation rite in the life of the people. This has been brought out

by the more serious attempts which have been made to trace the history of the observances marking the inauguration of a king in British history. Among these, Dr. Schramm's account takes its stand in the first rank, if only for its appreciation of distinctive features in a peculiar product of English methods in practical affairs.

In the matter of the English coronation, indeed, Dr. Schramm is something of an enthusiast. His book conveys the impression that not only is it pivotal in the English constitution, but also that its history is a mirror of the relations of king, church and people in domestic affairs, just as, at least in the early stages, it was made a determinant of the status of the English monarch in Continental contacts and policies. In form, Dr. Schramm holds it to be completely an expression of the English character, while in a sense it is its supreme political achievement. His study of the English royal inaugural rite falls into two sections, of which the first is a comparative history of the practices of northern Europe from the time of the earliest records, and the second contains three essays on the theory of the coronation, which deal respectively with the rite of anointing, the electoral element in the acclamation and recognition, and the contractual element in the coronation oath.

Dr. Schramm writes with an authority which is firmly based on a close study of the English coronation *ordines*. His profound knowledge of the medieval mentality, towards questions of a

theologico-legal nature, such as for example investiture, adds weight to his judgment in matters of doubtful interpretation; and when, as on occasion, he differs from generally accepted opinion, his verdict cannot be lightly set aside. His analysis of the development of the rite in relation to the growth of constitutional theory out of current events in the successive periods of English history is both stimulating and suggestive.

The rite, as we know it from textual evidence, is traced by the author to St. Dunstan in the tenth century, its derivation being West Frankish; but the elements of the rite, it is admitted, were of a much more ancient origin. Dr. Schramm

makes the pregnant suggestion that early practice must be viewed in the light of the fact that, in the passing of possession, the Saxons made no distinction between 'public' and 'private'; while the enthronement of the heir is compared with the pagan custom of seating the one who carries on the succession on the burial mound of his predecessor as a clue to the resolution of the apparent opposition between inheritance and election. While Dr. Schramm points out that there is a magical background to the ceremonial throughout, he has barely touched on this aspect. This is the more to be regretted, as he has thereby weakened his treatment of the origins of the rite in what is otherwise an excellent study.

African Pleistocene Mammals

Wissenschaftliche Ergebnisse der Oldoway-Expedition 1913

Herausgegeben von Prof. Dr. H. Reck. Neue Folge, Heft 4. Pp. 142+8 plates. (Berlin: Dietrich Reimer, 1937.) 34 gold marks.

THE fossil remains of mammals found in the Middle Pleistocene freshwater deposits at Oldoway in Tanganyika Territory are interesting because they include several survivors from the Pliocene period, mingled with a typical modern African fauna. Primitive elephants, such as *Dinotherium* and *Mastodon*, and three-toed horses, which became extinct in Europe before the Pleistocene period, lived in east Africa until towards the end of this period, and were associated with numerous mammals which are only varieties of those still existing on the same continent. We therefore welcome another instalment of Dr. H. Reck's valuable volume on the collection of these fossil mammals which he made in 1913, and look forward to the early publication of a similar report on the second collection made in 1931 by Dr. Leakey's expedition, in which Dr. Reck also took part.

The new instalment of the German report begins with an exhaustive description of the remains of antelopes by Dr. Ernst Schwarz. For this work Dr. Schwarz found it necessary to study and compare the skeletons of the existing African antelopes more closely than they had been studied and compared before; and his observations suggest some changes in the generally accepted classification, which he discusses and tabulates. Among the fossils he recognizes only fourteen species, which are very few compared with the number of species now living round Oldoway. He also notes that some

of the fossils belong to species which at present exist only farther north in Africa. With rare exceptions the fossil forms must be regarded as merely varieties of the existing species, but they are sometimes of smaller size with less developed horns. A variety of the brindled gnu is so common that it seems to have lived on the spot in large herds, and a considerable proportion of the remains belong to young individuals.

In the next two chapters Dr. W. O. Dietrich describes some fragmentary remains of pigs and giraffes, among which two teeth and a metacarpal bone of *Sivatherium* are the most interesting. The teeth were at first referred by Schlosser to *Helladotherium*, but the later discoveries by the Leakey expedition suggest that the new determination is more likely to be correct.

In another chapter Dr. A. T. Hopwood describes the remains of horses, among which the distal half of the associated three metatarsals belongs to a three-toed form like *Hipparion*. The teeth, which probably represent the same species, seem to be referable to *Stylohipparion*; this occurs fossil in the Orange Free State. With these fragments have also been found teeth and bones of ordinary one-toed horses, among which the well-preserved lower jaw of an apparently new species of zebra is noteworthy.

In a concluding chapter Dr. Reck himself describes the frontlet with horn-cores of a remarkable antelope, which seems to belong to a new extinct genus. He is to be congratulated on having thus completed the task of making known the Oldoway fossil mammals which he and his colleagues began more than twenty years ago. There now remains only the geological report, which will complete the work. A. S. W.

Annual Reports on the Progress of Chemistry for 1936 Vol. 33. Pp. 512. (London: Chemical Society, 1937.) 10s. 6d.

THE annual reports on the progress of chemistry, published by the Chemical Society, have for long tended to become collections of monographs on selected phases of the process whereby the science is advancing along the parallel paths of experiment and theory. In this way both professional chemists and other readers interested in the progress of the natural sciences can best be presented with an outline sketch of what is in reality a rapidly expanding and frequently changing picture.

The subject-matter is broadly divided into radio-activity and sub-atomic phenomena, general and physical chemistry, inorganic chemistry, crystallography, organic chemistry, biochemistry and analytical chemistry. The method of treatment may be exemplified by quoting the titles of the sections of organic chemistry, as follows: stereochemistry; carbohydrates; natural resins; aromatic compounds; dehydrogenation in the determination of structure; synthesis of polycyclic hydroaromatic compounds; natural products of the sterol group; heterocyclic compounds; alkaloids; vitamin B₁ and thiochrome. Under "Chemical Kinetics", the quantal theory of chemical change, the object of which is to predict the absolute magnitude of the velocity of chemical reactions of all kinetic orders in homogeneous and heterogeneous systems, is discussed. The chapter on atomic weights refers to the importance of establishing an invariable standard for chemical work, a requirement which has arisen from the discovery that oxygen in air is heavier than oxygen combined in water. A summary of recent work on fluorine and its compounds and on the rare earths is given; it is interesting to be reminded that the rare earths as a whole are not particularly rare, being as plentiful in Nature as lead, zinc or cobalt.

Reference is made to a new modification of insulin therapy involving the use of protamine insulinate, and considerable space is devoted to the phenomena of photosynthesis in plants, whilst the new magneto-optic method of chemical analysis is briefly criticized. Since in every case the authors are investigators of acknowledged authority, the volumes of this series are of permanent value as well as of immediate interest.

A. A. E.

An Outline of Malayan Agriculture

Compiled by D. H. Grist. (Malayan Planting Manual, No. 2.) Pp. xiii+388+86 plates. (Kuala Lumpur: Department of Agriculture, 1936.) 3 dollars.

THIS handbook, which has been prepared by the Agricultural Department in Malaya, is an enlarged and completely revised edition of one published some years ago. It supplies information on all aspects of Malayan agriculture.

The first chapters are devoted to a general discussion on agricultural conditions (including land tenure) and agricultural practice throughout the Peninsula. Part 3 of the volume deals in detail with the major crops, which are rubber; coco-nuts, rice,

oil-palms and pineapples. Parts 4 and 5 are devoted to the numerous secondary and minor crops of that region, including the large groups represented by fruits, vegetables and spices. Although some of the crops or plants dealt with, such as the durian, mangosteen and rambutan are typically Malayan or East Indian, most of the others are cultivated generally throughout the tropics. The book should therefore be of interest or value to agriculturalists in other parts of the tropics besides Malaya. In the section on livestock, cattle, pigs, poultry and freshwater fish are dealt with, and in the appendix there are lists of import and export duties, Malayan weights and measures and a full bibliography. A large number of photographs are used to illustrate the text.

The authentic nature of the information and the amount of detail contained in this handbook, combined with the care and thoroughness with which it has obviously been prepared, should place it in the front rank of works on tropical agriculture.

Higher School Revision Mathematics

By L. Croeland. Pp. viii+164+xviii. (London: Macmillan and Co., Ltd., 1937.) 3s. 6d.

THE usefulness of the author's "Revision Mathematics" for the First School Certificate Examination has led to a request from teachers for a similar book dealing with the pure mathematics required by the non-specialist for the Second or Higher Certificate Examination. The present volume has therefore been compiled to supply this demand.

The book provides a large number of exercises arranged in four main groups: algebra, trigonometry, geometry and calculus. Each section is introduced by some fully worked-out questions which are well chosen to illustrate the main points essential for adequate revision. The graphical illustrations are especially clear, and should lead pupils to see that what they sometimes consider to be rather a dull part of the subject, is really very interesting and stimulating. The section on integration, too, deserves special mention for its clarity and completeness. It should certainly help to pilot the pupil through the great sea of the calculus.

The concluding section consists of a very useful set of typical examination papers illustrating the standard required by the various examining authorities.

The book is excellently adapted to its purpose, and may be confidently recommended. We notice a few errors which will no doubt be corrected in a future issue.

Quantity Surveying for Builders:

a Text-Book for Surveyors, Civil Engineers, Builders and Contractors. By Wilfrid L. Evershed. (Directly-Useful Technical Series.) Fourth edition, revised. Pp. xix+282+12 plates. (London: Chapman and Hall, Ltd., 1936.) 10s. 6d. net.

THE fact that this work has necessitated four editions in fourteen years shows that it is fulfilling a definite need. Designed to illustrate methods commonly used in the best London practice, and clearly illustrated and set out, it can be recommended with confidence not only to students of quantity surveying, but also to the practitioner.

The Synthesis of Large Molecules*

By Prof. H. Mark, University of Vienna

NORMAL molecules with which the organic chemist has been concerned for many years, and which have led to an enormous number of interesting and important chemical combinations with valuable properties, have molecular weights between 50 and 2,000. Only a very few of them are smaller and few are larger, but even then they do not exceed these limits by a considerable amount.

For some time, it has been known that certain types of chemical reactions lead to products which do not crystallize and to which therefore was attributed the name of 'resins' or 'resin-like' substances. To identify and reproduce them was very difficult; hence for a long time it was considered that they could not be taken as objects for scientific investigation. But these substances offered mechanical, thermal and electrical qualities which made them very important from the technical point of view, and interest in their structure and synthesis began to develop.

On the other hand, the study of such natural products as cellulose, proteins, rubber, starch, silk, chitin, etc., led to the conclusion that their structural principles were the same as those of the synthetic resins; and the interest in this group of bodies was intense in view of their biochemical and technical qualities. Therefore a number of scientific workers began to investigate large molecules with enthusiasm; and our knowledge of them has rapidly increased.

It was found that two types of large molecules exist, one with chain-like molecules, another with large molecules which have the structure of a two- or three-dimensional network. In both cases, the number of atoms which are held together by normal chemical main valencies is very large—between 10^3 and 10^4 —and hence their molecular weight lies between 10^4 and 10^6 ($O = 16$). Several other qualities of these large molecules have been studied and cleared up; for example, their shape, reactivity, mechanical and optical behaviour, etc.

After our knowledge on the outstanding qualities of these bodies had reached a certain point, interest was aroused in that type of chemical reaction by which such macro-molecules are built up, and it is proposed to give a very short survey of the present state of evidence of this kind of chemical reactions, the so-called *polymerization* and *polycondensation* reactions.

* Friday evening discourse delivered at the Royal Institution on April 22.

THE POLYMERIZATION REACTION

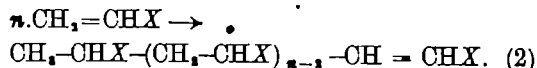
Small organic molecules with one or more double bonds have the peculiarity of polymerizing under certain conditions of temperature, pressure, etc. This polymerization leads mostly to macro-molecular substances, which are therefore also often called *high polymers* or *high polymeric substances*. Let us consider the most simple chemical molecule with a double bond, namely, ethylene and its derivatives.

In this case the total polymerization reaction (of an ethylene derivative) is given by the relation



In this equation, X signifies the substituent ($\text{H}, \text{CH}_3, \text{Cl}, \text{C}_2\text{H}_5, \text{OH}$, etc.), n is a number of the order of magnitude between 10^3 and 10^4 . The left side of the equation (1) represents a great number of *independent small* molecules, each of which is completely known regarding its structure and contains a double C-C linkage. The right side gives a large molecule, the structure of which is not quite clear in all its details, which contains all the atoms contributed by the n molecules linked together by main valence bonds.

Frequently the macro-molecules built up from ethylene monomers are *chains*, and in such cases one may write equation (1) in more detail thus:



In this case, a certain assumption is made as to the internal structure of the chain-like macro-molecule, an assumption which is justified in some cases by considerable experimental evidence. Many chain polymerization processes were carried out with substances of this kind and formulated by relations of type (2), and it may be pointed out that Staudinger in Germany and Carothers in the United States especially have worked systematically in preparing macro-molecules by the aid of such processes.

Besides the material which is built up hereby, and which at first absorbed the whole attention of investigators, the *mechanism of the process* by which such long chains are formed is also of great interest and hence should be studied systematically. We have therefore in Vienna in the last five years carried out some series of experiments to elucidate

the different steps of typical polymerization reactions.

From the beginning, it is clear that the numerous independent particles on the left side of equation (1) cannot be linked together in *one single* collision process, which would have a vanishing probability, but that there must be a kind of growth, which builds up the long chain. This *growth process* is the aim of our studies; it seems to be not only of scientific interest in connexion with the physical-chemical problem of reactivity, but also of technical and biochemical importance. The technical significance may be confirmed by the fact that a great number of synthetic high polymers are of considerable interest, such as artificial rubber, insulators, varnishes, etc., while the biochemical importance is indicated by the observation that our own bodies and the skeletal substances of all plants and animals are built up of high polymeric substances and that therefore the growth processes of organized Nature may be connected with the reactions studied. In any event, a profound knowledge of the simplest polymerization reactions will be indispensable for the understanding of natural growth. We thought, therefore, that it might be worth while to devote some work to a thorough investigation of the kinetics of polymerization.

The general situation was not unfavourable: the kinetics of normal chemical reactions even of a rather complicated type was cleared up recently to a considerable extent by such scientific workers as Abel, Bodenstein, Bonhoeffer, Hinshelwood, Polanyi, Rideal, Semenoff, H. S. Taylor and others. The experimental procedure is not too complicated and the methods of following gradually the rate of the process are more or less worked out. Besides our own studies (carried out in the Chemical Institute of the University in Vienna by Breitenbach, Dostal, Jorde, Marecek, Pilch, Raff, Rudorfer and Sues) in the last four or five years, authors such as Bawn, Chalmers, Flory, Melville, Norrish, Rideal, Schulz, Taylor, Vernon and others have contributed valuable results, and one can summarize the present state of our knowledge in the following way.

(1) The whole polymerization process is very *complicated*, even when only chains are built up, and depends to a high degree on such experimental conditions as temperature, pressure, solvent, presence of catalytically active bodies, etc. But in the simpler cases—and only these have been studied carefully up to date—one can always distinguish three typical steps in a reaction of this kind.

(a) *The building of germs or nuclei.* No polymerization can take place if there is not an *initiation process*, by which unsaturated and highly

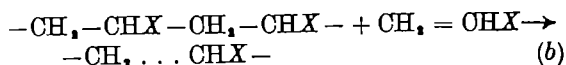
reactive 'germs' are formed. This process can be monomolecular, bimolecular or of another order, and furnishes the *centres* of growth. It consists in the fact that in a certain molecule a very high amount of activation energy or unsaturation is concentrated either by impact with another particle of high energy, or by absorption of a photon or by the formation of an intermediate combination. In any event, this *germ-building reaction* is rather slow and very dependent on the temperature or on the presence of a catalyst (including light).

This first step has been called the 'starting' process, and we can formulate a thermal bimolecular starting reaction, for example,



where the nucleus on the right side has two free chemical main valencies and therefore represents a very high free energy. Consistent observations by different workers led to the conclusion that the *activation energy* of the starting reaction in the case of polymerization of ethylene derivatives lies between 20,000 and 30,000 cal. per mol. The reaction is therefore slow and the germs are produced with a limited velocity.

(b) *The reaction of growth.* If an unsaturated germ is formed in the solution, there are two possibilities for its further fate. It may collide with another molecule (monomeric substance or solvent) and be *deactivated* by the impact. In this case, the nucleus just produced is annihilated again and no polymerization is started. But the germ may also *react* with the colliding particle and, if it is a monomeric molecule, may add it according to the relation:



This is a '*growth step*' and processes of this type lead to the result required, namely, to long chains, supposing that they follow one another very quickly. Really high polymeric bodies can only be formed when a slow germ production is followed by a quick growth reaction.

In fact the rate of reaction (b) is very much higher than that of (a). Measurement shows that (b) goes at least 10^4 -fold quicker than (a); every nucleus is built, begins at once to grow, and rapidly gives a chain of considerable length. This high velocity is easily understood: the free valencies at the end of the germ and of all intermediate members of the growing chain represent a high energy, and therefore the activation energy of the addition reaction (b) is rather low, lying between 4,000 and 8,000 cal. per mol., and explains the rapid growth, which is nearly independent of

temperature. Very interesting results concerned with the steric factor of growth would lead us much too far and cannot be considered here.

If the growing chains meet no obstacle during their period of adding monomolecular material, they will grow so long as molecules of the polymerizing substance are available, and the result of the whole process will depend only on the velocity of *germ formation*, k_1 , and of *growth rate*, k_2 . The competition of these two influences was discussed quantitatively by Dostal and Mark, and formulae have been derived and compared with the experimental results. It seems that only in very special cases one can reduce the whole complicated polymerization process to these two steps alone; mostly it is necessary to take into account a third elementary effect, which interferes with these two steps, namely, the *breaking-off* of the growth.

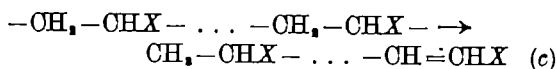
(c) *Breaking-off processes and sudden finishing of growth.* Our general knowledge of addition reactions between molecules shows that with increasing size of the reacting particles the probability for a successful collision, that is, the addition of a new member in the chain, decreases very rapidly with increased size of the molecules, even if the activation energy remains quite constant. Investigations of Evans, Eyring, Hellmann, Polanyi, Syrkin and Wassermann show that the reactivity falls off very quickly even with medium molecular weight (200-400). It is therefore to be expected that the rate of growth would be very much dependent on the actual chain length, an influence which was introduced into the formulae by Dostal and Mark, with the consequence that the growth-rate of an individual chain falls off slowly. Comparison with experiment showed that under certain conditions the polymerization of styrene seems to be remarkably influenced by this peculiar effect.

On the other hand, one must be aware of the fact that a *third type of reaction* finishes the growth of the chains by annihilating the active groups at their ends. Thus we have to introduce a third reaction constant, k_3 , which summarizes all possibilities for the saturation of the reactive spots. They are rather numerous, and it is therefore difficult to get a clear idea of the chain-breaking process.

(1) When the chains are flexible, it may happen that the two free valencies on their ends react with one another producing a ring molecule of many members. Such molecules are known from the work of Müller, Ruzicka and others, and even the kinetics of their formation was cleared up to a certain degree by Freundlich and Salomon. We do not yet know exactly how much this factor influences a given polymerization reaction, because we have no effective means of finding out how

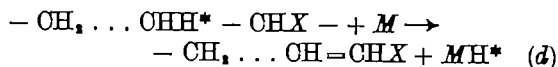
many ring molecules are present in the product of a particular polymerization reaction. In this connexion, new experimental evidence is wanted; such a breaking-off reaction would be monomolecular.

(2) A growing system can lose its active ends, if a hydrogen atom wanders along the chain and if a double bond is formed at one end:



The probability of such *isomerization* will be inversely proportional to the actual length of the chain, and a breaking-off reaction of this type will be of the first order, short chains being in greater danger of undergoing this isomerization than longer ones. Actually, in the case of short chains ($n=2$ or 3), the final products of this reaction could be isolated in one or two cases, but it is not yet clear what role this type of chain-cutting plays in the whole process.

(3) The annihilation of a single active group at one end of the growing thread-like molecule can also be accomplished during a collision according to the equation



Here the hydrogen atom H^* jumps under the influence of the collision with M from the penultimate carbon atom to the colliding particle M , and a double bond is formed. Several types of this reaction have been discussed by Dostal, Flory, Mark and Schulz. The probability of such a process is proportional to the concentration of the unsaturated ends and to the concentration of M . The latter partner may be any molecule able to take up a hydrogen atom present in the reacting system, for example, a normal monomeric particle, another growing chain, a solvent molecule or any impurity of the solution. Even the wall of the vessel could produce the change expressed by the relation (d). Therefore it is not easy in a given case to say precisely what will happen.

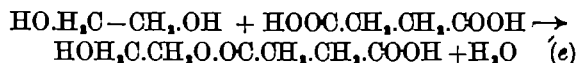
An important and interesting question is: What happens to the energy which is set free by the process (d)? As a new C-H bond is formed, we may estimate the energy excess of (d) to be about 70,000 cal. per mol. It may remain in the chain and increase its internal vibrations and rotations; perhaps with the effect that after a certain average life-time the second end of the chain is also stabilized by a similar action. But the energy may also be transferred to M and create a highly active particle. If M is a monomeric molecule, it can be transmuted into a new germ, so that one chain is ended by (d) but another is started. There are signs that something like that happens under

certain experimental conditions. If M is a solvent molecule, the energy may be dissipated by consecutive collisions, but it may also be attached to one monomeric particle in the course of reproduction of a germ with the aid of the solvent. In recent papers of Dostal, Flory, Mark, Schulz and others, these various possibilities are discussed and brought into relation with the experimental facts.

The result is that at present no polymerization process can yet be resolved quite clearly into all its elementary steps, but there is no doubt that the three above-mentioned processes, namely, chain start, chain growth, and chain ending always take the outstanding role during a polymerization reaction. Increasing experimental material will enable us to separate more and more neatly the different possible steps and to work out something like a fine structure of polymerization reactions.

POLYCONDENSATION REACTIONS

This is the second type of reaction by which high polymers can be produced. Here also we will confine ourselves to reactions which lead to pure chain polymers. In a condensation reaction a new molecule is built by removal of a part of the reactant particles; this part is usually water. If a dibasic acid, for example, succinic acid, reacts with glycol one gets:



This esterification leads to a molecule which can again react with an alcohol or with an acid, producing further reactive molecules and growing thus *slowly* to a long chain with alternate alcohol and acid members.

Reactions like this have been investigated recently by Dostal, Flory, Marecek, Raff and others. They are much easier to deal with because the intermediate products are not unsaturated but of the same type as the monomeric substance. It is therefore not a chain reaction, which we have before us, but a *stepwise esterification* for which kinetic formulæ can be derived without serious difficulties. The problem of the mutual interaction of three different elementary processes as it has to be solved in the case of polymerization is here reduced to the mathematical study of a step reaction with many steps. The production of 'germs' is here of the same order of magnitude as the velocity of growth, and therefore the chains which are formed are much shorter than in the case of polymerization. Therefore a fairly good agreement was obtained by comparing the results of experiments with the above-mentioned formulæ, and the problem of polycondensation reactions does not offer serious difficulties to a quantitative understanding.

This is a reason why the efforts of workers are being more and more concentrated on the study of polymerization processes, which still offer a great number of unsolved and interesting problems.

The Solar Eclipse of June 19, 1936

AN old practice was revived on May 27, when a joint meeting of the Royal Society and the Royal Astronomical Society was held to receive reports on the expeditions organized by the Joint Permanent Eclipse Committee of the two societies for the total solar eclipse of June 19, 1936. It was sad to observe that on this occasion the tradition by which the president of the Royal Astronomical Society sat facing the audience alongside the president of the Royal Society was allowed to lapse.

Prof. F. J. M. Stratton opened the discussion with an account of the expedition to Kamishari in Hokkaido, staffed from the Solar Physics Observatory, Cambridge, with the addition of Dr. T. Royds, of the Kodaikanal Observatory, sent by the Government of India. He mentioned that the site was chosen after consultation with the Meteorological Office and consideration of the data supplied by the National Research Council of

Japan. Unfortunately, the prevailing wind which should have given the desired weather for the eclipse chose the wrong week to prevail, and the day of the eclipse was cloudy. The second half of the partial phase was happily clear, and Dr. Royds was enabled to carry through most of his programme successfully; second contact was observed through gathering clouds which spoilt by scattering light the programme of observing intensities of chromospheric spectral lines at different heights above the sun's limb, though flash spectra were obtained; within five seconds of the commencement of totality the sun was completely covered by cloud too thick even for the infra-red cameras to penetrate; the sun did not emerge into a clear sky until 10 minutes after the end of totality.

It was unfortunate that the half of the eclipsed sun which was in clear sky for second contact and for the first few seconds of totality was on the

opposite limb to that of second contact, and valuable observations were lost by a margin of seconds only in the race of moon and clouds to cover the sun. Prof. Stratton devoted his remarks to the part of the programme which was lost due to the clouds—the polarization of the coronal light to be observed by Dr. C. W. Allen with a double camera and a Nicol prism in front of one lens, and the direction of polarization of skylight in the neighbourhood of the eclipsed sun, to be observed photographically by himself and visually by Dr. F. W. Aston with a set of Nicol prisms and Savart plates. Prof. Stratton paid a tribute to the generous help and assistance received from the Japanese authorities and scientific colleagues, and mentioned that, of the three neighbouring Japanese expeditions, all of whom had a clear sky for the eclipse, one was led by Prof. Matsukuma, of Sendai University, who had stood down from his original plan to go to Kamishari to make room for the English party.

Dr. Royds next gave an account of his measures of the displacement of the Fraunhofer lines at the centre and limb of the sun's disk with and without an eclipse. His values were as follows:

Intensity of lines	Mean displacement to red			
	Without eclipse		During eclipse	
	Centre A.	Limb A.	Centre A.	Limb A.
11.0	0.0100	0.0122	0.0078	0.0125
5.2	0.0084	0.0148	0.0068	0.0151
3.0	0.0050	0.0123	0.0068	0.0116

It was clear from Dr. Royds' eclipse observations that the values obtained from the limb without eclipse had not been seriously affected by light scattered from the bright centre of the disk, which would especially affect the weak lines. Observations had been made at distances from the centre of the sun's disk of 0, 0.28, 0.57, 0.76, 0.90, 0.95, 0.97 times the sun's radius: the observation at 0.992 and the hoped-for observation of chromospheric lines were lost owing to clouds. The explanation in terms of convection currents for lines of different intensities originating at different levels in the sun, which had been offered for the discrepancies at the centre of the sun, could not hold for the limb, and the divergencies from the predicted Einstein displacements had yet to be explained.

Dr. R. O. Redman discussed the advantages from spectrophotometry of the chromosphere of a jumping slit spectrograph (taking a series of exposures with a fixed plate) over a continuously moving slitless spectrograph: there was less trouble from scattered light, higher resolution, greater purity of spectrum, and no trouble such as arises from the varying width of the steadily narrowing crescent photographed with the slitless

instrument. He described the moving back camera specially designed by Mr. C. R. Davidson and himself for the eclipse, the instrumental set-up, and the programme of exposures at intervals of one second carried out at the eclipse through second contact. As defined by the final disappearance of the Fraunhofer spectrum, totality commenced 1 second late on the computed time.

Dr. A. D. Thackeray gave an account of the flash spectra secured by Dr. Redman with the moving plate camera and by himself with the Hills quartz spectrograph fed by light from an aluminized mirror. While in both cases the original plan of observing the changes of intensity of spectral lines with solar heights had to be abandoned because of light scattering by the clouds, yet much of value could be learned from the plates. In particular, Dr. Redman's spectra included one of the finest for the study of the transition from absorption to emission spectra that had ever been secured. He directed attention to the following points of special interest: (a) the presence of a bright line at 3969.40 Å. between $H\epsilon$ and $[H]$ never previously recorded in flash spectra and evidence of the excellent definition secured by Dr. Redman; (b) the presence in absorption of the subordinate series $3^1P^o - \pi^1S$ of Na at a stage where the D lines had practically vanished in transition from absorption to emission; (c) the displacement towards the violet of emission lines compared with the absorption lines in a spectrum taken at a distance 0.9994 r from the centre of the sun's disk; (d) the gradient of the Balmer series in emission from $H\beta$ to $H26$, with a value of lower weight for the total emission of $H\alpha$: the gradient showed manifest departure from the values given by the Schrödinger-Pauli formula, as had been found by Davidson and Stratton in the 1926 eclipse.

Prof. J. A. Carroll described the equipment of the expedition from Aberdeen to Omak: the objective interferometer prepared for a monochromatic image of the whole corona crossed by interference rings which should show by their displacements internal movements in the corona; a high-dispersion echelon spectroscope with 35 plates immersed in fluid and giving an effective thickness to each plate of 1 mm. in air; and a spectrograph for the extreme infra-red spectra of the corona and chromosphere. He then dealt in detail with the method of reducing the daily range of temperature of 12°C. to the range that could be allowed without loss of definition for the instruments, 0.1° for lenses and prisms, 0.01° for the interferometer and 0.001° for the echelon. Large thermal inertia in the optical parts and small and slow changes in the surround of each instrument were required. The hut was doubled-walled and

lagged inside; it was also equipped with heating and refrigerating plant controlled by thermostats and by fans for stirring the atmosphere. The instruments in their turn were surrounded by a further lagged cover with again a thermostatically controlled heating circuit inside. This first serious attempt at delicate temperature control under eclipse camp conditions had worked very successfully.

Mr. E. G. Williams spoke of the results obtained with the infra-red spectrograph. A composite plate had been used of special rapid panchromatic for 5800-6700 Å., Agfa 800 for the 8000 region and Agfa 950 for the region beyond 9000 Å. It had been intended to use Agfa 1050 for the region beyond 10,000 Å., but though the plates were specially flown over from Berlin to Moscow they were no longer sensitive when the day of eclipse arrived and could not be used. They were, therefore, unable to secure the lines at 10,748.80 Å., 10,797.95 Å. recently reported by Iyot. They did get a line at 7591.3 Å. in the coronal spectrum for which Curtis and Babcock in 1928 gave the

wave-length 7896 Å. and Iyot more recently from the Pic du Midi gave 7891.9 Å. No trace was found of the line about 9609 Å. to be expected if the coronal spectrum came from a doubly excited helium atom. In the chromospheric spectrum lines of the Paschen series were obtained, for the first time at an eclipse, from P4 to P17, and other lines were identified as due to He, O, Mg and Ca⁺.

In the subsequent discussion Mr. J. Evershed, referring to Dr. Royds' excellent spectra, pointed out that to reduce his shifts from an arc in air to an arc *in vacuo* meant an increase of 0.003 Å. and meant that the displacement at the limb was twice the predicted Einstein value. Prof. A. Fowler, in sympathizing with the Cambridge party on their failure, said that it was a magnificent failure. He was very much impressed by the mechanism of Dr. Redman's camera and with the very interesting and beautiful results he had obtained. He would also like to congratulate Mr. Williams on his infra-red spectra.

Obituary Notices

Prof. A. G. Perkin, F.R.S.

PROF. A. G. PERKIN died at his Leeds residence on May 30. Born at Sudbury, Middlesex, in December 1861, he was the second son of the late Sir William Perkin, brother of the late W. H. Perkin, jun., Waynflete professor of chemistry in the University of Oxford, and half-brother of the late Dr. F. M. Perkin, who was well known as a consulting chemist.

A. G. Perkin grew up in an atmosphere of chemistry and zeal for scientific investigation. His education was varied: he followed in his father's footsteps by attending the City of London School, and from 1877 until 1879 studied under Frankland and Guthrie at the Royal College of Chemistry, South Kensington, where he carried out the investigation leading to his first paper, "The Action of Nitric Acid on Di-p-tolylguanidine", communicated to the Chemical Society in 1880. He next spent a year at Anderson's College, Glasgow, under E. J. Mills, and finally a year in the Dyeing Department, Yorkshire College, Leeds, where he worked with J. J. Hummel on new compounds derived from the colouring matters of brasilwood and logwood. Perkin always paid generous tribute to the abilities and personality of Prof. Hummel, to whom he owed his first, and lasting, enthusiasm for the study of the natural colouring matters.

In 1882 Perkin left the Yorkshire College to take up an appointment as chemist at the alizarin factory of Hardman and Holden, Ltd., Manchester, and was

promoted to the position of manager in 1888. During this commercial period he continued scientific investigations and published papers on the action of nitric acid on anthracene, and in collaboration with W. H. Perkin, jun., on derivatives of anthraquinone, and on the colouring matter of the Indian dyestuff, kamala.

Perkin resigned his position with Hardman and Holden, Ltd., in 1892 to join the staff of the Dyeing Department, Yorkshire College, as lecturer and research chemist. Then followed a period of more than twenty years of intensive research, mainly concerned with the isolation of the colouring principles of natural products and the investigation of their constitutions. The profound knowledge of natural colouring matters that he gained by his brilliant researches established his international reputation in this field. He examined numerous natural colouring matters by degradative methods, and in certain instances deduced their constitutions, many of which, for example, those of catechin, luteolin, gossypetin, quercetagetin, etc., have since been confirmed synthetically by other workers.

In later years, Perkin devoted more of his time to the chemistry of anthraquinone derivatives. A study of the migration of the acyl group in partially acylated phenolic compounds led to the synthesis of, *inter alia*, some hydroxyanthraquinone methyl ethers, originally isolated from the Indian natural dyestuff, chay root, but not hitherto obtained synthetically. The constitutions of numerous hydroxyanthranols were

established by conversion into corresponding benz-anthrone and examination of the methylation products of the latter. The formation of hydroxy-anthracenes, -dianthrone, -dianthraquinone, -dianthraquinonyls and -helianthrone also was investigated and the constitutions of these compounds established.

Perkin's original papers, including those published in the *Proceedings of the Chemical Society*, all of which did not appear afterwards more comprehensively in the *Transactions*, exceeded 270. He was also author of numerous articles on natural colouring matters in "Thorpe's Dictionary of Applied Chemistry", and, in collaboration with Dr. A. E. Everest, he published the classical monograph "The Natural Organic Colouring Matters" in 1918.

Perkin was elected a fellow of the Institute of Chemistry in 1887, a fellow of the Royal Society of Edinburgh in 1893, a fellow of the Royal Society in 1903, and was awarded the Davy Medal of the Royal Society in 1924. He was also a vice-president of the Society of Dyers and Colourists, and a member of the Biochemical Society, the Chemical Society, the Pharmaceutical Society, Society of Chemical Industry, the Textile Institute, and the Livery of the Worshipful Company of Leathersellers.

In 1916, Perkin succeeded A. G. Green as professor of colour chemistry and dyeing in the University of Leeds. During the Great War he carried out investigations for the Ministry of Munitions, and also directed the work on intermediates and synthetic dyes carried out by the colony of research chemists of British Dyes Ltd. in his Department.

During his professorship, Perkin did much to widen the fundamental education of his undergraduates and to enhance the reputation of his Department as a scientific training ground for recruits for the dyestuffs, dyeing and allied industries. The very large number of students who entered for courses in colour chemistry and dyeing in the immediate post-War years were attracted at least as much by the opportunity of working under him as by the popular appeal of these subjects at that time. His students were very successful in securing appointments on completion of their courses and most of them now occupy important positions in industry.

Perkin exerted a profound, but unobtrusive, influence on his colleagues and students. He was a very gentle man with a most charming and lovable personality. He did most of his work with his own hands, and it was a privilege to observe him at work in his laboratory. He was not only a great chemist in his generation, but also he was so imbued with a passionate zeal for unravelling the secrets of Nature that all who came in contact with him were inspired by his pioneering spirit.

On his retirement in 1926, Perkin was accorded the title of emeritus professor, and in 1927 the University of Leeds conferred upon him the degree of D.Sc., *honoris causa*. In fact, he never retired, for he continued to prosecute his researches without any interruption in the professor's laboratory in the Colour Chemistry and Dyeing Department of the University of Leeds until his health began to

fail in February this year. At that time he was endeavouring to determine the constitution of a green vat dye which he had obtained some years previously by heating the hydroxylated anthranol, derived from alizarin, with tetrachlorothiophen and an alkylating agent.

Perkin was well known in the Isle of Man, for many years spending all vacations at his house at Port Erin, and he was a governor of King William's College. He was very fond of animals and took the greatest interest in his dogs, his pony and his tortoise. He also inherited a great love of music, and was an accomplished performer on the flute and bassoon; he was a leading member of amateur orchestras in Yorkshire. He married Annie, daughter of the late J. E. Bedford, of Leeds, who survives him. There were no children.

E. J. CROSS
F. M. ROWE.

Prof. S. H. Langdon, F.B.A.

THE study of Assyriology must nowadays be held to embrace, in principle, the whole of the archaeology, history, culture and languages of ancient western Asia. In this immense field the labourers are still few, and no country can at present boast more than a handful of them. The loss of any one is therefore serious, since replacement, much less reinforcement, is problematical. That loss is the more sensible when so active a worker as Prof. S. H. Langdon, professor of Assyriology in the University of Oxford, is withdrawn by death, on May 19, at the early age of sixty-one years.

Since the boundaries of the study have been so vastly extended by recent discovery, it has become inevitable in Assyriology, as in other sciences, that a man should specialize. Langdon's chosen branch was Sumerian, the primitive language of Babylonia, virtually extinct by the end of the third millennium B.C., but of paramount importance as belonging to a people who have been revealed, time and again, as the originators of most of the vital elements in the whole pre-Hellenic culture of western Asia. At the time when Langdon was beginning his career, knowledge of this language had scarcely passed the stage of entire dependence upon the translations furnished in bilingual texts by late Assyrian scribes, while the scepticism of Halévy still preoccupied the minds of many. Some of Langdon's early work, however, was devoted to the Sumerian religious texts without Semitic translation which have survived in large numbers, and because of their great difficulty of interpretation still remain to-day among the obscurest parts of the literature written in cuneiform.

This observation is, of course, in itself a criticism of Langdon's achievement, for throughout his working life it was upon these texts that his abundant energy was mainly concentrated; editions of the originals and translations make up a large part of his bibliography, whereas few of his contemporaries cared to venture upon so hazardous a ground. But it must be owned that, in the editions, his copies were not always of the most reliable, and that he failed to detect this

and other faults in his translations (though never unready to admit mistakes) chiefly because of a certain lack in comprehension of the practical sense of a phrase or of a text, and this allowed him too often to put forward merely verbal translations. It must be remembered, however, that some of the literature to which he devoted himself is jejune in content, and must necessarily look rather absurd in the baldness of translation. How carefully he had prepared himself for this work is shown by his "Sumerian Grammar" (1911), which, if it cannot be said to have marked a decisive advance, has the credit of being the first full-length treatment of the subject.

To the study of the Akkadian (Semitic) language, which is better known, Langdon's contributions were less copious. But he has to his credit at least one book which is still a standard work of reference, "Die neubabylonischen Königsinschriften" (1912) and, despite certain oddities, his "Babylonian Epic of Creation" (1923) contains much which subsequent translators have been glad to use. Besides one or two philological books of less importance he wrote in 1931 a general work on "Semitic Mythology" which, somewhat belying its name, drew very largely upon the Sumerian religious literature which he knew so well. But many will think that one of Langdon's

most remarkable achievements was that he, essentially a man of the study who had hitherto shown little interest in archaeology, seized the opportunity after the Great War to excavate in Iraq, and with great enthusiasm proposed, organized, and even raised part of the money for, an expedition which made important discoveries at Kish. He himself spent two seasons on the site, much to the detriment of his health, and afterwards began two series of volumes devoted to the archaeological and epigraphical results of the work. In his latest years he often spoke of a Sumerian dictionary which he had long been preparing, and he had announced a future edition of the Assyrian texts upon which his recent Schweich lectures were based.

We regret to announce the following deaths:

Prof. A. Erman, formerly director of the Egyptian Section of the Berlin Museum, and professor of Egyptology in the University, on June 26, aged eighty-three years.

Dr. H. H. Jeffcott, secretary of the Institution of Civil Engineers, on June 29.

Prof. T. Mather, F.R.S., emeritus professor of electrical engineering in the City and Guilds (Engineering) College, Imperial College of Science and Technology, on June 23, aged eighty-one years.

News and Views

Queen Mary and the Bodleian Extension

QUEEN MARY was given a warm and affectionate welcome when, on June 25, in royal weather, she visited Oxford to lay the foundation-stone of the great Bodleian extension to be erected in Broad Street opposite the Clarendon Building. A special Convocation of members of the University was held in the Sheldonian Theatre to which the public were admitted without ticket, and which was so filled in every part that although no one was turned away, twenty more could not have been accommodated in comfort. There an address of thanks was presented to Queen Mary by the Chancellor, Lord Halifax, and the Vice-Chancellor, the Master of Balliol. They spoke of how proud Oxford is of its ancient, Bodleian library, and how urgent it is for the work now being done in all branches of teaching and research that it should be properly maintained and extended. The Queen then crossed Broad Street to a stand raised above the enormous hole in the ground which is at present the site. There was assembled another large party representative of Oxford life, academic and civic, and of those entrusted with the erection of the building, Sir Giles Gilbert Scott, the architect, was present. The Queen then laid the foundation-stone on which the following words have been inscribed:

ÆDIFICII NOVI BODLIANI
HVNC PRIMVM LAPIDEM
POSUIT MARIA REGINA
REGIS GEORGII VI MATER
DIE XXV MENS. IVN. A.D. MCMXXXVII

Prof. F. Wood Jones, F.R.S.

PROF. FREDERIC WOOD JONES, at present professor of anatomy in the University of Melbourne, has accepted an invitation to fill the chair of anatomy in the University of Manchester, in succession to Prof. J. S. B. Stopford, who has asked to be relieved of the duties of the chair, in view of the increasing responsibilities of his administrative work as vice-chancellor of the University. Prof. Wood Jones graduated in science in the University of London in 1903, and in medicine and surgery in 1904. In 1910 he was awarded the degree of D.Sc. in zoology of the University of London. He was elected to the Royal Society in 1925 and to the fellowship of the Royal College of Surgeons in 1930. Prof. Wood Jones has held professorial chairs in the London School of Medicine for Women (anatomy) and in the Universities of Adelaide (anatomy), and Hawaii (physical anthropology) in addition to the chair of anatomy at Melbourne, to which he was appointed in 1930. In 1932-33 he acted as temporary director of the Peiping Union Medical College. His experience in other fields includes the duties of a medical officer in the Far East, anthropologist to the Egyptian Government, and membership of the Archaeological Survey of Nubia. On four occasions he has delivered the Arris and Gale Lectures of the Royal College of Surgeons. Among his numerous published works are "Coral and Atolls", "Arboreal Man", "The Mammals of South Australia" and "Man's Place among the Mammals".

Sir Morell Mackenzie (1837-1892)

SIR MORELL MACKENZIE, the eminent throat specialist of the Victorian era, was born at Leytonstone, Essex, on July 7, 1837. He came of a medical family, his father being a distinguished general practitioner, and his younger brother Stephen a prominent physician on the staff of the London Hospital. After qualifying in 1858, he went to Paris, where he attended the clinics of Trousson, Nelaton, Ricord and others, and then to Vienna, where he studied under Oppolzer, Skoda, Rokitsansky and Hebra, and finally to Budapest, where he made the acquaintance of Czermak, who was experimenting with the laryngoscope invented by Manuel Garcia. On his return to London, after holding the posts of resident medical officer and registrar at the London Hospital, he set up in practice in George Street, Hanover Square. In 1863 he gained the Jackson prize of the Royal College of Surgeons by an essay on the pathology and treatment of diseases of the larynx and in 1866 was appointed assistant physician to the London Hospital, becoming full physician in 1873. His chief publication was his work on "Diseases of the Throat and Nose", of which the first volume appeared in 1880 and the second in 1884, and at once became the standard book on the subject. He was also the author of "The Use of the Laryngoscope in Diseases of the Throat" (1865), "Diphtheria: Its Nature and Treatment" (1879) and "Hay Fever and Paroxysmal Sneezing", of which the fourth edition was published in 1887.

MACKENZIE'S eminence as a specialist won him many distinctions. He was elected an honorary member of the medical societies of Vienna, Budapest and Prague and one of the two foreign honorary fellows of the American Laryngological Association. In 1887 he was knighted, and in 1888 he received the Grand Cross and Star of the Royal Order of Hohenzollern for his attendance on the Emperor Frederick, the story of whose illness he relates in the book entitled "The Last Illness of Frederick the Noble", for which he incurred the censure of the Royal Colleges. Though a strong advocate for specialism in medicine, as he showed by two articles published in the *Fortnightly Review* in 1885, Mackenzie always maintained that a very complete medical training should be the basis of education for the specialist. Apart from his literary work, Mackenzie deserves to be remembered for his addition of a large number of instruments to the armamentarium of throat surgery and his skill as an operator in the removal of laryngeal growths. Like many other celebrated men, Mackenzie was the subject of asthma, from which he suffered for thirty years, and his death at the comparatively early age of fifty-five years took place on February 3, 1892.

Acculturation and Native Policy

In commenting on the recent debate in the House of Lords on policy in native administration in the Empire (see *NATURE*, June 26, p. 1083) it was urged that the contribution of anthropological science

should not be overlooked when the possible effect of administrative action, and its bearing on future policy were under consideration. A concrete example of the results which may be expected to emerge from such scientific investigation of the effects of cultural impact on a relatively simple people is afforded in a study by Prof. I. Schapera of the BaKxatla, a Bantu-speaking people, who migrated from the western Transvaal to evade the Boers about 1840 and settled in what afterwards became the Bechuanaland Protectorate. Here their earlier contact with Western civilization was continued, at first through missionaries, and afterwards through traders and administrative officials. Prof. Schapera in this study ("Contributions of Western Civilization to Modern Kxatla Culture", *Trans. Roy. Soc. S. Africa*, 24, 3) analyses both the acceptances and the rejections by the BaKxatla of elements of Western culture and their consequences, with the somewhat remarkable result that he finds that, while some traditional elements of their own culture are retained and new elements from Western culture are incorporated with little change, an entirely novel cultural pattern is also growing up out of the contact. His paper must be consulted for details, but one instance may be mentioned. As a result of the introduction of Christianity, ancestor worship has virtually died out, but magic is retained. At the same time, the Christianity which is their official religion has come to be something very different from the doctrine as it was first introduced among them. Although it is not possible to generalize from one African tribe to another without testing the premises of the argument, it is clear that investigation on these lines has been shown to be essential before the risk is run of making any fundamental changes of principle or detail in policy.

School of Colonial Administration at Oxford

ANTHROPOLOGISTS will be afforded an opportunity of bringing these and kindred matters to the notice of administrative officers of the Colonial Services at the Oxford University Summer School of Colonial Administration, which will meet at St. Hugh's College, Oxford on July 3-17. The arrangements have been made in connexion with the Social Studies Research Committee of the University. The School is intended primarily for the benefit of members of the Colonial Administrative Services, more especially, though not exclusively, those serving in Africa. The problems of native administration in tropical Africa will be discussed in a series of lectures, in which they will be brought into relation on broad lines with world problems of economics and politics; while the experience of other countries in tropical administration in relation to such matters as local government, education, elementary and adult, the co-operative movement and the like will be demonstrated. Leading foreign experts will lecture on a number of other topics, and more especially on methods of native administration in territories under other than British rule. The School will be opened by the Right Hon. W. G. A. Ormsby-Gore on July 4, and on the same day an inaugural address will be delivered by Lord Lugard. Among those who have promised to take

part in the proceedings and discussions are Sir Alfred Zimmern, Sir Arthur Salter, Lord Lothian, the Warden of All Souls, and Sir Donald Cameron. A number of anthropologists have been invited to join in the discussions and talks, dealing with problems affecting administration in different regions and from different aspects. About one hundred and seventy officers on leave have intimated their intention of attending the School. Although not 'official', the School has had the cordial support and assistance of the Colonial Office.

An Astronomical Jubilee

LA SOCIÉTÉ ASTRONOMIQUE DE FRANCE, the creation of Camille Flammarion, who did so much to popularize astronomy in France, has recently celebrated its jubilee. The chief event in the festivities which were held to commemorate the occasion was a great reception on June 16 in the Great Theatre of the Sorbonne, at which nearly three thousand people were present; the President of the French Republic attended and the Minister of Education, M. Jean Zay, presided. M. Jules Baillaud, the present president of the Society, gave an account of the history of the Society and of the work done for it successively by Camille Flammarion and his widow. After a short address by the Minister of Education, Prof. C. Fabry gave a charming account of the progress or revolution in the astronomical outlook in the past fifty years, and some beautiful slides which had been taken by Mr. Ritchey and by M. de Kerolx at Fourcalquier were shown by M. Baldet. A film was shown of Camille Flammarion's activities in connexion with the Society, and a recorded speech of his was repeated to the audience. A concert followed in which artists from the Opera assisted, while at an earlier stage artists from the Comédie-Française and elsewhere recited poems and read extracts from Camille Flammarion's works. A memorable evening, such as could scarcely have been held anywhere outside Paris, concluded with some ballets danced by pupils of the late Lote Fuller.

THE celebrations were attended by astronomers from Belgium, Czechoslovakia, Denmark, Great Britain, Italy and the United States to add their greetings and congratulations to the Society, its president and its secretary, Madame Camille Flammarion. Opportunity was taken of the presence of many astronomers in Paris for a discussion on various aspects of the problem of interstellar matter in space, which is to be the subject of a conference in Paris on July 11-17 at the Institut Henri Poincaré. Messrs. M. G. Darmois, J. Baillaud, Lacroute, F. Perrin, Chalonge, Barbier and Mineur gave an account of the present state of our knowledge on interstellar calcium absorption in space, the structure of the galaxy, the nature and distribution of absorbing clouds and their effect on stellar spectra and colour indices.

Covent Garden Laboratory

For the last eleven years, contact has been maintained between the work of the Department of

Scientific and Industrial Research on the transport and storage of food and an important branch of industry through the Department's Covent Garden Laboratory in Endell Street, London. This Laboratory has provided an excellent place for keeping under survey the condition of produce passing through our markets generally and for diagnosing or tracing to their source the different types of wastage and deterioration in fruit and vegetables. Samples of fruits showing wastage or abnormal features are collected from the market or are brought to the Laboratory by salesmen. Often the trouble can be diagnosed at once, but sometimes it is desirable to get the diagnosis confirmed by the Low Temperature Research Station at Cambridge or the Ditton Laboratory. The Covent Garden Laboratory also receives for examination samples of consignments of fruits new or comparatively new to Great Britain, such as mangoes, mangosteens and papaws. The interest taken in this work has now made it necessary to leave Endell Street for larger premises, which were opened by Sir Frank Smith on June 28. These are situated on the top floor of Nos. 9-13 Kean Street.

THE new accommodation includes two chemical laboratories, a large 'ice box' for cooling fruit to -30° F. and three cold stores. One, maintained at 34° F., will be used for delaying ripening and for observations on apples; another at 45° F. for work on citrus fruits, and the third at 65° F. will be used as a conditioning room for initiating ripening. The two colder stores will also be used for studying the advantages of temporary cold storage for wholesalers or retailers, that is, storage of, say, mushrooms and melons for short periods. In the chemical laboratories estimations of the sugar and acid content of the fruit will be carried out. The sugar content of apples, of course, varies between individual specimens, and to get a representative sample the apples are frozen solid and then ground up into a fine powder. Another important measurement to be made is the rate of respiration of the fruit. This not only gives an indication of the age of the apple, but also is important in connexion with research which is being carried out on the mechanism by which sugar breaks down to carbon dioxide. The alcohol content of apples increases as they grow older, and this is also a subject of measurement, as it is hoped that this factor will prove an important diagnostic indication. Produce from the Empire overseas is inspected before being shipped in order that nothing may be exported which is not up to standard. Facilities will be available at the new Laboratory for officers of the Dominions and Colonies engaged in following up this work.

Medicine Stamp Duties

DUTIES in respect of medicines were first imposed so far back as 1783. The tax then was twofold, as it is to-day. It was imposed on all persons who sold medicines, not being doctors, apothecaries, etc., and secondly a duty was 'laid on the medicines' themselves when sold by such persons. A Select Committee

was appointed in November 1936 to consider the duties of excise chargeable under the Acts of 1802, 1804 and 1812, and any amendments thereto, and to report thereon and to make recommendations, and its report has now been issued (London: H.M. Stationery Office, 1937; price 3d. net). Complete abolition of these duties has been advocated, but the Committee recommends that the duties ought to continue and should apply to a wider field, and bring in a much larger revenue. At the same time, it recommends that the duty should be at the rate of twopence instead of threepence in the shilling, and should be graduated less steeply. The recommendations are of a far-reaching character, and bring in everything that looks like a drug or smells like one. As drafted, it would even seem that medicines prescribed or dispensed by medical practitioners are included, though it can scarcely be believed that this was intended. The Committee also sees no reason why the "modern chemist" should have "a very valuable preference" in the sale of preparations which claim the "known, admitted, and approved remedy" exemption which has hitherto enabled them to sell unstamped certain types of preparations liable to duty if sold by ordinary shopkeepers. Despite defects, the recommendations are on the whole in the interests of the public, and with certain amendments should prove acceptable.

Acquisitions at the British Museum (Natural History)

H.M. THE KING has presented to the Museum an exceptionally fine specimen of a black leopard from India. The skin is very dark and the spots are scarcely visible in certain lights. In March 1936, Mr. H. St. J. B. Philby set out on a journey through the districts of Asir and Najran in Arabia, returning to Jidda in the early part of this year. During this trip, Mr. Philby made large natural history collections which he has presented to the Museum. Apart from the birds which number 747 specimens belonging to some 100 species, the collections include mammals, reptiles, fishes, mollusca, a large number of insects, 250 botanical specimens, some minerals, and about 400 rocks. Among the birds, three are new to science, namely, a race of the common magpie, a small Scops owl, and an emerald cuckoo. His collection includes a number of eggs previously unknown. The Department of Entomology has received from Mrs. Tillyard a collection of 800 mayflies and 700 dragonflies which formed part of the late Dr. R. J. Tillyard's collection. Among the dragonflies are included the type specimens of 105 species, and among the mayflies of 8 species. This gift is perhaps the most valuable addition to the Museum collections in these groups that has been received for many years. Accessions to the Department of Geology include a collection of about 20,000 fossil invertebrates (including 60 type and figured specimens) from the Ordovician and Silurian strata of the Girvan district of Ayrshire. The collection was made by the late Mrs. Robert Gray of Edinburgh and her daughters. Mr. F. N. Ashcroft has presented a further series of 747 specimens from his collection of Swiss minerals.

Repton School Science Society

At the triennial conversations of the Repton School Science Society on June 25 and 26, some forty demonstrations were shown. In the biology section, a way of recording the heart beat of a frog and the effect of stimulation by nerves, by electricity and by drugs, was shown and also a collection of local zoological and botanical specimens. Recent developments in chemical industry were illustrated by the moulding of bakelite cups in a home-made electrically-heated press producing a pressure of $1\frac{1}{2}$ tons per sq. in., by the manufacture of rubber gloves from the latex by a simple dipping process using an experimental plant, and by electro-plating and bronzing on a semi-technical scale. A lecture was given in the physics section on electrical illumination, dealing with the development of lighting from the carbon filament lamp to the modern vapour discharge lamps. There were also demonstrations of a way of eliminating dazzle from motor-car headlights using the new polaroid screens and of a home-made model railway fitted with a system of automatic signalling and train control.

Scientific and Industrial Research in Australia

THE tenth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1936, and in addition to reports on the five main divisions of the Council's work, refers to co-operation in research with New Zealand and to the meetings of the Standing Committee of Agriculture appointed as an advisory body to the Australian Council of Agriculture established in 1934 (Canberra: Government Printer, 1936. 4s.). Numerous reports to this Committee were furnished by the Council of Scientific and Industrial Research, dealing with such subjects as codling moth pest, survey of potato virus diseases, tobacco investigations, seed testing, weed pest investigations, soil drift, grasshopper investigations, etc. The Council also acts as a liaison with the Commonwealth Government on behalf of the Standards Association of Australia, and in this capacity provided reports on standardization of wearing parts of agricultural machinery, primary products, dusting sulphur, wire-netting and other galvanised products. During the year, the activities of the Council were extended to cover investigations into the problems of Australia's secondary industries, and a special committee has been set up to define the field and make recommendations regarding problems for investigation and the staff and organization required. A new Forest Products Laboratory approached completion during the year. This Division completed a full investigation of the veneer and plywood industry in Queensland with special reference to gluing practice, which has already led to a marked improvement in the quality of the products.

THE Division of Plant Industry has been responsible for work on the control of downy mildew of tobacco by benzene vapour in covered seed beds; this has made possible the prevention of a most destructive

disease which previously resisted all attempts at control. Considerable progress in the investigation on the control of the peach moth is reported by the Division of Economic Entomology and very favourable results have been obtained with nicotine-bentonite-sulphur sprays. The same Division has been responsible for work on termite control, while the work carried out on the control of weeds has been considerably extended by reorganizing the botanical and entomological phases in one section under joint control of the chiefs of the two Divisions. The Division of Animal Health Nutrition has been responsible for investigations on pleuro-pneumonia in cattle and on the treatment of internal parasites of sheep, while its fundamental investigations on the nutrition of sheep have already led to an increase of nearly 150 per cent in the yield of wool as well as to a remarkable variation in its character. Valuable contributions to viticulture and regarding the role of organic matter in plant nutrition have been made by the Soils Division, while the Food Preservation Section has obtained promising results in investigations on the storage of peaches and plums from the point of view of export to Great Britain which should decrease the wastage in export. The Radio Research Board has continued its investigations; appreciable advance in the control and eradication of prickly pear by biological methods is again reported, and a programme of fisheries research has also recently been initiated.

National and International Standardization

REALIZATION of the advantages of standardization of industrial materials and requirements has led in most of the industrially developed countries to the establishment of organizations to promote such standardization, and already a high degree of standardization has been reached in many countries. A most informative account of the work of the various national authoritative bodies engaged in this work is given in "A Survey of the Present Organization of Standardization—National and International", published by the World Power Conference. In Great Britain, the British Standards Institution is the national standardizing organization and is responsible for the determination of British standard specifications. Though the Institution has a strict rule that it does not initiate standardization but waits to be approached by a recognized outside authority such as a trade association, technical institution, or Government department, it has already issued more than 560 British Standard Specifications, exclusive of some 160 specifications for aircraft materials and components issued in co-operation with the Air Ministry.

INTERNATIONAL standardizing organizations, such as the International Federation of the National Standardizing Associations (ISA) or the International Electrotechnical Commission (IEC) have also been established. ISA, for example, federates the national standardizing organizations of nineteen countries and was founded in New York in 1926 with the object of

promoting co-operation, co-ordination and interchange of information. But international co-operation, in contrast to the development of standardization along national lines, has made slow progress. It was indeed the need for further development in this direction that led the International Executive Council of the World Power Conference to initiate this inquiry, and the report has been published with the hope that it may serve as a stimulus to a greater degree of co-operation in national standardization and to a closer co-ordination of the activities of international organizations engaged in standardization, to the end that duplication and overlapping may be avoided and international standardization may be more speedily effected.

Scientific Basis of Birth Control

In *Science and Society* of June–September 1937, there appears an article on "The Scientific Basis of Birth Control" by Dr. C. V. Drysdale, president of the Malthusian League. The author remarks that the true, present-day application of the Malthusian doctrine may best be understood by reference to the affairs of an ordinary married couple. "The average young man marries when his income is sufficient to support a wife and perhaps one child, and, if that income were fixed, every additional child would mean a lowering of the family standard of existence." But, in many occupations, salaries rise with age and service, and if additional children come when there has been a sufficient rise in income, no lowering of the standard need take place. "This is the population problem as it confronts almost every middle-class couple." If children arrive at a greater rate than can be allowed for by increases of salary, then such a family is "over-populated". It amounts to this, that, in general, in civilized countries, birth-control has assisted in the preservation of the amenities and standards of living. Another aspect of birth-control is, of course, its application to what is called negative eugenics, that is, the avoidance of parenthood by persons afflicted with transmissible disease or defect. Dr. Drysdale looks forward to a future in which a planned social economy shall ensure general early marriage with reasonable family limitation. But it will be necessary to arrange that the limitation does not go too far, and the question is: How?

Fauna of the U.S.S.R.

SOME years before the Great War, the Russian Academy of Sciences launched an ambitious scheme of publishing detailed monographs on all groups of animals occurring within the Russian Empire and in neighbouring countries, under the title "Fauna de la Russie et de pays limitrophes". The programme of the publication was so extensive that the first few volumes which appeared were sufficient to show the virtual impossibility of continuing the work on the same scale. The idea, however, was not abandoned, and the Academy of Sciences of the U.S.S.R. has now commenced the publication of a new "Faune de l'URSS", which aims at giving a full, but concisely graphic treatment

of the systematics and distribution of all animals already found, or expected to occur, in the Soviet territories. Six volumes and two smaller parts, mostly dealing with insects, have already appeared, and they make a very good impression, particularly as regards the generally high scientific standard, although the paper, printing and illustrations might be improved. Unfortunately, not all the volumes are by outstanding experts in the systematics of the groups treated, and some have apparently been prepared by authors who may be excellent specialists, but not in the groups they had to monograph. All foreign zoologists will be pleased to see that each volume has a very full summary in a Western language, in which all determination keys, new descriptions and more important notes are given. Since the "Fauna" covers the whole of extra-tropical Asia and eastern Europe, its value for systematists working on the palaearctic region will be inestimable, and volumes on their respective groups will be eagerly awaited by all zoologists.

The Botanical Society of Edinburgh

THE *Transactions and Proceedings of the Botanical Society of Edinburgh*, 82, Part 1, 1936, is a particularly interesting number, including as it does the record of the centenary meeting of this Society. The main contribution is in effect a local flora—a list of the flowering plants and ferns from Fife and Kinross by William Young. The address delivered by Prof. F. O. Bower at the centenary meeting is included. No more appropriate speaker could have been found for that interesting occasion, and his appreciation of botanical progress during the period of activity of the Society could only have been delivered by a veteran whose reminiscences still feed his botanical enthusiasm. Prof. Bower points out how plant physiology has gained since 1836 by the precision that can now be assigned to the medium in which vital functions are proceeding, through the advances in cytology and anatomy. With arresting phrase and breadth of vision, in a few pages the main movements of botanical thought during the century are brought before the reader. The last half century, it is pointed out, because it is an age of specialization, has increased the need for the services of such general societies as the Botanical Society of Edinburgh. Prof. Bower indicates how the 'herd sense' among his fellow botanists is probably responsible for the temporary ascendancy of one field of investigation, thus leading to "multiplying instances of what has been already demonstrated". He then shows himself fully aware where the 'herd' is gathering now when he ends an eloquent plea for a modern morphology, based upon developmental studies of the meristem, with the speculation that hormones may then prove the key to unlock those phenomena of symmetry that are expressed in appendages. The Botanical Society of Edinburgh began principally as a means to the formation of a herbarium for its members, and has taken a prominent part in the creation of the magnificent herbarium that is now housed at the Botanic Gardens.

Giorgi's System of Units

DR. A. E. KENNELLY recently presented a report, from the historical point of view, to the Society for the Promotion of Engineering Education, in regard to the adoption of the M.K.S. (metre-kilogram-second) system of units ("The M.K.S. System of Giorgi as adopted by the International Electrotechnical Commission (I.E.C.) in June 1935"). Dr. Kennelly has done his work well, giving a fair statement of the present position. Unfortunately, physicists and engineers are not yet agreed as to the best system of units to adopt. Many of them are in favour of following Heaviside and completely rationalizing the system of units. Others are more conservative, and think that the change, although saving much arithmetic, would scarcely be worth the labour involved in learning all the relations connecting the new and the old units. The two leading organizations are in agreement that a fourth unit is theoretically necessary to link internationally adopted electrical units with the dynamical units of the M.K.S. system. They agree that this fourth unit may preferably be 'space permeability' taken at the definite numerical value of 10^{-7} (unrationalized). This report of Dr. Kennelly's can do nothing but good.

Prohibition and Cirrhosis of the Liver

At an address given at the recent annual meeting of the Royal Institute of Public Health at Margate, Dr. C. C. Weeks stated that, in the United States, when prohibition really was prohibiting, there was a marked decrease in the death-rate from cirrhosis of the liver and a rise as 'boot-legging' became more extensive. The liquor sold under 'boot-legging' conditions was much more alcoholic than usual, ethyl alcohol being so high as 70 per cent in much of the whisky sold. There was consequently a good deal of acute alcoholism attributed to all sorts of causes, whereas the one effective cause was that the whisky was 50 per cent stronger than usual. Since the repeal of prohibition, there has been a slight but steady increase in deaths due to alcoholism. Official figures for 1935 showed that, out of 24 States, 20 had an increase in the death-rate from cirrhosis, while only 11 showed an increase in the death-rate for alcoholism as compared with 1932. The steady drinking of a more normal alcoholic beverage was leading inevitably to more cirrhosis of the liver but to less acute alcoholism.

Society of Chemical Industry: Food Group

At a recent meeting of the Food Group of the Society of Chemical Industry, it was decided, in view of the growing interest in food science and the diversity of the subject, to form panels within the Group. These panels will be responsible for directing the activities of the Group in connexion with their respective divisions of the science. The first two panels, of which there will be several, are now in process of formation, namely, a nutritional panel and a microbiological panel.

Studentships and Fellowships for Medical Research

THE Medical Research Council invites applications for a second series of studentships and fellowships for research into disease together with experimental work of an immediately relevant kind. Six post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Four research fellowships are also offered for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. These fellowships are intended as probationary appointments for research in clinical science or experimental pathology. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

Announcements

SIR WILLIAM BRAGG, president of the Royal Society and director of the Royal Institution, has been elected an honorary associate of the Royal Institute of British Architects.

By an order of the Committee of Privy Council, Mr. W. M. Goodenough has been appointed a member of the Medical Research Council on the retirement of the Right Hon. Lord Mildmay of Flete. Mr. Goodenough also succeeds Lord Mildmay as treasurer of the Council.

THE Howard Prize for 1937 of the Royal Meteorological Society has been awarded to Cadet Ralph Wills of H.M.S. *Comboy* School Ship. Cadet Julius Cornel Donner and Cadet John Easton Neils Carter of H.M.S. *Worcester*, were placed second and third respectively. The subject of the essays was "The Meteorology of the Voyages of Discovery to America and to South Africa".

ON the occasion of the seventy-fifth birthday of Prof. E. Leclainche and of his election to the presidency of the Paris Academy of Sciences, the National French Syndicate of Veterinarians recently organized a ceremony in his honour. Prof. Leclainche is honorary director of the French Veterinarian Services and president of the International Office of Epizootics.

PROF. KARL NEUBERG, founder and editor of the *Biochemische Zeitschrift* and formerly director of the Biochemical Institute of the Kaiser-Wilhelm Gesellschaft, celebrates his sixtieth birthday on July 29. An issue of the periodical *Enzymologia*, with which he is associated, is to be published in honour of this anniversary; more than seventy authors, chiefly his pupils, have contributed to the number.

It is announced by the New York correspondent of *The Times* that a fund of about £2,000,000 for cancer research has been given to Yale University by Mr. Starling W. Childs. It is to be called the Jane Coffin Childs Memorial Fund for Scientific Research, and the deed of gift provides that, if the problem of cancer should be solved, the Foundation is to devote itself to other unsolved medical problems or to problems in other fields of science.

A GENERAL Discussion on reaction kinetics has been arranged by the Faraday Society, to be held in the Chemistry Theatre of the University of Manchester on September 13-15. As is usual at these discussions, a number of distinguished foreign investigators have agreed to take part. Further particulars can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

READERS interested in psychology may like to know that a Graphological Society has been formed, and the first public meeting will take place in October. The honorary secretary is Mrs. Paula Friedenham, 50 Heathway Court, West Heath Road, London, N.W.3.

THE second Congress of the Austrian Society of Röntgenology will be held in the Central Röntgen Institute of the General Hospital at Vienna on July 10-11. Further information can be obtained from the Secretariat, Zentral Röntgen Institut, Allgemeines Krankenhaus, Alserstrasse 4, Wien IX.

AN institute for anatomy, physiology and hygiene is shortly to be opened at Riga.

DR. THEODOR VAHLEN, professor of applied mathematics at Berlin, has been made an honorary professor in the University of Greifswald.

THE fourth International Leprosy Congress will be held at Cairo on March 21, 1938. Further information can be obtained from the Secretary, 131 Baker Street, W.1.

R270

THE Congress of the International Union of Towns will be held in Paris on July 5-10, when a discussion will be held on the campaign against smoke in various countries, and other subjects. Further information can be obtained from M. R. Hummery, 28 rue de Liège, Paris.

WE have received List No. 25, a catalogue of old medical books, issued by Messrs. E. P. Goldschmidt and Co., Ltd., 45 Old Bond Street, London, W.1. Among 214 items, are several early works on bacteriology and parasitology of Behring, Ehrlich, Köch and Laveran, and a collection of French X-ray photographic prints, made about 1890. It also includes a copy of the rare third edition of Harvey's "De Motu Cordis", a first edition of Laennec's "De l'Auscultation mediate", and early works on anaesthesia, ophthalmology, pharmacology and physiology.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 31.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Use of the Name 'Racemic Acid'

THE discovery of racemic acid by Karl Kestner or Koestner, a chemical manufacturer at Thann, in the Vosges, and the elucidation of its relationship to ordinary tartaric acid, more especially by Gay-Lussac, Berzelius and Pasteur, constitute one of the most important episodes in the history of organic chemistry. Upon an account of the nature of racemic acid there is no need, and we do not intend, to enter here; but, owing to the confusion which exists in chemical literature regarding the authorship of the name *racemic acid* (variously attributed to Gay-Lussac, Gmelin and Berzelius), a note on this subject may be of interest to students of the history of chemistry.

The author of the term *racemic acid* is Gay-Lussac. The first occurrence of the term in print is found in a publication, "Cours de Chimie par M. Gay-Lussac, comprenant l'histoire des sels, la chimie végétale et animale", published in Paris by Pichon et Didier, in 1828. In the "Summary" at the beginning of the 24th Lecture, one finds the term, "Acide racémique", and on p. 23 one reads: "Ce serait ici le lieu de parler de l'acide racémique". The mis-spelling which is found here, *racémique* (with or without the accent) in place of *racémique*, finds its explanation in the fact that the "Cours de Chimie" was reproduced from shorthand notes of the course of lectures "professés à la Faculté des Sciences" by Gay-Lussac, and published without the co-operation or sanction of the lecturer. Gay-Lussac, in fact, protested vigorously against this *nouveau genre d'industrie*, which had arisen in Paris, of publishing the lectures of certain professors without their permission or supervision. "Je ne sais", wrote Gay-Lussac¹, "jusqu'à quel point il est juste de s'approprier ainsi des leçons publiques, contre la volonté même des professeurs; . . . Mais il n'est pas indifférent que l'on sache que je n'ai pris aucune part à cette nouvelle spéculation de librairie . . . Je déclare donc que mes leçons de chimie sont imprimées contre mon gré; que j'ai refusé les épreuves qu'on m'a offertes pour me faire coopérer à leur publication, et que je n'y prends absolument aucune part."

Meanwhile, the publishers had issued a note that "le désir que nous avions de terminer la publication de cet ouvrage presque aussitôt que le Cours du Professeur; la promptitude avec laquelle il a fallu par conséquent corriger les épreuves; et d'ailleurs la nécessité où nous fûmes de recourir à une autre personne que le Professeur, pour faire cette correction à laquelle il ne voulait pas se livrer lui-même, ont été cause que plusieurs fautes d'impression se sont glissées dans quelques-unes des Livraisons que nous avons envoyées à nos Souscripteurs." The text was

read by M. Gaultier de Claubry and a list of errata was drawn up. In this list, *racémique* is corrected to *racémique* (without an accent on the e). The unaltered text, however, was republished, with its errors, in 1833 by the firm of de Just Rouvier et E. Le Bouvier, Paris.

The authorship of the term, *acide racémique*, is established also by a footnote which appears in the French translation² of Berzelius's original Swedish paper. The French translation is entitled: "Composition de l'acide tartarique et de l'acide racémique (traubensäure), etc", and the footnote to this reads: "M. Gay-Lussac a donné, en 1828, le nom d'*acide racémique* à l'acide dont il est ici question." Thomas Thomson, who made an examination of racemic acid³, also states in his "Chemistry of Organic Bodies. Vegetables" (1838), p. 66: "This acid has been described in the Chemistry of Inorganic Bodies (Vol. ii, p. 69) under the name of *vinic acid*. But the term *racemic acid*, given it by M. Gay-Lussac in 1828, is better."

While the authorship of the specific term *acide racémique*, applied to the isomer of tartaric acid which Berzelius, in 1830, proposed to call *paratartronic acid*⁴, must undoubtedly be attributed to Gay-Lussac, the general application of the term racemic to the optically inactive, resolvable isomer of a substance, must be credited to Pasteur⁵.

With regard to the position of Gmelin and Berzelius in the naming of the acid called racemic by Gay-Lussac, the facts are as follows. Walchner, in 1827, had carried out an investigation of racemic acid and its salts⁶, and his results were communicated in Gmelin's "Handbuch der theoretischen Chemie", 3rd Edit., vol. 2, p. 53 (published in 1829). Here the acid is called, for the first time, *Traubensäure*; and in his paper communicated to the Swedish Academy of Sciences, Berzelius (p. 64) states: "Gmelin har gifvit den namnet drufsyra, Traubensäure". In this same paper, Berzelius suggested the name paratartronic acid, and this name was widely used. To sum up. To the acid discovered by Kestner and first called by John, "Säure aus den Voghesen", Gay-Lussac, in 1828, gave the name, *acide racémique*. In 1829, Gmelin called it *Traubensäure* (rendered by Berzelius in Swedish as *drufsyra*), and, in 1830, Berzelius called the acid, *acidum paratartronicum*.

ALEX. FINDLAY.

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June 2.

¹ *Ann. Chim.*, 27, 441 (1828).

² *Ann. Chim.*, 48, 113 (1831).

³ *Records of General Science*, II, 97, 161, 241 (1835).

⁴ *Konst. Vetensk. Acad. Handl.*, 40 (1830).

⁵ *Ann. Chim.*, 61, 438 (1861).

⁶ *Schweigger's J.*, 40, 238 (1827).

Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts

ACCURATE observations on cosmic ray intensities as measured by Neher electroscopes have been made in the equatorial belt (Madras, India, mag. lat. 3° N.) and in San Antonio, Texas (mag. lat. 38.5° N.) up to between 98 and 99 per cent of the way to the top of the atmosphere. The most significant results of these measurements may be summarized as follows:

(1) Cosmic rays, whatever their nature, are so rapidly absorbed as a whole in the outer layers of the atmosphere that even in the equatorial belt, where the effect of the earth's magnetic field upon them is a maximum, they get into equilibrium with their secondaries and produce their maximum ionization before they have penetrated through the first tenth of the atmosphere. (This effect was suggested as a possibility by Millikan and Cameron in 1927¹ in their report made at the Leeds meeting of the British Association on their first voyage (1926) made from Los Angeles to Peru to look for the effect of the earth's magnetic field on incoming electrons. The words then used were: "If the northern hemisphere and the southern hemisphere curves [of ionization with altitude] coincided, it would go a long way toward eliminating the possibility that the rays are generated by the incidence of high-speed beta rays on the very outer layers of the atmosphere. . . . For such beta rays would be expected to be influenced by the earth's magnetic field so as to generate stronger radiation over the poles than over the equator". This is precisely what the present experiments show to be the case for the whole field-sensitive portion of the cosmic rays.)

(2) From that point on, they fall off exceedingly rapidly in intensity, following an exponential equation, their law of absorption being like that of X-rays and not like that of particles that exhibit range phenomena such as low-energy beta rays, proton rays or alpha rays.

(3) The depth beneath the top of the atmosphere at which the maximum ionization is attained, always less than a tenth of an atmosphere, changes but slightly in going from San Antonio, where no electrons of energy less than 6×10^6 electron volts can get vertically through the blocking effect of the earth's magnetic field, to Madras where no electron-rays of energy less than 17×10^6 electron-volts can similarly get through.

(4) The difference between the San Antonio and the Madras curves makes possible for the first time the determination of the complete curve of ionization produced in the atmosphere by incoming charged particles contained within a sharply limited band of energies having a weighted mean value of 10×10^6 electron-volts.

(5) Down to a depth of a third of an atmosphere from the top (3 metres of water) this curve is in good agreement with the Bethe-Heitler theory of nuclear electron absorption as recently extended by Carlson and Oppenheimer as well as by Bhabha and Heitler.

(6) The exceedingly rapid absorption of this latitude-sensitive radiation, with an absorption coefficient which is nearly constant and independent of incident energy, qualitatively justifies the 'shower theory' of Millikan and Cameron as the main cause of the ionization of the atmosphere produced by incoming electrons even of this huge energy.

(7) The latitude-sensitive part of the cosmic ray ionization found in the lower part of the atmosphere

is considerably more penetrating than is predicted by the foregoing extended Bethe-Heitler theory of electron absorption; nevertheless, while at a distance of one twentieth of an atmosphere from the top, these 10×10^6 electron volt field-sensitive rays are producing 160 ions per c.c. per sec., at sea-level their total ionizing influence has fallen to but 0.3 ion per c.c. per sec., that is to less than 1/500 of its value near the top of the atmosphere.

(8) The two foregoing results in (7) show that the process of nuclear absorption of electrons is more complicated and involves the production of more penetrating secondaries than is pictured in the simple physical assumptions underlying the Bethe-Heitler theory, but, at the same time, that the whole progeny of secondaries, whatever their nature, has been reduced almost to zero by the time sea-level has been reached, not more than about one tenth of the sea-level ionization being accounted for by field-sensitive rays at all.

(9) The latitude-sensitive part of the cosmic ray ionization found in the lower atmosphere is practically all due to the secondary effects of varied nature resulting from the absorption of the incoming electrons in the upper tenth of the atmosphere.

(10) The apparent absorption coefficient, namely, 0.54 per metre of water, of the actual curve representing the whole progeny of secondary influences resulting down to sea-level from the absorption of incoming electrons in the very top layers of the atmosphere is approximately the same as that found by Johnson and by Neher for the east-west effect, thus proving that the particles causing the latitude and the east-west effect are of the same type. Both absorption coefficients are such as to suggest that these particles are electrons (predominantly positive), not protons.

I. S. BOWEN.
R. A. MILLIKAN.
H. V. NEHRB.

California Institute of
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June 15.

¹ NATURE, 121, 20, 1937.

Longitude Effect and the Asymmetry of Cosmic Radiation.

IN a recent letter, Dr. M. S. Vallarta¹ has emphasized the discrepancy which arises from the comparison of the variation of intensity of the cosmic rays along the magnetic equator (longitude effect) and the position of the magnetic centre of the earth as determined from magnetic observations. According to Hoerlin, the longitude of the magnetic centre as determined by cosmic rays should be 100° E. instead of 160° E. as found directly.

The theory according to which the cosmic ray observations are interpreted is that the angle of opening of the cone $\pi/2 + \theta$ must be computed by Störmer's formula

$$\sin \theta = \frac{2}{r} - \frac{1}{r^2},$$

with a value of $r = r_0(1 - \rho \cos L + \dots)$ proportional to the distance to the magnetic centre and therefore dependent on the eccentricity ρ of the dipole and on the difference of longitude L reckoned from the dipole (positive towards the east).

It should be noted that the angle θ in Störmer's formula is reckoned, not from the vertical of the place

but from the line joining the dipole to the point of observation. If we take account of this circumstance, we find that the change of the angle of opening becomes

$$\Delta\theta = -\alpha\rho \cos L + \rho \sin L;$$

where the first term is the effect due to the change of distance from the dipole and the last term is the new parallactic effect. The coefficient

$$\alpha = \frac{2}{r_0} \left(\frac{1}{r_0} - 1 \right) / \cos \theta$$

varies with the energy of the rays. For the rays just able to come from the zenith ($\theta = 0$), it is equal to 4 and its minimum value is $\sqrt{2}$.

For negative particles, the angle of opening of the cone must be taken not from the west but from the east, and therefore the sign of the new term must be inverted. The usual theory is therefore correct only if the rays are a mixture of positive and negative rays in equal amount. This is not the case, as the asymmetry measurements have shown that the positive rays are more important.

If we write $\tan \beta = 1/\alpha$ we get

$$\Delta\theta = \frac{-\rho}{\sin \beta} \cos(L + \beta),$$

showing that the improvement of the theory essentially amounts to reckoning the longitudes from an origin at an angle β west of the position of the dipole. This angle β , which is 0 for rays just able to reach the equator, is 14° for rays of 0.5 Störmer, that is, 15×10^6 eV. (for protons) and goes up to 36° for the limiting case of 60×10^6 eV. Although this correction is far from the 60° asked for by Hoerlin, it is in the right direction and will substantially reduce the discrepancy between theory and observation.

The fact that the longitude effect is different according to the effective value of the intensity of the rays and therefore according to the screens used, and also depends on the sign of the charge, will make the analysis more difficult; but when it is achieved, due to improvement in observations and also to progress in the working out of the details of the theory, it will probably afford information on the sign of the charge and the distribution of the intensity of the rays.

G. LEMAÎTRE.

University of Louvain.

May 22.

¹ NATURE, 120, 24 (1937).

Crystallization of Lysozyme

THE occurrence in nasal mucosa of a substance capable of lysing certain bacteria was noted by Fleming¹, and this or a similar compound was later obtained from egg-white by Wolff² who, however, did not recognize the true chemical nature of the substance. Meyer, Thompson, Palmer and Khoraso³, adopting an entirely different procedure, showed that lysozyme is a protein giving some of the typical reactions; they also quoted analytical data.

Dr. E. A. H. Roberts, of the Department of Pathology, has further improved the technique of the preparation and his results will shortly be published in another place. In the meantime we have undertaken the purely chemical side of the investigation of this interesting protein, and we wish to express our gratitude to Dr. Roberts and Prof. Florey for the facilities provided.

The material made according to the method of Roberts seems to possess a high degree of homogeneity and it may be crystallized by one operation from solution in $N/20$ acetic acid and concentration over aqueous potassium hydroxide in a vacuum desiccator. The crystals (Fig. 1, photomicrograph by Mr. H. M. Powell) appear to be dodecahedra, and Miss D. Crowfoot has kindly undertaken their crystallographic examination.

Crystalline lysozyme is about as active as the Roberts specimen in bringing about lysis of *Micrococcus lysodeikticus*, but comparisons by the method used are not capable of great accuracy.



Fig. 1.

Mr. H. S. Philpot has kindly studied the behaviour of lysozyme in the ultracentrifuge, and the molecular weight appears to be of the order of 18,000, a quite provisional estimate.

The ultra-violet absorption shows the usual tyrosine-tryptophan band at about 2770 Å. in acid solution; this is shifted to about 2870 Å. in $N/10$ sodium hydroxide solution. Using the method of Holiday⁴, analysis of the curves indicates the presence of 4.4 per cent of tyrosine residues and of 2.2 per cent of tryptophan residues in the molecule.

E. P. ABRAHAM.

Dyson Perrins Laboratory,
University, Oxford.

R. ROBINSON.

¹ Fleming, A., *Proc. Roy. Soc., B*, 28, 306 (1923).

² Wolff, L. K., *J. Immunology*, 50, 88; 54, 188 (1927).

³ Meyer, K., Thompson, R., Palmer, J. W., and Khoraso, D., *J. Biol. Chem.*, 112, 303 (1936).

⁴ Holiday, E. R., *Biochem. J.*, 20, 1796 (1936).

Thermal Decomposition of Ethylene Bromide

WHILE we were investigating the behaviour of certain gaseous alkyl and alkylene bromides at high temperatures, with the view of finding out how the energy of activation was related to the zero point energies (or vibration frequencies) of adjacent bonds (for example, tert.-butyl bromide with three C-C bonds might be expected to require a less activation energy than normal butyl bromide with two C-H and one C-C bonds) we found that the homogeneous nature of the decomposition could not always be predicted, and that the calculations made for ethylene bromide ($C_2H_4Br_2$) by Sherman and Sum¹ based on the Eyring method were somewhat misleading.

We used an all-glass pyrex apparatus, with a diaphragm gauge (electrical contact) balanced against a mercury manometer. The decomposition of ethylene

bromide took place in a pyrex vessel immersed in a molten metal bath. The temperatures ranged from 340° to 400° C. and were controlled by a chromel-alumel thermocouple and potentiometer system. At 340°-370° the decomposition is heterogeneous; the introduction of pyrex glass tubing leads to considerable increases in the reaction velocity. The final pressure is double the initial pressure, the products of decomposition are vinyl bromide (C_2H_3Br) and hydrogen bromide, and the reverse reaction is not appreciable at these temperatures. The reaction follows the first order equation very well.

There is no decomposition into ethylene and bromine. The calculations of Sherman and Sun lead us to believe that the decomposition into ethylene and bromine would take place at an appreciable rate at 350° with an activation energy of 50,000 calories. We have calculated an approximate activation energy for the heterogeneous reaction of about 30,000 calories.

Since the ethylene bromide molecule prefers to dissociate into vinyl bromide and hydrogen bromide, we would be inclined to look for some structural explanation of this phenomenon. The *trans* form of ethylene bromide is considered to be the more 'stable' (preferred) form, even at high temperatures¹. This interesting theory may explain how it is that ethylene bromide can become attached to the surface in such a way as to give rise to these decomposition products. It is very different from the behaviour of ethylene iodide ($C_2H_4I_2$), where an iodine atom (or an adsorbed iodine atom) acts as a catalyst for the decomposition into ethylene and iodine². Also, the molecule decomposes homogeneously into the same products. Here one of the iodine atoms in the molecule acts as a sort of 'intramolecular catalyst'. One would expect the *cis* form of ethylene iodide to be its normal condition, but there do not appear to be any definite data on this point. Recently, however, the idea that ethylene iodide dissociates directly into ethylene and iodine has been disputed³.

Further data and experimental details will be published shortly.

Department of Chemistry,
University, Sydney.
May 4.

T. IREDALE.
A. MACCOLL.

¹ J. Amer. Chem. Soc., 55, 1096 (1933).

² Trumphy, Z. Phys., 98, 624 (1935).

³ Arnold and Kudlakovsky, J. Chem. Phys., 1, 166 (1933); Iredale and Martin, J. Phys. Chem., 38, 305 (1934).

⁴ Ogg, J. Amer. Chem. Soc., 58, 607 (1936).

Pyruvic Acid Dehydrogenation, Vitamin B₁ and Cocarboxylase

It had been found by Davis¹ that pyruvic acid is oxidized by the acetone preparation of *Bacterium Debrückeri*. This preparation has proved to be very useful for a closer study of pyruvic acid dehydrogenation².

A coenzyme could be removed from the acetone-treated lactic acid bacteria by washing with phosphate of pH 8. The washed preparation was activated by the addition of decoctions of animal tissues (kidney, brain, liver). The addition of vitamin B₁ was without effect. Therefore cocarboxylase was tried, which had been found by Lohmann to be a vitamin B₁ pyrophosphate³. A pure preparation of cocarboxylase was

most kindly supplied to me by Dr. K. Lohmann, with which the following experiment was carried out.

Activator	None	Kidney decoction	30% cocarboxylase
Oxygen consumed in 30 minutes (c.m.m.)	8	137	175

The effect of cocarboxylase is surprising, because no decarboxylation to aldehyde and carbon dioxide was found with the bacteria. Pyruvic acid was broken down only by dehydrogenation to acetic acid and carbon dioxide.

With highly concentrated organ extracts, the activation found was notably higher than with cocarboxylase at saturation. Probably the additional activation is due to the presence of flavin phosphate in the concentrates. A highly purified, but not pure, preparation of flavin phosphate from heart together with cocarboxylase gave the same additional activation.

Furthermore, it was found that no dehydration takes place with the complete system in the absence of free phosphate. Phosphate is easily removed from the acetone preparation by washing with an acetate mixture of pH 4-7. The effect of phosphate is shown by the following experiment.

Phosphate (10 ⁻⁴ M. per lit.)	0	1.4	2.8	5.5
Oxygen consumed in 60 minutes (c.m.m.)	9	45	79	132

Phosphopyruvic acid was found to be inactive as hydrogen donor.

In the ocatatorulin test of Peters⁴, free vitamin B₁ activates pyruvic acid oxidation with brain tissue. But from certain experiments, Peters *et al.* concluded that after the addition of vitamin, a substance α is converted into γ , γ being the activator of pyruvic acid oxidation. The experiments reported here suggest that the α of Peters is vitamin itself and the γ vitamin pyrophosphate, into which it is converted by the tissue.

FRITZ LIPMANN.

Biological Institute of the
Carlsberg Foundation,
Copenhagen.
May 18.

¹ Davis, J. G., Biochem. Z., 285, 90 (1933).

² See also Lipmann, NATURE, 123, 1097 (1936) and Stand. Arch. f. Physiol., 75, 186 (1937).

³ Lohmann, K., Naturwissenschaften, 25, 25 (1937).

⁴ Peters, R. A., Biochem. J., 30, 2205 (1936).

⁵ Peters, Rydin and Thompson, Biochem. J., 30, 53 (1935).

Crystals with Vitamin K Potency

THE evidence for the existence of anti-haemorrhagic vitamin (K) required by the chick for preservation of normal blood clotting time has been reviewed in a former paper¹.

This vitamin has been obtained in a crystalline fraction isolated from concentrates obtained in molecular distillation by cooling such concentrates in absolute methanol with solid carbon dioxide. The colourless crystal fraction obtained by this method was recrystallized from methanol three times by the same cooling procedure. Two such lots of crystals have been obtained.

The first lot was found capable of restoring normal blood clotting time within four days when added to the basal deficient diet given to five chicks with clotting time greater than 30 minutes. The second lot, tested by preventive assay, maintained normal

blood clotting time in chicks when added to the basal diet, while the clotting time of chicks receiving no vitamin K supplement was in every case greater than 30 minutes.

Some vitamin still remained in solution. On the basis of comparative clotting times, the crystal fraction was approximately eight times as potent as the fraction not crystallized out by cooling with solid carbon dioxide.

H. J. ALMQUIST.

University of California,
Berkeley.

¹ Almquist, H. J. "The Anti-hemorrhagic Vitamin (Review)" *Poultry Science*, 16, 166 (1937)

Effect of Hetero-auxin on the Growth of Broad Bean Plants in Water Culture.

HITCHCOCK and Zimmerman¹ induced responses in the shoots of tomato and tobacco plants by applying a solution of hetero-auxin to the soil. These responses included bending, swelling, the production of adventitious roots on the stems, and epinasty of the leaves. This letter describes the relative effect of adding small amounts of hetero-auxin to the culture solution bathing the roots, and spraying approximately the same quantity on the shoots by the method described by Pearse². *Vicia Faba* (Dobbie's Champion Long Pod) was used as the test plant, and



Fig. 1.

THE SHOOTS OF THE PLANTS ON THE LEFT HAVE BEEN SPRAYED WITH HETERO-AUXIN, THOSE IN THE CENTRE ARE THE CONTROLS, WHILE THOSE ON THE RIGHT HAVE BEEN SUPPLIED WITH HETERO-AUXIN IN THE CULTURE SOLUTION TO THE ROOTS.

the seedlings were three weeks old at the time of the first applications of hetero-auxin; the shoots were then about 10 cm. high. Fig. 1 shows the result of one week's treatment; the plants on the left were sprayed daily with 1 c.c. of a 0.01 per cent solution of hetero-auxin, those in the centre are the controls, while those on the right were supplied daily with 1 c.c. of a 0.01 per cent solution in 500 c.c. of culture solution.

In Table 1 the average total length of lateral root for three plants, and the average dry weights of root and shoot are given.

Fig. 1 and Table 1 show that supplying hetero-auxin to the solution has retarded the growth in length of the roots, although the total root weight is practically unaltered, while spraying the shoots with hetero-auxin has slightly decreased the weight of root growth without altering its form. The shoot growth was retarded by both treatments, but whereas spraying induced swelling of the stem and epinasty of the leaves, the plants receiving hetero-auxin in the culture solution did not exhibit any such symptoms. The immediate effects of the treatments therefore appeared to be strictly local in each case, and the subsequent retardation of the growth of the parts of the plants other than those receiving the hetero-auxin would seem to be due to an alteration in the dynamic equilibrium of the plant, rather than to its movement within the plant body. The movement of hetero-auxin from the soil into the shoots of tomato plants noted by Hitchcock and Zimmerman¹ may have been due to the much greater amount of hetero-auxin applied.

TABLE 1.

Series	Total length of lateral root (cm.)	Root dry weight (mgm.)	Shoot dry weight (mgm.)
Control	335.4	356	917
Shoots sprayed daily with 1 c.c. of a 0.1 per cent solution of hetero-auxin	356.3	335	680
1 c.c. of a 0.1 per cent solution of hetero-auxin added daily to culture solution	180.6	352	642

The terminal bud was inhibited by spraying, an effect previously noted by Pearse³ when spraying tomato plants with phenylacetic acid, and with indolebutyric acid. Thimann and Skoog⁴ caused inhibition of the lateral buds of plants of *Vicia Faba* by applying hetero-auxin to the cut-off stump of the terminal bud; but here it has inhibited the growth of the terminal bud itself.

A full account of this work is being prepared for publication.

H. L. PEARSE.

East Malling Research Station,
East Malling, Kent.
May 11.

¹ Hitchcock, A. R., and Zimmerman, P. W., *Contrib. Boyce Thompson Inst.*, 7, 447 (1936).

² Pearse, H. L., *NATURE*, 136, 363 (1936).

³ Pearse, H. L., *J. Pom. and Hort. Sci.*, 14, 366 (1937).

⁴ Thimann, K. V., and Skoog, F., *Proc. Roy. Soc., B*, 114, 317 (1934).

Skatole as a Root Forming Substance

The activity of skatole as a growth-promoting substance has been noted by Glover¹. We have carried out experiments which show that skatole accelerates root formation in cuttings. Cuttings of *Leptospermum scoparium* and of *Ficus repens* were treated with an aqueous solution of skatole in the manner described by Hitchcock and Zimmerman², and the cuttings planted in a mixture of coco-nut fibre and sand in a propagator. The treatment accelerated root production. With *Leptospermum scoparium* cuttings, treatment for six hours with skatole solution of a concentration of 20 mgm. per 100 c.c. on March 19 gave 60 per cent of the cuttings well rooted in 20 days. A control set showed 30 per cent only of the cuttings to be slightly rooted. With

Ficus repens, a more marked response was obtained. Cuttings planted on April 22 and examined after 19 days showed in the control set 10 per cent rooted with an average of 0.3 roots per cutting and an average length of root per cutting of 1.6 mm. Of cuttings treated for 3 hours with a skatole solution of a concentration of 20 mgm. per 100 c.c., 90 per cent were rooted with an average of 4.2 roots per cutting and an average length of root per cutting of 38.4 mm.

Parallel experiments showed L-tryptophane to be inactive.

L. G. G. WARNE.
A. A. JACKSON.

Botany Department,
Victoria University of Manchester.
June 1.

¹ NATURE, 127, 320 (1936).

² Contrib. Boyce Thompson Inst., 8, 63 (1936).

Function of the Gills of the Mayfly Nymph, *Closon dipterum*

It is generally supposed that the plate-like abdominal gills occurring in some ephemeropterid nymphs are respiratory organs, although little experimental evidence is available to support this view. Moreover, both Dewitt¹ and Cuenot² have shown that these gills are not essential to life. Recently, another function has been ascribed to these structures by Eastham³, who shows that in the nymph of the mayfly, *Ecdyonurus venosus*, they act as paddles which bathe with water the gill tufts attached to their bases.

In order to test whether or not these gill plates are truly respiratory in nature, the oxygen consumption of both the normal and gill-less nymphs of the mayfly, *Closon dipterum*, has been measured at 10° C. at various oxygen concentrations. The results are shown in Fig. 1, each point in which is the average of three to eight experiments. This figure may be compared with Fig. 1 of Fox, Wingfield and Simmonds⁴.

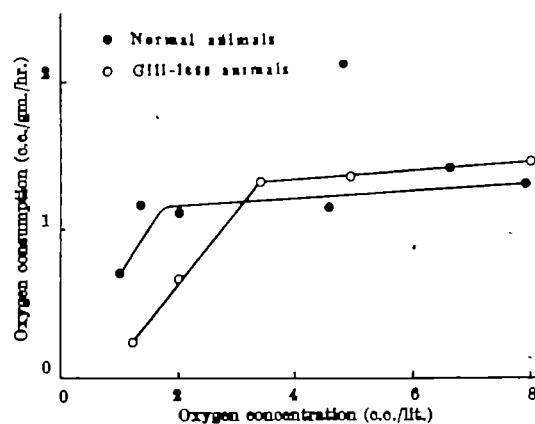


Fig. 1.

It will be seen that, as the oxygen content of the water is decreased, the oxygen consumption of both the normal and the gill-less nymphs remains nearly the same until a concentration of about 3 c.c./lit. is reached. Below this concentration the oxygen consumption of the gill-less nymphs falls off rapidly, but this marked decrease does not occur in the

normal animals until the oxygen content of the water is reduced to about 1.5 c.c./lit. It is clear that the gills in this species of mayfly nymph only aid the oxygen consumption in water of low oxygen concentration, that is, below 3 c.c./lit.

At high oxygen concentrations, the gills of *Closon dipterum* only beat intermittently, but as the oxygen content of the water falls the quiescent periods are much reduced, thus causing a greater volume of water to pass over the dorsal surface of the animal in a given time.

It is not yet clear whether at low oxygen concentrations the level of oxygen consumption in the normal animal is maintained by gaseous exchange taking place at the gill surface, or whether under these conditions the gills merely act as paddles which pass a greater volume of water over the respiratory surfaces of the animal. Either of these processes would enable the animal to maintain its normal level of oxygen consumption at low oxygen concentrations.

The results summarized above will be published in full elsewhere.

C. A. WINGFIELD.

Zoology Department,
University of Birmingham.
May 14.

¹ Dewitt, H., *Zool. Anz.*, 12, 525 (1900).

² Cuenot, L., "L'Adaptation", Paris (1925).

³ Eastham, L., *J. Exp. Biol.*, 14, 219 (1937).

⁴ Fox, H. Munro, Wingfield, C. A., and Simmonds, B. G., *J. Exp. Biol.*, 14, 210 (1936).

Zoological Nomenclature

IN spite of various criticisms, it must be admitted that the system of nomenclature used by zoologists and botanists is fundamentally sound and serviceable. Much depends, however, upon uniformity of practice, and certain irregularities which are becoming current are likely to cause serious confusion.

The International Code, Article 10, states: "When it is desired to cite the name of a subgenus, this name is to be placed in parenthesis between the generic and the specific names. Example: *Vanessa (Pyrameis) cardui*." The example is not well chosen, *Pyrameis* being a synonym of *Vanessa*; but the meaning is clear.

In the admirable *Review of Applied Entomology*, it has become the custom to cite an alternative generic name as if (according to the above rule) it were a subgenus. Thus, in the part for February 1937 we read "*Aonidiella (Oxytetranychus) aurantii*", for the red scale of the orange. *Oxytetranychus* is the older name, and opinions differ as to whether the red scale should be referred to that genus, with *Aonidiella* as a subgenus, or whether *Aonidiella* should be raised to full generic rank. The method of citation used by the Imperial Institute of Entomology, and indeed by others, would be intelligible were it not for the instructions given (following the usage of many decades) in article 10. If the method proposed in article 10 is abandoned, it is difficult to see how subgenera can be properly cited.

A quite different tendency, which seems to be on the increase, is to cite subgenera as if they were genera. An example (many more might be found) is furnished by C. Friek's "Horned Ruminants of North America", just published. A new subgenus *Stoeboceros* is proposed for *Tetrameryx conlingi* of Stock; but although

it is repeatedly stated to be a subgenus only, the species is written *Stoekoceros conkingi*, or in one place *S. (Tetrameryx) conkingi*, and a subfamily Stoekocerotinae is proposed (p. 36) to include the group containing *Stoekoceros*. Evidently the subfamily should be Capromerycinae, based on the oldest genus, and in no case, according to the rules, can it be based on a subgenus. It might be possible to argue, perhaps, that in spite of his intention, Friek had in fact raised *Stoekoceros* to generic rank by his mode of citation. Should this view prevail, Stoekocerotinae might be retained.

Another problem relates to the permissible length of generic and subgeneric names. Friek has, for example, a new subgenus *Pseudoparablastomeryx*. I have for many years followed a suggestion made by an author whose name I have forgotten, that such names should never exceed six syllables. There must be a limit somewhere, and perhaps the six-syllable rule would be acceptable, at least for future proposals.

T. D. A. COCKERELL.

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May 12.

The Number of Discriminable Colours

ALTHOUGH a calculation of the approximate number of discriminable colours must depend upon the individual concerned, 'normal' persons may be expected to furnish data which agree to the correct order of magnitude. The method used here involves the choice of an arbitrary colour solid, the well-known Titchener-Ebbinghaus double pyramid, to which available experimental data are applied with simplifying assumptions, in order that ordinary geometry may be used in the calculations. A straight line connecting the apexes of this double pyramid represents the black-white, or brilliance series; the saturation series is represented by lines running from the central axis to the surface; and the hue series is given by lines on the surface of the figure parallel to the base.

The observations of König¹, ranging from threshold to blinding intensity, give 660 discrete steps as the length of the brilliance axis. Jones², utilizing the measurements of Steindler, Nutting and himself, found 128 just noticeable chromaticity steps in the spectrum. Smith³ obtained 28 hues in the psychological purples. For the total number of hues, equivalent to the perimeter of the base, we have 156. Data for saturation are taken from the incomplete experiments of Geissler⁴, the work being done with coloured papers and covering only certain limited ranges. The results show 90 discrete steps from neutral grey to red. While Geissler did not determine the number of steps to each of the other corners, he measured the relative saturations from which the appropriate data may be computed: yellow, 35; green, 28; and blue, 67.

These values indicate that the base of the pyramid, if drawn to scale, could not be represented by conventional geometry. For the degree of approximation required here we may take arithmetical averages. We find 39 hue steps between each corner of the base and 55 saturation steps from the periphery to central grey. We shall assume that the number of hues, a function of the saturation, decreases linearly from periphery to centre, thus giving 78 hues at mean saturation. The number of colours in the base becomes 4,200. This is not the 'area', but the total

colour sensations, the spacing of which depends upon location. Since König's results are approximately symmetrical, we may use the ordinary formula for the volume of a double pyramid, and thus we obtain for the number of discriminable colours, to two significant figures, the value 9.4×10^4 . If a double cone is chosen, the results will be the same.

GEORGE B. WELCH.

Department of Physics,
Northeastern University,
Boston, Mass.
May 1.

¹ König, A., *Z. für Psych. u. Physiol. der Sinnesorg.*, 8, 375 (1896).

² Jones, L. A., *J. Opt. Soc. Amer.*, 1, 63 (1917).

³ Smith, F. O., *J. Exper. Psych.*, 8, 381 (1925).

⁴ Geissler, L. R., *Amer. J. Psych.*, 24, 171 (1913).

An Effect of X-Radiation on the ζ Potential of Colloidal Graphite

IN the course of our attempts to elucidate the nature of the action of X-rays on colloids, we have been investigating the effect of irradiation on the ζ potential of the colloidal particles. The sol selected for the preliminary experiments was an artificial graphite dispersed in conductivity water with the aid of traces of ammonia. This sol is practically homogeneous towards X-radiation, and has a low electrolytic content. It is stable, and the ζ potential of a given stock shows no significant changes over a period of four months. The ζ potential is deduced from measurements on the electrophoretic velocity of the particles. The experimental technique employed in our laboratory has been fully described by Lane and White¹, who have shown that the probable error of a single observation is of the order of 2½ per cent.

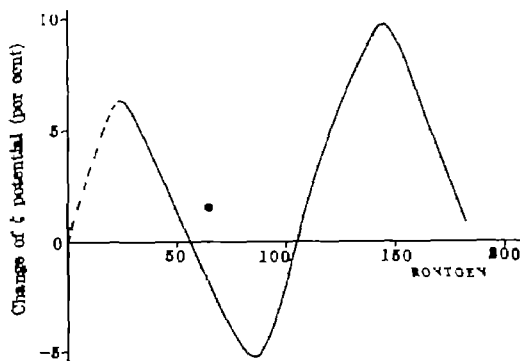


Fig. 1.

The nature of the results obtained is indicated, for small doses of radiation, in the accompanying graph (Fig. 1). The ordinates represent the percentage change in ζ potential, the abscissae the corresponding doses measured in röntgens. It will be seen that a significant increase in the negative ζ potential is produced by a dose of only 25 r., but that the effect is not a monotonic function of the dose. The oscillations persist, with undiminished amplitude, but with increasing wave-length, up to doses of 25,000 r. Effects of a similar kind were also obtained with gamma radiation. For one of the sols measured the percentage changes in potential at the first maximum (25 r.), first minimum (85 r.) and second maximum (145 r.) were $+ (7.0 \pm 0.6)$ per cent, $- (6.0 \pm 0.6)$

per cent and $+ (9.6 \pm 1.1)$ per cent respectively. The scatter of the separate observations for a particular dose was, in all cases, consistent with the estimate of the probable error of a single observation given by Lane and White.

The demonstration of a significant physical effect in a stable colloid by X-radiation amounting to no more than 25 röntgens is, so far as we can ascertain, novel: as is also the peculiar relation between effect and dosage. The experiments, in which we have been aided by a grant from the British Empire Cancer Campaign, are being continued.

J. A. CROWTHER.
H. LIEBMAN.

Department of Physics,
University, Reading.
June 1.

¹ *Phil. Mag.*, **23**, 834 (1937).

Determination of Electronic Charge by the Oil Drop Method

We have eliminated the convection current and the effect of the arc and minimized the variation of time of descent of the drops and the greatest common divisor, by using our new oil.

The battery used was two ampere-hour lead cells, highly insulated, giving constant potential with drop of less than two volts per 10,000 volts per five hours. This high potential enabled us to reduce the number of charges on the drop considerably. The water of the bath was constantly circulated and its temperature controlled to within a few thousandths of a degree centigrade for a period of weeks. The condenser plates, having a diameter of 22 cm. and thickness of 2.5 cm., were of stainless steel, optically polished and separated by the quartz prisms. The air used in the tank was dry and free from foreign matters. The timings were recorded on the Société Genevoise printing chronograph, which was controlled every second by the Riefler master clock of the Institute, the variation of which is less than one hundredth of a second per day.

With these precautions and improvements, and further, eliminating the non-spherical drops, we have determined the electronic charge, using Harrington's value for viscosity, and obtained

$$e = (4.806 \pm 3) \times 10^{-10} \text{ e.s.u.}$$

We wish to express our thanks for a financial grant from the Hattori Hokokai.

Institute of Physical
and Chemical Research,
Tokyo.
May 15.

Y. ISHIDA.
I. FUKUSHIMA.
T. SUMISUGU.

Temperature Variation of Magnetic Anisotropy of Organic Crystals

As has been shown by Krishnan¹ and his collaborators, the study of the magnetic anisotropy of organic crystals enables us in many cases to determine the orientation of the molecules in the crystal lattice. A natural extension of this important line of work, suggested to me by Sir C. V. Raman, is the investigation of the effect of temperature on magnetic anisotropy, which may be expected to yield valuable information regarding the character of the thermal

motions (for example, oscillations and hindered or free rotations) of the molecules in the crystal lattice and to elucidate the mechanism of fusion.

I have carried out measurements in the case of resorcinol over a range of temperature from 26° C. up to the melting point (110° C.) of the substance. Resorcinol was chosen because the crystal is stable and does not volatilize easily. The structure of the crystal has been studied by Robertson² by X-ray analysis, and the magnetic anisotropy at room temperature has also been determined by K. Lonsdale³. The method described by Krishnan⁴ was adopted for the measurement of anisotropy, a modified technique being employed for fixing the crystal at the end of the quartz fibre and for making the measurements at the higher temperatures.

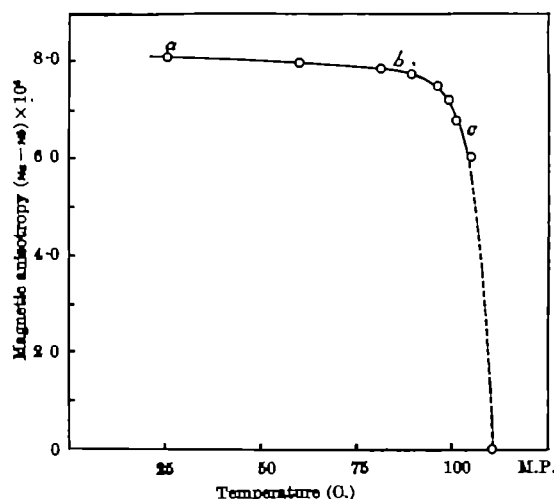


Fig. 1.

The following experimental procedure was adopted. For any setting of the crystal, the magnetic anisotropy in the plane concerned was first of all determined at room temperature. The crystal was then raised to the desired temperature by electrically heating the surrounding tube, the temperature at the region near the crystal being measured by means of a calibrated thermo-element. The magnetic anisotropy at the high temperature was then measured. The crystal was finally allowed to cool down to room temperature and the anisotropy again measured. It was found that when the high temperature did not exceed 105° C., the initial value of the anisotropy was almost fully restored. In all cases the mean of the initial and the final values of the magnetic anisotropy at room temperature was used in the calculations.

The variation of the magnetic anisotropy with temperature when the crystal is suspended with the *c* axis vertical is shown in Fig. 1. Up to about 15° C. below the melting point, the change of anisotropy is comparatively small. From *b* to *c* on the curve the variation is pronounced. From *c* onwards the transition is very rapid, indicating a state of instability. When the crystal was heated until it began to melt, the anisotropy practically disappeared. It is significant that the effect of temperature becomes prominent only in the vicinity of the melting point.

A determination of the magnetic anisotropy of resorcinol at room temperature gave the values: $\chi_a - \chi_b = 8.13 \times 10^{-4}$, $\chi_a - \chi_c = 13.30 \times 10^{-4}$, $\chi_c - \chi_b = 5.22 \times 10^{-4}$, whence assuming Pascal's value

-67.2×10^{-6} , for the mean susceptibility, we get $\chi_a = -66.2 \times 10^{-6}$, $\chi_b = -74.3 \times 10^{-6}$, $\chi_c = -61.0 \times 10^{-6}$, and $\alpha = 55.9^\circ$, $\beta = 47.0^\circ$, $\gamma = 62.1^\circ$, in satisfactory agreement with the results of K. Lonsdale.

I have also made a preliminary investigation of the magnetic anisotropy of ammonium nitrate at different temperatures up to the melting point of the crystal. The magneto-crystalline data seem to lend support to the findings of X-ray analysis³ in regard to the variation of the crystalline structure of ammonium nitrate with temperature.

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Department of Physics,
Indian Institute of Science,
Bangalore.

May 18.

¹ Krishnan, K. S., Guha, B. C., and Banerjee, S., *Phil. Trans., A*, **231**, 235 (1935).

² Robertson, J. M., *Proc. Roy. Soc., A*, **127**, 79 (1930).

³ Lonsdale, K., *NATURE*, **127**, 826 (1930).

⁴ Krishnan, K. S., and Banerjee, S., *Phil. Trans., A*, **234**, 265 (1935).

⁵ Hendricks, S. B., Pomjack, J., and Krasok, H. O., *J. Amer. Chem. Soc.*, **54**, 2766 (1932).

The X-Ray Microscope

As I pointed out some time ago¹, a new kind of X-ray spectra can be obtained by focusing the characteristic X-radiation emerging from the surface layer of an object. Instead of the usual spectral lines, these spectra contain a series of monochromatic *spectral images*, each of them showing the distribution of a certain chemical element in the surface layer of the object. Fig. 1 shows a new arrangement of the object, crystal and photographic plate giving a more distinct and even enlarged monochromatic X-ray image. The object *O* is excited to secondary radiation by primary X-rays. The secondary radiation is reflected on the concave side of the cylindrical crystal *K* and collected to the true monochromatic X-ray image *I*. If the dimensions of the object are small compared with the radius *R* of the crystal, it is possible to satisfy the conditions for a *true enlarged image* by adjusting the positions and inclinations of object and photographic plate.

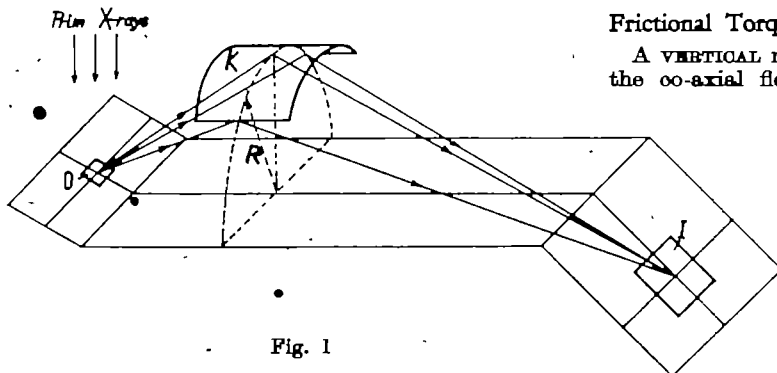
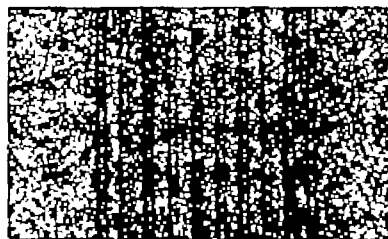


Fig. 1

The test-object for the method was a packet of thin metal foil polished perpendicular to the planes of the different layers. Fig. 2 shows the X-ray photomicrograph of such a test-object (above), with the dimensions of the different layers (below). The X-ray photo-micrograph corresponds to the iron *K α* -radiation, and as this radiation consists of two slightly different wave-lengths, the image of the iron foil appears twice.

By such X-ray photomicrographs chemical analysis for a great number of chemical elements in objects not larger than 10^{-8} c.c. is made possible without dissipating the sample.

A more detailed theory of this X-ray microscope will be published in the *Journal of Scientific Instruments*.



1mm.

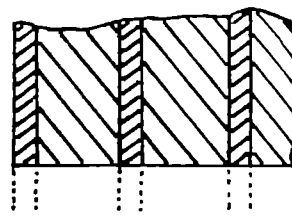


Fig. 2

I wish to acknowledge my grateful thanks to Prof. G. Aminoff for giving me the opportunity to carry out this investigation at the Mineralogical Department of the Riksmuseum, Stockholm, and to Prof. W. L. Bragg for suggestions concerning the publication of this paper.

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April 19.

¹ *NATURE*, **124**, 181 (1934).

Frictional Torque of an Axial Magnetic Suspension

A VERTICAL needle of iron suspended *in vacuo* by the co-axial field of a solenoid theoretically may have infinitesimal frictional torque against axial rotation. The purpose of the present note is to report an observed value of this frictional torque.

The arrangement used is a modification of that previously reported by one of us¹. A solenoid carrying a steady direct current produces a magnetic field sufficiently strong to support a large fraction of the weight of the needle. A vane mounted on the needle controls the amount of light striking a photo-cell. The current from this cell is amplified and fed to a second lifting solenoid. Thus the needle is automatically maintained at a pre-determined height. Vertical oscillations about this position were damped out by using a large resistance in, and capacitance across, the power supply for the amplifier output tube².

For this experiment the vane was a solid aluminum

alloy disk, 15 mm. in diameter and 5 mm. thick, mounted co-axially with the needle. The entire unit had a mass and moment of inertia of about 6 gm. and 0.8 gm. cm.² respectively. It was spun *in vacuo* by the action of the field of a small bar magnet mounted horizontally on an air-driven turbine¹ spinning below the disk at about 1,500 rev./sec.

The rotor was speeded up to about 1,200 rev./sec. Its action was such as to indicate that small or large rotors probably can be taken up to their bursting speeds with macroscopic stability, and that many types of drive may be used.

Damping observations were carried out at speeds in the neighbourhood of 600 rev./sec. with the driving magnet removed. Under these conditions, one encounters a frictional torque due to residual gases, and three torques of electromagnetic origin due to misalignment and the earth's magnetic field. In this preliminary work the residual gas pressure was estimated to be of the order of magnitude of 10^{-3} mm. mercury, alignment was done roughly, and no attempt

was made to neutralize the earth's field. However, the observed deceleration at the above speed was about 2×10^{-3} rev./sec.², corresponding to a frictional torque of about 10^{-3} dyne cm.

It is believed that this device offers possibilities in experiments in which it is necessary to suspend rotatable systems under a variety of conditions. The low frictional torque exhibited suggests its use in experiments in which this property is useful directly, or indirectly as in the attainment of relatively constant rotational speeds for use in velocity of light determinations, etc.

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May 12.

J. W. BEAMS.

¹ Holmes, F. T., *Phys. Rev.*, **51**, 689 (1937).

² Reported by F. T. Holmes at meeting of the Va. Acad. Sci., May 7, 1937.

³ Beams, J. W., Weed, A. J., and Pickels, H. G., *Science*, **78**, 338 (1933).

Points from Foregoing Letters

Measurements of cosmic ray intensities at various atmospheric heights at Madras, India and San Antonio, Texas, indicate, according to Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, that the incident cosmic rays produce their maximum ionisation before they penetrate more than one tenth of the atmosphere. The authors deduce, from the absorption coefficient down to sea-level, that the particles in the cosmic rays are predominately positive electrons, not protons.

Prof. G. Lemaitre points out that the discrepancy in the position of the magnetic centre of the earth, as determined from magnetic measurements and as calculated (from the variations in the intensity of cosmic rays along the magnetic equator), is considerably reduced if one takes into consideration that the cosmic rays consist mainly of positively charged particles.

A photomicrograph of crystals of lysozyme, a protein occurring in the nasal mucosa, capable of lysing certain bacteria, is submitted by E. P. Abraham and Prof. R. Robinson. From the ultra-violet absorption spectrum, the presence of 4.4 per cent of tyrosine and 2.2 per cent of tryptophane is deduced.

Dr. T. Iredale and A. Maccoll find that ethylene bromide ($C_2H_4Br_2$) decomposes at 340° – 370° in a pyrex vessel into vinyl bromide (C_2H_3Br) and hydrogen bromide. This reaction is heterogeneous. No decomposition into ethylene and bromine was observed. The authors suggest that the *trans* form of ethylene bromide is the more stable at high temperatures.

Addition of co-carboxylase to acetone-treated lactic acid bacteria (which had thereby lost the ability to dehydrogenate pyruvic acid) restores their power of dehydrogenation, or oxidation, according to F. Lipmann. The presence of phosphate is essential to the reaction.

H. J. Almquist reports that vitamin K, which preserves normal blood-clotting in chicks, has been obtained in crystalline form.

Dr. H. L. Pearce finds that hetero-auxin sprayed on to the shoots of plants of the broad bean grown in water culture causes swelling of the stem, epinasty of the leaves, and inhibition of the terminal bud,

while the form of the root growth is unaffected. Approximately the same amount added to the culture solution retards the growth in length of the roots, and accelerates their growth in thickness, while the shoots, although slightly retarded, remain normal in appearance.

Experiments with cuttings of *Leptospermum scoparium* and of *Picea repens*, confirming the root-stimulating properties of skatole, are reported by L. G. G. Warne and A. A. Jackson.

C. A. Wingfield has compared the oxygen consumption of normal and gill-less nymphs of a mayfly at various oxygen concentrations. It appears that the gills play little or no part in respiration at high oxygen concentrations, and only aid the oxygen consumption when the oxygen content of the water is reduced to a low value.

Using the Titchener-Ebbinghaus colour pyramid as the psychological colour solid, Dr. G. B. Welch calculates the number of discriminable colours to be of the order of 940,000.

A curve submitted by J. A. Crowther and H. Liebmans shows that when a colloidal dispersion of graphite is treated with increasing doses of X-rays, its zeta-potential (measured by the velocity of the suspended particles in an electric field) alternately increases and decreases.

A new determination of the charge of an electron by Y. Ishida, I. Fukushima and T. Suetsugu, with additional precautions and improvements, gives a value of $e = (4.806 \pm 3) \times 10^{-10}$ e.s.u.

An X-ray microscope by means of which a true enlarged image of chemically different layers, about 1/100th millimetre apart, was obtained, is described by Dr. L. V. Hamos. It depends on the focusing of the characteristic secondary radiation emitted from a surface layer of an object subjected to primary X-ray irradiation.

Drs. F. T. Holmes and J. W. Beams describe a macroscopically stable axial magnetic suspension which has a very small frictional torque. A six gram rotor when coasting at 600 r.p.s. required about eight minutes to lose one revolution per second.

Research Items

Delaware Ceremonies and Dances

MR. FRANK G. SPECK, who has made a detailed study of the Big House ceremonial of the Delaware, or Lenape Nation, now turns his attention to other ceremonies of no less importance, but of lesser duration (*Mem. Amer. Phil. Soc.*, Philadelphia, 7; 1937). The Big House ceremonial lasts for twelve consecutive nights, and is the periodical communal ceremony, which is the consummation of Delaware religious fervour. It expresses their attitude towards the benign Supreme Being. In their annual cycle, however, there is a number of other rites and ceremonies, in which they enter into relation with other spiritual beings, from whom, for the most part, evil is anticipated. Even though the Lenape have been removed from their original home in Pennsylvania and New Jersey to Oklahoma, these ancient rites have continued in practice down to the present day. It is probable that they are of a more ancient origin than the Big House ceremony. Some of them, as for example the Grease Drinking ceremony and the Doll dance, are family properties handed down as obligations to the tribe within the family group. The ceremonies are supposed to have originated through the mythical association of family ancestors with supernatural agencies. This is usually explained in a mythical narrative. Their purpose is to satisfy an offended spiritual force and to prevent a recurrence of the original misfortune avoided by the rite. The group performing the ceremony gains an added blessing in some form, such as an augmentation of crops. There are various officials of the ceremonial, of whom the chief is a master of ceremonies. The performance usually takes place at night. In addition to the description of the ceremonies, an account is given of the Delaware form of the dance taking place when the bones of the dead, from which the flesh has been stripped, are buried.

Early Peruvian Textiles

A LARGE number of specimens of textiles from early sites in the Nasca valley, Peru, numbering one hundred and sixty in all, collected by Prof. A. L. Kroeber in 1928, on behalf of the Field Museum, Chicago, have been described by Dr. Lila M. O'Neale, associate curator of textiles in the Museum of Anthropology at the University of California (*Anthropology: Memoirs*, Field Museum, Chicago, 2, 3). In an introductory note, Prof. Kroeber points out that Early Nasca textiles were not previously well known, and in fact were scarcely recognized; but the present material affords adequate data for satisfactory study, owing to the fact that he was able to establish the archaeological associations of his specimens. It has now been shown by Dr. Tello's archaeological investigations at Paracas that the finely embroidered polychrome shawls and garments, at first identified as Ica and then as Nasca, are now to be associated with Paracas. The stylistic relation between Early Nasca pottery designs and those of Paracas textiles is so close as to leave little doubt of a common origin, the pottery probably being the earlier. The Early Nasca textile art discovered in association with Early Nasca pottery is largely decorative and tends to the geometrical, while its representations of naturalistic

impulses are relatively undeveloped. Nasca pottery and Paracas fabrics go together, while Nasca fabrics and Paracas pottery are alike in not attempting naturalistic representation. When the Early Nasca peoples wanted a picture on cloth, they painted it on. One example of this was found, duplicating in design a well-known Early Nasca pottery type, birds in attitude and placement in the design being identical with birds painted on double-spouted jars. The most striking feature of the Early Nasca textiles is their range of colours. They show a total of 190 hues by comparison with a colour scale, the majority to be described in terms of red, orange and yellow. The material used is a finely spun cotton yarn. Five of the eight standard weaves known to modern weaving were known to the Early Nasca, and in addition they did wrapped weaving, as in basketry.

Problems of Population Density

THE biological principles affecting populations are discussed by Raymond Pearl (*Amer. Naturalist*, 71, 50), with references to experimental work on animal populations. He points out that the fundamental underlying principles are the same in man and in other animals; and that population growth or decrease has had an important effect in shaping political conduct and national policies, human populations differing in size, growth and quality. He is inclined to conclude that the human population of the earth grew very slowly until about three centuries ago, and then, as a result of scientific discoveries, took a great spurt and so increased from some 445 millions to more than 2,000 millions, or 40 persons per square mile of the earth's land surface. He regards this cycle of population growth as about two-thirds completed, and compares it with the cycles of lessening population. He interprets these cycles as beginning with a period in which the population remains relatively constant, followed by abatement of some of the natural checks, which leads to rapid increase. Population density finally reaches a point where new stimuli, reinforced by gregariousness, lead to migratory movements and ultimate destruction of masses of individuals. In the same journal, Dr. Thomas Park discusses in detail the recent experimental work on insect populations, with special reference to density effects.

Laboratory Diagnosis of Psittacosis

PSITTACOSIS or 'parrot' fever is a virus disease of cage birds, and is communicable to man, in whom it causes a serious and often fatal malady. This disease was comparatively prevalent in Great Britain and in the United States some years ago, and was of sufficient importance for the Ministry of Health to issue a memorandum, with recommendations upon its diagnosis and prevention. As a result of recent investigations, it has become possible to give more precise indications for the detection of the disease in man and in animals, and the Ministry of Health has published a report containing details of the technique of laboratory diagnosis (*Laboratory Diagnosis of Psittacosis*. Reps. on Pub. Health and Med. Subjects, No. 80. London: H.M. Stationery Office. 6d. net). The examination of suspected birds and

of suspected human beings is described. The staining of smears of material for virus bodies, and the microscopic appearance of the virus are also described, and the appearances found are illustrated in an excellent coloured plate.

Feeding of *Chirocephalus*

SIR E. RAY LANKESTER in his essay on *Apus* (1881) first used the term 'gnathopod' for the proximal endite of the trunk limb, stating that it was a jaw-process which clearly had the function of assisting, by means of apposition to its fellows on the opposite side, in seizing and moving particles which may be introduced into the mouth. A. G. Lowndes, in his recent paper on *Chirocephalus* (The Term "Gnathopod" (Lankester). *Proc. Zool. Soc. Lond.*, B, Part 1; 1937), is in complete agreement with Lankester, and concludes from direct observations and by the use of his strobographic method, described in *NATURE* (1935, 1006; 1935) that the setules of the basal endites can and do act in apposition while the limbs are working normally. He finds, however, that they do not do so always, and this, he believes, confirms his previous observation that the endites are under both muscular and nervous control and that one need not look upon the passage of food particles towards the mouth as being in any way automatic. Mr. Lowndes and his pupils have examined hundreds of specimens of *Chirocephalus* for gut contents, and find that the food consists almost entirely of quite coarse particles, such as remains of vascular bundles of leaves, etc., which are to be found at the bottom of most ponds. Other detritus such as algal filaments, leaves of moss, and dead Entomostraca are also found in the gut.

New Porcellanids and Pinnotherids

UNDER the title "Porcellanids and Pinnotherids from Tropical North American Waters", Mr. Steve A. Glassel describes several interesting forms, mostly collected by himself (*Trans. San Diego Soc. Nat. Hist.*, 8, No. 21; 1936) from the west coast of Mexico and from the Gulf of California. Four new species of *Petrolisthes*, three of *Piscesoma*, two of *Pachycheles* and three of *Porcellana* are included. The new genus *Orthochela* in the Porcellanids is created for another new species, *O. pumila*, which is very peculiar in the shape of its carapace, resembling *Uroptychus* in the family Galatheidæ. This crab is figured and also the outer maxillipedes of the three new species of Pinnotherids, *Fabia unguiculata*, *Disceodactylus zantusi* and *Pinnixia richardsoni*. Otherwise the paper is not illustrated.

Locust Control

THE Committee on Locust Control of the Economic Advisory Council has issued a fifth survey of the locust outbreak in Africa and Western Asia. The latest of these surveys deals with the situation in 1935 and has been prepared by Dr. B. P. Uvarov, in collaboration with Miss W. Milnthorpe, of the Imperial Institute of Entomology. It appears that the outbreak of the three species of locusts, which have brought about so much damage during the past eleven years, is subsiding. At the same time it is pointed out that no relaxation in the campaign of locust investigation would be justified on this account. The desert locust, for the first time since 1926, had not invaded North Africa. The appearance of a swarm in May, 1936, in the Darfur province of the

Anglo-Egyptian Sudan is disquieting, since its origin must be in an unexplored coastal area of the Red Sea. The possibility that it may sooner or later develop into a new invasion needs to be kept in mind. As regards the African migratory locust, it is now known that the outbreak centres are in the Middle Niger region. It is believed that this area is the only real danger spot in the whole continent of Africa in so far as this species is concerned. Practical measures are being planned for the permanent supervision of that outbreak area. With the red locust, heavy mortality has been caused by the fungal disease *Empusa grylli* among both the hoppers and winged forms. Viewed generally, the outbreak of this species is on the decline; but swarms are likely to be still produced for some years to come.

Mutation in Tobacco Virus

MUTATIONS in viruses are the subject of a paper by Dr. H. H. McKinney (*J. Hered.*, 28, No. 2), who cites experimental work, especially with mosaics of tobacco. While these viruses tend to remain true to type over long periods, yet they give rise in local zones of the infected plant to aberrant viruses which when isolated induce distinct symptoms. Some of these aberrant viruses in turn give rise to others. This is interpreted as a mutational phenomenon. Such mutants differ in the changes they produce in the chlorophyll mechanism of the leaf, some producing no disturbance, others a slight disturbance (light green mottling), others a yellowish-green, yellow or even almost white colour. Temperature has an important effect on these disturbances. Nearly a hundred mutants have been isolated from the common mosaic, but the number of distinct types is uncertain. Sub-mutants are also produced, the whole system of types tending to show certain relationships. The generation of these bodies is believed to be different from that of an enzyme from its precursor. The primary virus and its mutants are regarded as a series of closely related compounds which function essentially as genes.

A Rice Fermentation

ALCOHOLIC fermentations fall into three groups: (1) the direct inoculation of the fruit juice by yeasts as in wine production; (2) the fermentation of a grain extract after pretreatment as the malted grain in beer; and (3) the reinoculation of a partially cooked plant material. Rice as a source of alcohol has had to be approached from this third angle by K. Rami Reddi and Dr. V. Subrahmanyam, of the Indian Institute of Science, Bangalore, who have published a most interesting paper upon 'Sonti' fermentation (*Trans. Nat. Inst. Sci., India*, 1, No. 11, 1937), which describes and analyses traditional methods of rice fermentation handed down from father to son, often as secret customs in small village communities, and then gives a preliminary estimate of their biochemical and biological basis. The 'Sonti' fermentation is practised in certain districts of the Madras Presidency. The main organism associated with the process appears to be a hitherto undescribed species of *Rhizopus* provisionally named *Rhizopus Sontii*. It is allied to *R. cambodia*, but its physiological activities are more pronounced. Indeed *R. Sontii* may have a practical future before it as it liquifies and saccharifies cooked rice more rapidly than other well-known organisms, including *Aspergillus oryzae*. This paper is fascinating in its linkage of tradition

with modern problems of biochemistry and mycology, and it shows the great possibilities of advance in standards of nutrition as the result of scientific study of methods of food preparations that are acceptable to a conservative native population. Studies of the species of *Rhizopus* isolated from Chinese yeast cakes such as are used in brewing alcohol from cereal grains in China, Manchoukou and Korea are also being extensively carried out by M. Yamazaki, professor of zymology (*Bull. Utsunomiya Agric. Coll.*, A, 2, No. 6, 1937).

Cyclones in the South Indian Ocean

MISCELLANEOUS PUBLICATIONS of the Royal Alfred Observatory, Mauritius, have in recent years included an annual publication in which an account is given of all the tropical cyclones that have been noted in the last cyclone season in the South Indian Ocean from Coos Keeling Island across to Madagascar and the adjacent coast of South Africa. Publication No. 16, by N. R. McCurdy, director of the Observatory, which is the seventh of its kind, covers the season 1933-34. The number of depressions of sufficient intensity to be classed as tropical cyclones or hurricanes in that season was eight, which is about the average number; but the weather was more than usually disturbed during the hurricane season, and seven other disturbances are referred to briefly. It is said to have become increasingly evident in recent years with improvements in the synoptic charts, that the formation of cyclones is closely related to the periodic invasions into low latitudes of the cooler air associated with subtropical high-pressure systems. These systems usually move north-eastwards from South Africa but sometimes northwards. In the season under discussion, areas of disturbed weather always developed at the northern limit of the high-pressure wave when the latter was of appreciable intensity, and these sometimes led to the development of a tropical cyclone. Observations with pilot balloons at Mauritius showed that this happened whenever the east or south-east trade winds of the 'high' extended up to 5,000 metres. This is held to be a result of importance in forecasting, in the absence of enough observations from the Indian Ocean to the north of Mauritius to permit of the approach of cyclones to be studied for some days before their arrival near to or over the island itself. None of the storms of this season appears to have been of very outstanding intensity, but some showed interesting features; for example, that of January 26-February 2, which was deflected from its course by the high land of Mauritius, although the highest 'peak' of the island has only an elevation of about 2,700 ft. Another storm in March was broken up into two centres by its encounter with Madagascar, and soon died out.

Absolute Measurements of Sound Intensity

E. N. DA C. ANDRADE and R. C. Parker (*Proc. Roy. Soc.*, A, 159, 507) have measured the amplitude of vibration of smoke particles suspended in a vibrating air column. A theoretical calculation shows that, in the case of fine particles (radius about 0.03μ), this amplitude is very nearly indeed that of the air itself, and this result is confirmed by the fact that particles of different size in the same air column show the same amplitude of motion. The particles were seen and photographed by scattered light: they appeared as well-defined short lines of light. The

apparatus was kept at a constant temperature both to reduce convection and to give generally consistent operation. When the apparatus had been calibrated, it was used to determine the minimum amplitude audible to a number of observers. The end of the tube was allowed to radiate into the open air, and the intensity varied while the observer indicated when the sound passed above and below his threshold of hearing. The observed minimum intensities for audibility were very similar for a number of observers. They corresponded to a pressure variation of 1.2×10^{-3} dynes/cm.² R.M.S. at 410 cycles and 0.9×10^{-3} dynes/cm.² R.M.S. at 646 cycles. The corresponding energy fluxes are 8.4×10^{-8} erg./cm.² sec. and 2.1 erg./cm.² sec.

Lead Borates

A KNOWLEDGE of the system $PbO-B_2O_3$ is of importance in the manufacture of ceramic glazes and glasses, and a study by well-known methods involving quenching and petrographic examination has been made by R. F. Geller and E. N. Bunting (*J. Res. Nat. Bur. Stand.*, 18, 585; 1937). Four compounds were characterized, namely, $4PbO.B_2O_3$, occurring in two forms and melting congruently at 585° ; $2PbO.B_2O_3$, occurring in two forms and melting incongruently at 497° ; $5PbO.4B_2O_3$, melting incongruently at 548° ; and $PbO.2B_2O_3$, melting congruently at 788° . No evidence of compounds richer in B_2O_3 was obtained, although these have previously been reported. Particular attention was given to the proof that the compound $5PbO.4B_2O_3$ is not the metaborate ($PbO.B_2O_3$). The eutectic of lowest melting point, 493° , was composed of 88 per cent PbO and 12 per cent B_2O_3 . The report also gives the indices of refraction and optical characters of the compounds, and the indices of refraction, coefficients of expansion and softening points of some lead borate glasses.

Isotopes of Potassium

THE abundance ratio for the two principal isotopes of potassium, K^{39}/K^{41} (the exceedingly rare isotope K^{41} is responsible for part and possibly all the radioactivity) in various animal tissues has been measured by J. H. Yoe and R. T. Hall (*J. Amer. Chem. Soc.*, 59, 869; 1937) by means of the mass spectrograph. Any process which concentrates K^{41} will doubtless concentrate K^{39} , and as speculations have been made on the possible biological importance of potassium, owing to its radioactivity, it was of interest to see whether the abundance ratio varied in different tissues. The results showed that the ratio for most organs is close to the value found for most plants and minerals and for ocean water. A few tissues, such as the lining of the auricle and the lining of the small intestine, appear to possess an abnormally high concentration of K^{39} , whilst bone marrow is abnormally high in K^{41} . The atomic weight of potassium was calculated, with the most probable value of the packing fraction and the conversion factor; for most tissues it is 39.094. Since all deviations from this normal value are small, it does not seem probable that potassium in animal tissue could be distinguished from mineral potassium by radioactive measurements as has been suggested by some investigators. The results with bone marrow indicate a possible relationship between the abundance ratio and the age of the animal, and hence with the development of embryonic cells within the organism.

The International Congress of Agriculture

MEETING AT THE HAGUE

THE seventeenth International Congress of Agriculture was held at The Hague on June 16-24. Great Britain was officially represented for the first time for many years, though at recent congresses members of the Women's Institutes and the Horace Plunkett Foundation have been present. There is always a tendency in Great Britain to regard international congresses, other than those of specialists, as somewhat in the nature of 'joy-rides'. Languages undoubtedly present a difficulty that weighs more upon our people than upon Continentals, and this applies more particularly to those informal discussions and personal contacts from which those who participate in the Congress gain most.

The abstention of British representatives of agriculture from this Congress has most probably been due to the feeling that their industry is fundamentally different from the European system, in which peasant farming predominates. However, nowadays nearly all nations have embarked upon policies of control and regulated marketing, about which there is much to be heard from the Continental experiments, which aim like our own at the safeguarding of an industry ill-adapted to hold its own under modern conditions. From every nation one hears the same tale of low prices, of the inability of the farmer to hold his own against the trader or to get his products to the consumer at prices commensurate with those which he receives, and of the drift of men from the land. A 'Green International' is not possible, so diverse are the interests and the organization of the land and the farmers in different countries, but one's domestic policy is more likely to be successful if it is informed of what is going on elsewhere.

From the technical side, Holland is the country most worthy of study by the British farmer; its agriculture is highly accomplished and works under conditions of mixed capitalist exploitation and small holders, analogous to our own. Livestock bulk large in the system and the organization either of registration, disease prevention, advice, even of shows, affords us much to think about. The production of sugar from beet is higher in the Netherlands than in any other country—for the years 1926-29, 4,000 lb. per acre as against 2,500 lb. in Great Britain. Vegetable growing exhibits an exceptionally high general level of efficiency, even if some of our experts need fear no comparison.

It was therefore somewhat of a lost opportunity that British representation at the Hague Congress, except in the women's section, was still so limited. The formal opening was attended by H.R.H. Prince Bernhard and a representative of the Queen, the Prime Minister of the Netherlands and the Minister of Agriculture, the Minister of Agriculture of Italy, the president and secretary general of the International Institute of Agriculture at Rome, and representatives of forty nations in all. In welcoming the Congress, M. Colijn, Prime Minister, made a courageous speech on the necessity of breaking down the trade barriers between nations which have so often been set up in response to the pressure of particular interests. This was followed by a remarkable

demonstration, at which the representatives of one country after another affirmed that the maintenance of peace was the prime necessity for the maintenance of agriculture and indeed of the world's civilization.

Then, as is customary, the Congress resolved itself into its various committees. The first and third sections, dealing with agrarian policy and co-operation respectively, bore perhaps little upon British conditions, though the discussion on the international market for butter was of interest to the Dominions. The second section discussed education and propaganda, and the chief point raised was the importance of economic studies in the agricultural colleges as a means of preparing trustworthy leaders of opinion in these times when so much legislation affecting agriculture is being proposed. The fourth section, on plant production, produced discussions on the improvement of protein yield from light soils and on vernalization, with some reference to the recent clash between the advocates of vernalization and the geneticists in Russia. Of great interest was the account of recent legislation in Germany to restrict the number of varieties of farm crops that can be offered for sale, a restriction dependent upon an organization for testing the productivity of the immense number of varieties that are more or less in cultivation. It was reported, for example, that from the 348 varieties of wheat formerly to be found in Germany, only 11 may now be sold, with a further 34 under trial. The vexed question of assuring to the breeder of a new variety protection analogous to that of a patent was discussed at some length. If legislative control is obtained of the varieties that may be offered for sale, it is possible to secure royalties on the stocks multiplied from the original which has been duly characterized and registered, but while something is thus practicable internally, the situation is complicated by the existence of international trade and the lack of any general system of testing and registration. In the section on livestock production, discussion chiefly turned on the role of vitamins and mineral accessories, and several of the papers presented merit careful consideration.

In the women's section the chief report had been prepared by Mrs. Haldane, on public health regulations in English villages. The role of the woman in agriculture is obviously much larger in the European countries than in Great Britain, owing to the predominance of peasant farming; hence the greater attention that is being paid to instruction in the domestic economy of the farm.

The Congress was admirably prepared and organized; before the meetings copies were available in French of the reports and of the main communications. It might, however, well be laid down that a speaker whose paper has been printed should not read it at length, particularly in a language in which he is not at home; in some sections the time for discussion was seriously curtailed by this.

The Congress was followed by excursions to the reclamation works of the Zuider Zee, the experiment station at Wageningen, and to farms representative of the milk production and market gardening industries.

The National Physical Laboratory

INSPECTION BY THE GENERAL BOARD

THE annual inspection of the work in progress at the National Physical Laboratory was made on June 22, by the General Board and also by about two thousand visitors, who were received in the High Voltage Laboratory by Sir William Bragg, president of the Royal Society, chairman of the Board, Lord Rayleigh, chairman of the Executive Committee, and Sir Frank Smith, director of the Laboratory. Amongst the numerous exhibits in the eight departments of the Laboratory the following may be mentioned.

A comprehensive investigation into the thermal properties of a number of alloy steels is being made in the Physics Department up to temperatures of the order of 800°C . The thermal and electrical conductivity, specific heat, latent heat at the transformation points, and thermal expansion, are measured *in vacuo*. The specific and latent heats are determined by measuring the rate of rise of temperature of a hollow cylindrical specimen in which an electric heater is embedded. Loss of heat by radiation is avoided by surrounding the specimen with a jacket of low thermal capacity, which can be adjusted always to the same temperature as the specimen. The thermal conductivities of a large variety of materials are also measured in this section, the method generally employed consisting in the determination of the electrical energy required to maintain a known difference of temperature across a specimen of slab or cylindrical form, lateral flow of heat either being annulled by some form of guard system or else determined by a separate experiment.

In another building the apparatus used for the accurate realization of various points on the International Temperature Scale was shown, and the routine testing of various types of thermometers was demonstrated. It should be mentioned here that approximately half a million clinical thermometers have been tested at the Laboratory during the last year.

The radiological work done at the Laboratory can be divided into two sections, one devoted to the precise measurement of the properties and intensities of X-rays and gamma rays and the other to the application of radiography and diffraction methods to the study of the structure of materials. This latter has now become a valuable experimental tool, and typical results obtained by it on electro-deposited, heat-treated and strained metals, tooth-enamel and dentine were shown. A considerable amount of radium has been tested lately, and a valve amplifier apparatus for facilitating this work was demonstrated. The lead equivalents of various building materials to X-rays of different hardness have also been investigated, and the superior performance of barium concrete in this respect was illustrated.

A popular exhibit in the acoustics laboratory—which is at present in process of enlargement—was designed to test the efficacy of various anti-drumming treatments applied to metal panels representative of the bodywork of vehicles. The panel under test is held in a rigid square frame which is attached to a moving-coil loud-speaker movement at each corner

and thereby driven at any desired frequency. The acoustic output is measured over a range of frequencies. The measurement of the absorption coefficient of sheet material was also demonstrated in the reverberation room, and a portable instrument for the measurement of noise, in which the peculiarities of the average human ear in this respect have been copied, was shown.

In the Optics Division, apparatus for measuring the intensity-response function of thermopiles and also the time-constant of this response was demonstrated. In the latter, the thermopile is connected to a condenser which is discharged through a ballistic galvanometer by an adjustable time-switch. Amongst the numerous exhibits here devoted to the measurement of colour a spectrophotometer for opaque surfaces was noted. The feeble intensity available from such a surface is counteracted by using a zonal concave mirror which focuses the light received from the specimen on to a photo-electric cell.

The Electrical Standards Division is now in a strong position with regard to the absolute determination of the ohm, inasmuch as the value finally obtained by the A.C. method devised by Albert Campbell has been found to agree to within 1 part in 100,000 with that obtained by the Lorenz machine. The apparatus used in these refined measurements was exhibited and the precautions necessary to attain the required accuracy were illustrated. Amongst other exhibits in this section was a simple form of apparatus for calibrating audio-frequency oscillators, using 50-cycle A.C. mains as a standard. The 50-cycle wave-form is distorted by passage through a metal rectifier and then mixed in suitable proportions with the oscillator output. The resulting combination is passed through a telephone in series with another metal rectifier, and integral multiples of the mains frequency are revealed by the presence of beats. A new type of quartz ring oscillator which will form the principal unit in a standard clock for the Royal Observatory, Greenwich, was also shown, together with the quartz bars used in a recent experiment, which showed that the frequency of vibration of these bars remains constant to ± 4 parts in 10^{11} irrespective of their orientation in a horizontal plane. This has been cited as being the highest precision ever achieved in a physical measurement.

In the Electrotechnics Building, the standard apparatus for the routine testing of alternating and direct current meters of all kinds was shown. The functioning of the thyatron stroboscope recently developed was illustrated by cathode ray oscillograms of the current in various parts of the operating circuit, and the results of a comprehensive theoretical and experimental investigation into the eddy-current losses in square-section alternating current conductors were also shown here.

The work in the High Voltage Laboratory is mainly carried out with impulsive voltages, and cathode ray oscillograms illustrating the work recently done were exhibited. In addition, the testing of a pin insulator with simultaneous alternating and impulsive voltages

was demonstrated, and the relation between the phase of the impulse and the probability of an ensuing power arc illustrated. The demonstration of high voltage sparks proved, as usual, to be a very popular exhibit.

In the Photometry Building, an exhibit which attracted attention was concerned with street lighting. A cinema film was prepared from a series of photographs of a night street scene and the projected image viewed from a definite position. On recognising the change from one scene to another, the observer presses a key which operates the shutter of a camera, thereby recording the instantaneous position of the film, and hence the delay in recognition. This has been carried out with various sources of illumination in order to find out if any of them have advantages from this point of view. In this building there were also exhibits illustrating the routine testing of electric lamps, maintenance of photometric standards, and other illumination research. The photo-electric spectrophotometer recently developed was shown in operation: this has materially reduced the time and tedium involved in visual measurements of this nature.

In the Radio Department the chief exhibits, which were shown on the same occasion last year, were a direction-finding radio receiver for use on wavelengths between 8 and 10 metres, a self-checking, direct-reading, frequency-measuring equipment for the range 1-70 megacycles per second, which is based on a standard 1,000-cycle tuning fork, and a number of coils and condensers of very low or adjustable temperature-coefficients of reactance.

The synchronization of a pulse transmitter and receiver, such as are used in the ionosphere research of the Radio Department, where the frequency of the exploring waves may be varied over the range 1-20 megacycles per second, has been effected automatically. The receiver is tuned by means of a small reversible electric motor, suitably geared down, which is controlled, through a system of relays, by currents which depend on the difference in frequency between the transmission and the frequency-change oscillator of the receiver.

An interferometer for routine measurements of block gauges which was exhibited in the Metrology Department has very materially decreased the time occupied by such tests. A series of gauges is wrung radially on to a circular lapped plate which is rotated so that each is viewed successively in light of four monochromatic radiations from a cadmium lamp. By estimating to 1/10th of a fringe for each radiation, the amount by which the path-difference between light reflected from the surfaces of the gauge and the plate differs from an integral number of wave-lengths, and knowing the approximate thickness of the gauge, the true thickness may be determined rapidly and without ambiguity. Amongst the new exhibits in this Department was a comparator sensitive to a millionth of an inch, and a circular dividing table reading to 1 second and accurate to 5 seconds of arc, in which the driving mechanism and the reading mechanism are entirely separate, so that the latter is not subject to wear.

An appliance for measuring the drunkenness (that is, departure from a true helix) of screw threads was shown. A pair of round-nosed feelers attached to a floating carriage register in the vee-groove of the screw at opposite ends of a diameter. Rotation of the screw produces axial movement of the feelers, and any inequalities in the movements of the two feelers is revealed on a dial gauge capable of detecting

errors as small as 0.00005 inch. A horizontal projection machine has just been completed. By using suitable lenses, plate gauges up to 3 inches in length can be projected as a whole to a magnification of 25, the maximum error over any part of this field not exceeding 0.0002 inch, whilst the threads of screw gauges up to 8 inches in diameter, and the teeth of large gear-cutting hobs, can be examined at a magnification of 50. An experimental machine for testing the wearing qualities of gauge steels consists of a lapping table on which three ring-shaped specimens rest. The table and the specimens all rotate slowly about their own axes, thereby reproducing a lapping operation.

The combined fatigue testing machine developed in the Engineering Department was in operation on specimens of cast material for use as crankshafts. The high resistance to fatigue of these materials has emerged from the results so far obtained, and a law has been devised determining the behaviour of cast materials under conditions of combined bending and torsional fatigue stresses. Another exhibit of interest showed the results of fatigue tests under corrosive conditions, and the effect of using protective coatings to combat the deleterious effects thereby obtained on a number of steels. Amongst the exhibits connected with problems of lubrication, the influence of small quantities of water on the lubricating value of a motor-car oil was shown. In a journal-bearing machine, a reduction of seizing temperature from 200° C. to 140° C., and an increase of about 40 per cent in the minimum friction, was obtained, with only 0.05 per cent of water.

In the Metallurgy Department the development of magnesium alloys has continued, and data showing the valuable properties possessed by certain alloys containing aluminium and cerium were illustrated. In the rolling mill, the technique of working these alloys was demonstrated, and some very clean examples of forged and machined work were exhibited. A careful exploration of the delta region of the iron-carbon system has recently been made, using materials of the highest purity *in vacuo*. The results were exhibited in the form of the constitution diagram of this particular region of the iron-carbon system. The iron used in this and other researches is prepared in the Department by reduction of ferric oxide in hydrogen. The vacuum fusion method of determining the oxygen content of steels has been improved in reliability by the removal of gases from the apparatus at 2,200° C., thereby reducing both the correction to be applied and the time taken to carry out a test. The main results of the work which has been done on dental alloys for several years were summed up in a model, which shows the relation between the composition of the alloy and its volume change during setting. The narrow limits within which a satisfactory alloy lies were thus well illustrated. Experiments have been made in this Department on the diffusion of gases through wood. With hydrogen diffusing across the grain, it has been found that the rates vary by as much as 2,500 to 1, depending on the variety of wood under test.

The electron microscope is being developed as an experimental tool, and a magnified image of a very fine wire gauge was exhibited to show some of the possibilities of this instrument.

In the Aerodynamics Department the pitot traverse method of measuring aerofoil drag appears to be now more widely used, and satisfactory agreement has been obtained between this and balance measurements. The drags of a number of aerofoils

with various surface finishes have been measured in the compressed air tunnel up to a Reynolds number of 24 millions. Similar experiments on a thin aluminium plate with suitably shaped leading and trailing edges have given very good agreement with the theoretical curve for turbulent flow over a flat plate except at low Reynolds numbers, where the experimental curve tends to fall to the theoretical curve for laminar flow. Two other exhibits in this Department were devoted to the investigation of the transition from laminar to turbulent flow along the boundary of an aerofoil, one employing a visual—or photographic—method, and the other a hot-wire method of detection.

In the large 'duplex' wind tunnel the effect of the slipstream from the propellers of a model monoplane on the stability of the model was being studied, the propellers being driven by an internal electric motor. Another exhibit of interest here was concerned with the problem of wing flutter. The aerodynamic forces acting on a wing section subjected to a sinusoidal pitching motion are measured by the aid of a magnetostriction stress recorder. The high-speed tunnel, which operates by induction from the exhaust from the compressed air tunnel, has been employed in the investigation of the behaviour of aerofoils up to speeds of more than 600 miles per hour, where the effects of the compressibility of air attain a predominating importance.

Experiments on the improvement of ships' lifeboats enabling them to avoid shipping seas in rough water were in progress in the William Froude Laboratory, and the results obtained with a model have been confirmed by full-scale trials of a lifeboat of the best design. Tests were also being made in the new tank on a model propeller partially immersed in water, as for a ship in ballast condition. Automatic records of thrust, torque, revolutions, etc., are made at different immersions. By means of a stroboscope, the action of the blades upon the water during emersion and submersion is observed. It should be noted that during 1936, 88 ship designs were tested in this Laboratory, representing 80 per cent of the merchant shipping listed as "under construction" in Great Britain.

University Events

CAMBRIDGE.—Dr. H. J. Bhabha, of Gonville and Caius College, has been awarded an 1851 Exhibition studentship.

The General Board recommends that three additional part-time University lectureships in zoology be established from October 1; that an additional University demonstrators in zoology be established from October 1, and that a readership in invertebrate zoology be established for one tenure only, and that the General Board be authorized to appoint Dr. C. F. A. Pantin to this post from October 1.

Dr. R. N. Chopra, of Downing College, has been approved for the degree of Sc.D.

At Christ's College, Dr. R. D. Davies, of Gonville and Caius College, has been elected into a research fellowship. Dr. Davies was elected to a Salomons engineering scholarship in 1921, and was placed in Class I of the Mechanical Sciences Tripos in 1922. He is a University demonstrator in engineering and was formerly a captain in the Royal Engineers.

Sir David Chadwick, formerly a scholar of Sidney Sussex College, secretary of the Imperial Economic Committee and of the executive council of the Imperial Agricultural Bureau, has been elected an honorary fellow of Christ's College.

LONDON.—University postgraduate studentships of the value of £150 for one year have been awarded to W. J. Allum (Imperial College—Royal College of Science), W. J. Arrol (Queen Mary College and Imperial College—Royal College of Science), Elizabeth Carey (University College), J. A. Kitchener (University College), D. McMillan (University College), J. D. Marcantoni (Queen Mary College), Dorothee Metlitzky (University College), A. A. Ruddock (University College, Southampton) and Elizabeth Sweeting (Royal Holloway College).

The University studentship in physiology of the value of £100 has been awarded to J. P. Quilliam (University College) who will carry on physiological research at University College.

O. A. Saunders has been appointed as from October 1 to the Clothworkers' readership in applied thermodynamics tenable at the Imperial College—City and Guilds College. Since 1932 he has been lecturer in applied mathematical physics at the College.

OXFORD.—Sir Farquhar Buzzard, Christ Church, and I. O. Griffith, Brasenose College, have been elected to the Hebdomadal Council.

Dr. A. D. Gardner, University College, has been appointed to the new readership in bacteriology as from October 1. The title of professor has been conferred on Dr. A. D. Gardner. Dr. A. H. T. Robb-Smith has been appointed assistant director of pathology at the Nuffield Institute.

The senior mathematical scholarship for 1937 has been awarded to G. L. Camm of Balliol and New Colleges.

Dr. H. M. Sinclair, Oriol College, has been elected to an official fellowship and tutorship in physiology at Magdalen College. Miss M. G. Adam, senior scholar of Lady Margaret Hall, has been appointed assistant tutor in science at St. Hugh's College. At Christ Church, J. F. Hope Simpson (Balliol College) has been elected to a senior scholarship for work in botany and J. A. Moy-Thomas re-elected to a lectureship (the equivalent of a research fellowship) in zoology.

J. A. Boycott, Brasenose College and Miss E. J. Cookram, Society of Oxford Home-Students, have been granted degrees of M.D. Dr. N. O. Wright (Christ Church), of the Rowett Institute, has been granted the degree of D.Sc. for his work on proteins.

At Queen's College, M. Abercrombie has been elected to a junior research fellowship for work in zoology and E. P. Abraham, New College, to a readership for work in chemistry.

R. Campbell Thompson, Merton College, has been elected Shillito reader in Assyriology in succession to the late Prof. S. Langdon.

ST. ANDREWS.—At a graduation ceremonial to be held on September 28 in connexion with the celebration of the quarter-centenary of St. Mary's College, the honorary degree of LL.D. is to be conferred on Sir Leonard Woolley, archaeologist, among others.

The following appointments have recently been made: J. Dewar to be lecturer in chemistry in the United College, St. Andrews; T. G. Cowling to be lecturer in mathematics, and R. E. Stedman to be lecturer in philosophy, both in University College, Dundee.

Science News a Century Ago

The Grand Junction Railway

THE most important addition to the railways of Great Britain in 1837 was the Grand Junction Railway, uniting Birmingham with Liverpool and Manchester. The Bill for the line had been passed in 1833, and in 1834 the directors appointed George Stephenson and Joseph Locke as joint engineers. Stephenson withdrawing in August 1835, Locke became engineer-in-chief, and the line was constructed under his supervision. The opening of the line took place on July 4, 1837, when a train left Newton on the Liverpool and Manchester Railway at 7.0 a.m. and, after stopping at Crewe, Stafford and other places, finally arrived at Birmingham at 11.30 a.m. The distance was 82½ miles. Describing the events of the day, the *Morning Herald* said: "From Wolverhampton to Birmingham a general holiday appeared to be observed and the scene was highly interesting both to the observed and observers. Tents were pitched in several fields, and parties given by the respective tenants in honour of the day. The weather was extremely beautiful, and the freedom from dust which exists on railways is another interesting feature connected with this branch of mechanics." Among the most notable works on the line was the Dutton Viaduct, over the valley of the River Weaver.

Death in the Candle

UNDER this sensational heading the *Lancet* of July 8, 1837, contains the following account of a meeting of the Medico-Botanical Society held on June 28: "Mr. Everett detailed the results of several experiments made with the view of ascertaining the constituents of some 'new composition candles' which have lately been much employed by the public. His attention had been called to the subject by his having detected a strong garlic odour from the burning candles similar to that given out during the combustion of metallic arsenic. He purchased candles from various vendors of them, and, after considerable trouble, discovered a method by which he could collect a large quantity of the condensed smoke given out during their burning. He broke off the bottom of a glass retort with a very long neck, and placed the burning candle under it, the smoke having to traverse the lengthened tube was deposited on its sides. On carefully collecting this matter, and subjecting it to all the most unequivocal tests for arsenic, that metal was in every instance detected. The quantity contained in each candle would, according to the quantity collected by the experimenter, be about two grains; but in consequence of the difficulty in preventing the escape of a large quantity of the smoke, he considered that double that quantity might be fairly inferred to be present. He supposed the makers of the candles used this metal for the purpose of giving the candles a better appearance, and to give them a higher melting point, and this had since been acknowledged to him by a manufacturer of them, as the fact, the arsenic being found an excellent substitute for a small quantity of wax which answered the same purpose. Now, the question was to be decided whether or not this quantity of arsenic burnt in a room was injurious. . . . He (Mr. E.) would say that the vapours of metallic arsenic were fully as if not more noxious than those of sulphuretted hydrogen."

Medical Practitioners in Russia

THE *London Medical Gazette* of July 8, 1837, contains the following account of medical practitioners in Russia at that time:

"There are several classes of practitioners, but the deference paid to each is not in a ratio with their medical, so much as their military or civil rank. The degrees conferred by the universities are the following: Physician, Surgeon-in-Chief; Surgeon-in-Ordinary; Staff Surgeon; and Surgeon's Mate; Hospital Mate; Barber Surgeon; Apothecary. In general practice there is no positive distinction in the labours allotted to the first three ranks. The physician and the surgeon, in most cases, practise indiscriminately all branches of the profession. The physician receives homage from the surgeons, takes precedence as he passes through the wards of the hospital, signs documents and makes valid his rank by several operations. The hospital mates dressed in military uniform, march up and down the wards, half face about and stand to attention, as their superiors command them. The hospital mates and surgeon's mates are completely under military control, although attached to civil institutions. The apothecaries . . . are mere vendors of drugs and preparers of recipes, and their shops are all licensed by Government. . . . The last class is the *Tsivulnik* or barber surgeon, and is a numerous and thriving brotherhood. It falls to their lot to bleed, cup, draw teeth, apply leeches, and perform other little odd jobs of minor consequence. . . . There are no distinct aurists; aural surgery forming part of the practice of ordinary surgeons. There are likewise but few oculists who devote their whole time to diseases of the eye. Many physicians and surgeons include the treatment of these diseases in their general practice. Dentists abound in every street, and their profession is perfectly distinct, and not within the pale of the medical faculty. There are no distinct chiropodists in Russia."

Schönbein and Faraday

ON July 9, 1837, Schönbein wrote to Faraday, sending him copies of a book containing an account of his researches on iron dedicated by Schönbein to Faraday. He expressed his regret at not being able to visit England for the meeting of the British Association, and asked that a copy of his book might be presented to the Association if such gifts were received.

In the course of his letter, Schönbein said: "The other day I got a letter from Mr. Berzelius, the contents of which relate to my observations on the peculiar state of Iron. The distinguished Chemist, though he does not yet give a decided opinion upon the subject, is inclined to think, that in one notice of yours, published some time ago in the *Phil. Mag.*, which alludes to the observations of Ritter and de la Rive regarding the secondary poles and the electrical state of polar Platina-wires, the true cause of the inactivity of Iron is hinted at. According to the view of Berzelius, Iron performing the function of the positive Electrode undergoes a change with regard to its primitive electrical condition in such a manner as to be turned from a positive electrical body into a negative one. As my views with respect to electro-chemical subjects essentially differ from those of Berzelius, I cannot on this account think the ideas of that Philosopher correct. . . ."

Societies and Academies

Dublin

Royal Irish Academy, January 25.

E. J. CONWAY, J. M. O'CONNOR and D. K. O'DONOVAN: Influence of temperature on the activity of the kidney in relation to its influence on oxygen consumption. Expressing the secretory activity as an energy equation—with free passage of urea across the tubular cells—the slope of the oxygen consumption of the animal and that of the activity of the kidney with temperature are identical. On the curve of activity with temperature there appear three main phases similar to those on the oxygen curve, the latter being already described (O'Connor, *Proc. R.I.A.*). The diurnal variations of body temperature in the normal human subject (98.4° – 98.6° F. in the subject investigated) also show a temperature effect similar to that on total oxygen consumption, with minimum at 97.2° F., and the two main phases already described for renal activity (Conway) receive a satisfactory metabolic explanation. The lowest energy requirement for the maximum urea secretion was computed on the most general basis of an active secretion process, and found to be of the same order as that derived from the experimental values of the oxygen consumption as given in the general literature.

February 22.

E. J. CONWAY: Structural laws of the mammalian kidney with theoretical derivations. Details of certain structural laws of the mammalian kidney with theoretical derivation were presented. These were already briefly announced in *NATURE* of February 6, and referred to the agreement of the actual relationships with the following theoretical equations:

$$\begin{aligned} n \text{ (number of tubules)} &= W^{0.444} \times \text{a constant.} \\ l \text{ (length of the first convoluted} \\ &\text{tubule)} &= W^{0.111} \times \text{"} \\ g \text{ (diameter of the glomerulus)} &= W^{0.111} \times \text{"} \\ d \text{ (diameter of the first con-} \\ &\text{voluted tubule)} &= W^{0.444} \times \text{"} \end{aligned}$$

Paris

Academy of Sciences, May 10 (*C.R.*, 204, 1377–1448).

ALEXANDRE GUILLERMOND and ROGER GAUTHIER: The conditions under which neutral red produces the vital coloration of the vacuoles. For most of the fungi studied, the vital coloration of the vacuoles with neutral red is only possible in cells which have their growth arrested: as soon as the cells start growing they are decolorized. *Saprolegnia* and roots of wheat behave differently, and always accumulate neutral red at the commencement of their growth.

JEAN BOSLER and HENRI ROURE: The disappearance of Biéla's comet. In 1867, C. Bruhns pointed out that Biéla's comet in January 1848 passed near the orbit of the Leonids; if the orbits met, this might account for the disappearance of the comet. The author's calculations confirm those of Bruhns.

NICOLAS KEYLOFF and NICOLAS BOGOLIOUBOFF: Probabilities on chains.

Z. WARASZKIEWICZ: Topologically homogeneous plane curves.

CHI-TAI CHUANG: A generalization of a theorem of Valiron.

ROBERT FORET: The iteration of certain linear substitutions.

HENRI MILLOUX: The meromorphic functions in a circle.

ARNAUD DENJOY: The approximation of certain sums.

DE MIRA FERNANDES: The calculation of the energy of acceleration of a solid body.

LUCIEN MALAVARD and JOSEPH PARRIS: The boundary wall corrections in elliptical wind chambers.

GUSTAV ANDRÉ MOKREYOKI: The work required from starting an aeroplane to the point at which it leaves the ground.

JEAN LOUIS DESTOUCHES: The interaction of two corpuscles in relativistic wave mechanics.

JEAN ROUBAUD-VALETTE: The interpretation of the operators employed by Dirac by means of the fundamental magnitudes of hyperspace.

PHILIPPE TONGAS: A new empirical expression for the total heat of superheated steam.

THEODORE V. IONESCU: A new oscillator with very short waves (microwaves). The apparatus described and illustrated gives an oscillation of wavelength 36 cm.

MME. ARLETTE TOURNAIN-VASSY: The relative measurement of the absorption coefficients of ozone in the region of the Chappuis bands.

LÉON CAPDECOMME and PIERRE JACQUET: The reflecting power of copper. Polishing by the anodic method gives copper surfaces the reflective power of which is more constant and less alterable than surfaces obtained by the usual mechanical method.

MME. WILLY A. LUB: The optical spectrum of actinium. Actinium is the only element the optical spectrum of which is unknown. Starting with lanthanum oxide containing actinium, the wavelengths of seven new lines have been measured which appear to be due to actinium.

F. BARILLET and MME. A. CHOENARD: The evolution of the interfacial tensions in the neighbourhood of saturation.

FRANÇOIS BOURION, E. ROUYER and MME. O. HUN: The determination of the individual hydration of the ions.

MME. HENRIETTE SCHUHLER: The ultra-violet spectral properties of salicylic acid as a function of the pH.

VICTOR AUGER and MME. NINA IVANOFF: The molybdenum blues. A phosphoceruleomolybdic acid.

HALDUN N. TERREM: The corrosion of beryllium bronzes.

GEORGES LAUDE: The formation of ammonia by boiling some proteins with solutions of potash.

ROGER DE LARAMBERGUE: The synthesis of cyanamide by the oxidation, in the presence of ammonia, of some sugars, levulose, arabinose, mannitol and glycerol.

FRANÇOIS KRAUT: The breccias and conglomerates of the neighbourhood of Rochechouart (Haute-Vienne).

ANTONIO DE MEDeiros GOUVEA and GEORGES ZBYRZEWSKI: Observations on the Portuguese coast between the mouth of the River Odeceixe and that of Rio Mira.

ROBERT LAFFETTE: Some levels containing Foraminifera of the Cretaceous at Aurès (Algeria).

JOSUA HEILMANN HOFFET: The Cretaceous of Bas-Laos.

LÉVI HERMAN and MME. RENÉE HERMAN-MONTAGNE: The meaning of measurements relating to the quantity of dust or smoke shown at the ground-level.

JUAN CHAZZ: The production of choline in the caryopses and seedlings of dandelion, in relation with parasitism.

HENRI MARCELLET: The presence of a new C_{19} alcohol in the wax extracted from the oil of the fruit of the raspberry.

GEORGE BROOKS: The phosphorescent mineral matter in the bony tissues of the frog (*Rana esculenta*).

Amsterdam

Royal Academy (Proc., 40, No. 5, May 1937).

J. F. SCHOUTEN: The role of electric, photochemical and diffusion phenomena in vision. Quantitative determinations of the change in the sensitivity of the fovea produced by stimulation of a part of the retina by light.

F. A. VENING MEUNESZ: The gravity expedition of the Dutch submarine *O16* in the North Atlantic, January 11–March 16, 1937.

W. H. KESOM, MISS H. VAN DER HORST and K. W. TACONIS: Measurements concerning the volumes of mercury menisci. Determinations carried out by an X-ray method.

W. H. KESOM and P. H. VAN LAAR: (1) Measurements of the latent heat of tin in passing from the superconductive to the non-superconductive state at constant temperature. (2) Relaxation phenomena in superconductivity.

A. A. NIJLAND: Mean light curves of long-period variables. (28) Z. Ceti. (29) U. Persei. (30) S. Lynceis.

H. R. KRUYT and J. OOSTERMAN: Flow potentials on platinum.

J. TER BERG and F. M. JAEGER: The possibility of distinguishing right- and left-handed structures in crystals by means of their Laue patterns.

P. E. VERKADEN, J. VAN DER LEE and A. J. S. VAN ALPHEN: Researches on fat metabolism (10). Feeding experiments on dogs with simple saturated triglycerides.

H. A. BROUWER: Metamorphic rocks at Torne Träsk (Lappland).

K. MAHLER: Arithmetic properties of a class of decimal fractions.

V. LEVIN: Two remarks on van der Corput's generalization of Knopp's inequality.

W. H. ARIZ and J. OUDMAN: (1) Influence of aggregation on the transport of asparagine and caffeine in the tentacles of *Drosera capensis*. (2) Transport of introduced nitrogenous substances in the leaves of *Vallisneria spiralis*.

L. A. H. BOUWMAN: A new species of the genus *Sabinia*.

G. P. FRETZ: The relation of head length and head index of Johanneen and the spurious correlation of Pearson.

Moscow

Academy of Sciences (O.R., 14, No. 5; 1937).

S. FINIKOV: Laplacean suites with two projectively applicable congruences.

A. ANDRONOV and L. PONTEJAGIN: Gross systems.

E. LEONTOVIČ and A. MAYER: Trajectories which determine the qualitative structure and the division of the sphere into trajectories.

L. KANTOROVICH: The sequence of linear operations.

H. HILMY: A property of the minimal ensembles.

S. N. VERNOV: Measurement of cosmic rays in the stratosphere at the magnetic latitude 35° .

A. S. KOMPANILETZ: Absorption of sound by crystals at high temperatures.

S. A. UKHOLIN: Influence of temperature on the combined spectrum of carbon tetrachloride in the liquid and gaseous states.

P. BAZULIN: Influence of temperature on the absorption of ultra-sonic waves by benzene and carbon tetrachloride.

P. P. LAZAROFF: Thermic theory of changes in the peripheral visual sensibility due to geophysical causes.

P. P. LAZAROFF and I. A. LOURIN: Adaptation in peripheral vision in normal and imbecile infants.

K. A. KRAKAU, E. J. MUKHIN and M. S. HEDERICH: Equilibrium diagram of the ternary system Na_2SiO_3 — $PbSiO_3$ — SiO_2 .

S. FRISCH: The $^3P_2$ — ^3P term combination in the arc spectrum of cerium.

V. V. CHLIMOV: Compounds of quinones with HCl , H_3PO_4 , CH_3COOH , and their chlorination.

N. K. PÄENOV: A new type of iridium compound.

A. V. SOLOVJEV: Electrochemical investigation of the anti-corrosive properties of sodium nitrite.

A. F. SOSENKO: Geochemical diagram of pegmatites of the principal arcs of mountain chains of Central Asia.

J. LARIONOV and J. M. TOLMAČEV: Chemical composition of cassiterites.

M. GUDLET and E. KARDO-SYSOJEVA: Oxidation of ascorbic acid (vitamin C) in plants.

V. S. SADIKOV: A new method of isolating amino acids, peptides and cyclopeptides from protein hydrolysates.

J. D. POLJAKOV: A new apparatus for measuring the oxygen consumed by small aquatic animals.

Vienna

Academy of Sciences, March 11.

LUDWIG ECKHART: Affine representation and axonometry. A method is given for the construction of the projection of a body in any plane from its ground plan and elevation.

KARL FIEDERHOFER: Calculation of the normal modes of vibration of a spherical shell.

ALFONSO KLEMMENC and WALTER NEUMANN: Exact estimation of a nitric oxide—nitrogen dioxide mixture by the methods of gas analysis.

ERNST STORFER: Precipitation of trithiocarea cuprous chloride from its aqueous solution.

F. BILGER, W. HALDEN, E. MAYER-PITTSCH and M. PRISTEMER: Fatty matter in yeast (5). Quantitative relations in the biological formation of ergosterin.

W. JORDE: Thermal polymerization of styrol.

WALTER HÄUSELMAYER: Chemical development of the markings of butterflies. Wings extracted from the pupae develop markings when placed in tyrosinase. This action of tyrosinase is hindered by uric acid.

MARTEA GEIRINGER: Influence of the central nervous system on the adaptation of the colour of the frog (*Hyla arborea* L.). Severing the nerve connecting the regio chiasmatica to the pituitary destroys the ability of the frog to adapt its colour to its surroundings, while leaving the eyesight unimpaired.

GUSTAV GÖTZINGER: Geological analysis of the Quaternary deposits in the Traun valley region above Gmunden. The hydrographical state of the valley during various periods of recession of the main glacier is determined.

Forthcoming Events

SOCIETY OF CHEMICAL INDUSTRY, July 5-9.—Annual Meeting to be held at Harrogate.

MUSEUMS ASSOCIATION, July 5-9.—Annual Conference to be held at Newcastle-upon-Tyne.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT CIVIL ENGINEERS (male) in the Air Ministry—The Secretary (S.2(c)), Air Ministry, Adastral House, Kingsway, London, W.O.2 (July 5).

TWO CHEMISTS and TWO JUNIOR ASSISTANT METALLURGISTS in the Royal Ordnance Factories at Nottingham and Birtley—The Chief Superintendent of Ordnance Factories (Advert. No. 144), Royal Arsenal, Woolwich, S.E. 18 (July 6).

LECTURER IN MINING SUBJECTS and a LECTURER IN MECHANICAL ENGINEERING in the Mining and Technical College, Onnch Street, Barnsley—The Principal (July 6).

A TEACHER OF MATHEMATICS AND PHYSICS with a knowledge of rubber technology, in the Northern Polytechnic, Holloway, London, N.7—The Clerk to the Governors (July 7).

LECTURER IN CIVIL ENGINEERING at Wigan and District Mining and Technical College—The Principal (July 7).

ASSISTANT ENGINEER INSPECTOR (MECHANICAL) for service in Great Britain in the Office of the High Commissioner for India—The Director-General, India Store Department, Belvedere Road, S.E. 1 (July 7).

A GRADUATE IN MECHANICAL ENGINEERING to teach mathematics and engineering subjects in the North-east Essex Technical College, Colchester—The Clerk to the Governors (July 7).

ASSISTANT LECTURER IN MATHEMATICS in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (July 7).

TEMPORARY ASSISTANT LECTURER IN BOTANY in the University of Liverpool—The Registrar (July 7).

DESIGNER (Ref. No. 542 B) and ASSISTANTS II (Ref. No. 296 B) in the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (July 9).

SCIENTIFIC OFFICER, ASSISTANTS III (male and female) in the Ballistics Directorate, Research Department, Woolwich, S.E. 18—The Chief Superintendent (July 9).

PRINCIPAL of the County Technical College, Guildford—The Chief Education Officer, County Hall, Kingston-upon-Thames (July 10).

LECTURER IN CHEMISTRY at Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton 1 (July 10).

ASSISTANT CIVIL ENGINEERS (male) in the Civil Engineer-in-Chief's Department, Admiralty and H. M. naval establishments at home and abroad—The Civil Engineer-in-Chief, Admiralty, London, S.W. 1, envelope marked "A.C.E." (July 12).

CITY ENGINEER of Kingston-upon-Hull—The Town Clerk, Guildhall, Hull, envelope marked "City Engineer" (July 12).

TECHNICAL OFFICER in the METEOROLOGICAL OFFICE—The Secretary (S.2 A), Air Ministry, Adastral House, Kingsway, London, W.O.2 (July 12).

LECTURER IN MATHEMATICS in the Manchester Municipal College of Technology—The Registrar (July 12).

DEPUTY OF THE Technological Research Laboratory at Calcutta of the Indian Central Jute Committee—The High Commissioner for India, General Department, India House, Aldwych, London, W.O.2 (July 12).

LECTURER IN MATHEMATICS at the Cheltenham Technical College, Lansdown Road—The Secretary (July 12).

SENIOR SCIENTIFIC OFFICER (male) in the Admiralty Scientific Pole—The Secretary of the Admiralty (C.B. Branch) (quote O.H. 4561/37) (July 17).

CHEMIST in the Geological Survey Department, Federated Malay States—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, London, S.W. 1 (July 31).

PART-TIME LECTURER IN BIOLOGY (woman) in Sedgley Park Training College, Manchester—The Principal.

MECHANICAL and ELECTRICAL ENGINEER in the Public Works Department, Gold Coast—Crown Agents for the Colonies, quoting M/5220.

ENGINEERS for the Public Works Department, Somaliland—Crown Agents for the Colonies, quoting M/5076.

CIVILIAN LABORATORY INSTRUCTORS at the Electrical and Wireless School, Royal Air Force, Cranwell—The Principal.

TEMPORARY ASSISTANT ENGINEERS, ENGINEERING ASSISTANTS and JUNIOR ENGINEERING ASSISTANTS in the Ministry of Transport for work in connection with surveys of trunk roads—The Establishment Officer, Ministry of Transport, Northumberland Avenue, London, W.O.2.

EXAMINERS in the Aeronautical Inspection Directorate Test Houses—The Secretary (S.2(d)), Air Ministry, Adastral House, Kingsway, W.O.2.

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1731 (2291): Plane Table Method of Measuring Take-off and Landing Flight Paths. By S. P. Osborne. Pp. 14. 2s. 6d. net. No. 1734 (2287): Full Scale Tests of Hartshorn Ailerons on a Bulldog. By A. B. Woodward Nutt. Pp. 16. 2s. 6d. net. No. 1736 (2300): Wind Tunnel Tests to determine the Efficiency of an Aircrew working in front of a Thick Section Wing. By D. W. Bottles and C. Callen. Pp. 18. 2s. net. No. 1740 (2119): Note on Performance Data for Honeycomb Radiators in a Duct. By A. S. Hartshorn. Pp. 21. 2s. net. No. 1742 (2125 and 2257): The Wing Stiffness of Monoplanes. By A. G. Pugsley, with an Appendix on the Measurement of Wing Stiffness, by A. G. Pugsley and A. W. Olegg. Pp. 16. 2s. 6d. net. No. 1744 (2258): On the Problem of Sparking Plug Electrode Materials and the Variation of Sparking Plug Voltage. By W. R. Debenham and F. G. Haydon. Pp. 22. 3s. net. No. 1746 (1258): Aircrew Theory; a Paper delivered before the Fourth International Congress for Applied Mechanics, Cambridge, 1934. By O. N. H. Lock. Pp. 11. 2s. 6d. net. No. 1748 (2354): The Streaming of a Particular Rigid-jointed Fuselage under Bending Loads. By J. Morris and G. O. Abel. Pp. 21. 3s. net. No. 1761 (2306): A Study of the Flexural Axis Positions for certain Box Sections. By D. Williams and D. W. G. Fairbank. Pp. 14. 2s. net. No. 1762 (2358): Calibration of Standard Pitot-Static Heads in the High-Speed Tunnel. By O. N. H. Lock and Dr. W. E. Hilton. Pp. 4. 6d. net. No. 1763 (2356): Full Scale Trials on Sclon M. 3 with a Gauge Flap. By J. Cohen. Pp. 12. 2s. 6d. net. No. 1764 (1806): Abstract—Turbulent Flow in a Circular Pipe. By A. Fage. Pp. 9. 1s. 6d. net. No. 1769 (1904): Abstract—Some Applications of Conformal Transformation to Aircrew Theory. By F. L. Westwater. Pp. 2. 6d. net. (London: H.M. Stationery Office.) [26]

Other Countries

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 40, Part 1: A Limnological Study of Aikoshi Lake with Special Reference to the Propagation of the Oyster. By Tetsuo Inukai and Shiroku Nishio. Pp. 33. Vol. 41, Part 1: Studies on the Phytology Specialization in *Ophiobolus erigeronensis* Ito et Kurabayashi. By Yoshitaka Tochinai and Masayuki Sakamoto. Pp. 95. (Tokyo: Marusen Co., Ltd.) [27]

Salmon Markings in Norway, 1936. By Knut Dahl and Sven Somme. (Skript utgitt av det Norske Videnskaps-Akademi i Oslo: 1. Mat. Naturv. Klasse, 1937, No. 1.) Pp. 37. (Oslo: Jacob Dyrwad.) 3 00 kr. [315]

Contributions from the Physical Laboratories of Harvard University for the Year 1935. Series 2, Vol. 2. Pp. vii+57 pages. (Cambridge, Mass.: Harvard University; London: Oxford University Press.) 10s. 6d. net. [316]

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Indholdene i de Arktiske Hæfte (The State of the Ice in the Arctic Seas) 1936. Pp. 14+8 plates. (København: G. E. O. Gad.) [16]

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 90. Zoological Results of the Third De Schauensee Seamount Expedition, Part 8: Fishes obtained in 1935. By Henry W. Fowler. Pp. 125-254. (Philadelphia: Academy of Natural Sciences.) [16]

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 11: Sugarcane in Mauritius; a Review of the Present Position with respect to its Cultivation and Manuring. By N. Orskov. Pp. 41. (Port Louis: Government Printer.) [16]

Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Rocznik 16. Pp. 256. Nr. 47: Rzut oka na stan obecny Ochrony Przyrody w Polsce na tie 17-letniej dzialalnosci Państwowej Rady Ochrony Przyrody (Present Status of Nature Protection in Poland: 17 Years of the Activity of the State Council for the Protection of Nature). Raport Wladyslaw Szafer. Pp. 22. (Kraków: Państwowa Rada Ochrony Przyrody.) [16]

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bind 55, Nr. 1. Opdagelsesrejser til Grønland 1473-1806. Indledning Nr. 1 til Diplomatarium Grønlandium 1492-1814. Af Louis Bobé. Pp. 54. 2.50 kr. Bind 55, Nr. 2: Den Grønlandske Handels og Kolonisations Historie indtil 1870. Indledning Nr. 2 til Diplomatarium Grønlandium 1492-1814. Af Louis Bobé. Pp. 152+8 plates. 7.00 kr. Bind 55, Nr. 3: Diplomatarium Grønlandium 1492-1814; Afskrifter og breve til oplysning om Grønlands besættelse, kolonisation og missionering. Udgivne ved Louis Bobé. Pp. 431. 30.00 kr. Bind 106, Nr. 1: 6 og 7 Thule Expedition til Sydgrønland 1931-33. Bohnoderna. By S. G. Hedling. Pp. 34. 1.50 kr. Bind 106, Nr. 2: 6 og 7 Thule Expedition til Sydgrønland 1931-33. A Quantitative and Qualitative Investigation of the Microfauna Communities of the Soil at Angmagssalik and in Mikkil Fjord. By Marie Hammer. Pp. 53. 2.50 kr. Bind 118, Nr. 6: Die Paläozoischen Hrupplivsgesteine von Canning-Land. Von Arne Nee-Nygaard. Pp. 163+8 plates. 8.50 kr. Bind 118, Nr. 7: On the Genus *Ulophycus* Brattstrom with Description of a New Species from East Greenland. By Hans Brattstrom. Pp. 24+1 plate. 1.25 kr. (København: O. A. Reitzels Forlag.) [26]

Catalogues, etc.

The Wild-Barfield Heat-Treatment Journal. Vol. 2, No. 13, June. Pp. 59-71+vi. (London: Wild-Barfield Electric Furnaces, Ltd.)

A Catalogue of Books and Periodicals on Aeronautics, Astronomy, Chemistry, Electricity, Engineering, Fortification and Gunnery, Horology, Mathematics, Meteorology, Mining and Minerals, Navigation, Physics, Pyrotechnics, Surveying, etc. (No. 635.) Pp. 68. (London: Bernard Quaritch, Ltd.)

Plastic Mouldage Materials. Pp. 20. (Philadelphia: Warren-Knight Co.)

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SATURDAY, JULY 10, 1937

Vol. 140

Citizenship

AT the recent conference of the Association of Teachers in Technical Institutions, Mr. W. E. Park referred in his presidential address to a report on training for citizenship for students in technical institutions which had been prepared by his Association in conjunction with the Association of Principals of Technical Institutions and the Association of Technical Institutions. The report has just been issued, and is one which we believe ought to be regarded as of first-class importance.

The reasons for our belief are not far to seek. A glance about the world reveals its present discontents with an uncomfortable vividness. The old values which seemed once so secure are fading. Human organizations, which seemed but a few years ago to be leading, however slowly, to sane and rational ends, are crumbling. Over-production on one hand and even starvation on the other become more sharply defined. Political ideas appear charged with a newer and more emotional violence. The dream of a world-State shatters down to a grim reality of nations self-contained, self-striving and living in a fear-haunted hostility which keeps us on the brink of unimaginable dangers. If we are not, at the moment, living under the actual threat of war, we are daily made aware of rearmament and the need to be prepared for what can be little else than the crash of civilization as we know it. Yet, in spite of the distinguished writer who informed us with grim courtliness that we are witnessing a race between education and catastrophe, it would seem, in Great Britain, at any rate, that the world of education moves on with calm serenity and is by no means convinced that, if it neglects the problems which none of its students can ultimately

avoid, it neglects a vital duty. Whatever we may think of dictator countries, they have at least learned to use the machinery of their schools. They have infused education with their own enthusiasms and made it aware of its part in the life and work of the community.

Sir Ernest Simon, chairman of the Association for Education in Citizenship, has summed up the aims of that education under four heads : a sense of social responsibility ; a love of truth and freedom ; the power of clear thinking in everyday affairs ; a knowledge of the broad political and economic facts of the modern world. Those aims are ambitious, and we would hesitate even to attempt to sketch the means whereby they might be attained. We know perfectly well that those responsible for any kind of school can point to their time-tables and syllabuses and ask where and how they are capable of addition. They can say, broadly, that the aims are inherent in their present work. But the problem has an urgency which will not permit it to be so easily dismissed. The manipulation of time-tables and syllabuses is a matter for experts, and none would be so bold as to say that it may not be somehow used to make education that very real thing—*adaptation to environment*. Inherent qualities, too, need more discussion than the phrase sometimes permits. We have long since given up the belief that training in one subject necessarily gives facility to deal with another. If that were so, we should find that our specialists were invariably wise and their judgment, outside their specialist field, invariably sound. But we know that is not the case. The specialist in physics cannot necessarily be regarded as being free from prejudice, emotion and even ignorance when he is asked to make a judgment

on the League of Nations or the need for tariff reform. Clear thinking, in short, cannot be transferred from specialist subjects to others with which the voter has to deal in everyday life.

Whatever may be done in other fields of education, then, it is clear that those concerned in technical education are to be encouraged in their attempt to view the problem of education for citizenship from the point of view of their own work; for it is a task which presents the utmost difficulties when any *direct* method of teaching the subjects which citizenship may include is attempted. Naturally, if and when other branches of education take up those subjects, it is a task which will become correspondingly easier.

A large body of the students of technical institutions are those who take part-time courses. They are engineers, chemists, builders and the like, who are already in employment. Since they attend courses on some three evenings per week, and since they have to undertake homework in addition, and since their work is directed to the attainment of some recognized professional or industrial qualification, it is difficult to see how it can be possible to secure their attendance for additional, and, at first sight, 'unrelated' subjects. For these students there is the possibility of the 'indirect' method. If education for citizenship means training the individual for his relationship to the various communities on which he impinges, it is certainly within the bounds of possibility—to put it no higher—that specialist subjects could be used by skilful teachers so that their backgrounds, contacts and relationships could be shown in the everyday world. The discussions and debates of students' societies, too, could be used. One imagines, for example, engineering and commercial students dealing with problems of production and distribution—under happier titles, perhaps—and arriving at conclusions concerning duties and relationships which normally they might miss.

For full-time students we hope more can be done. In their case it ought to be possible to apply the 'direct' method. The introduction of studies of the social sciences, the structure of government, modern political and industrial problems would, in our opinion, be of immense value in attaining the ends we have in mind. It is not for us here to suggest the precise subjects, their method of treatment or their particular place in particular curricula. It may be that the use of daily papers—with a view to comparison of opposing views on a single issue which are so

constant a feature of our modern daily Press—will take the place of the more orthodox text-book. (Such a method would, at least, train students to sift evidence and arguments for themselves rather than be swayed by the prejudice of partisan announcements.) It may be that local circumstances could be used to demonstrate problems of town-planning, means of transport, food supply, organization of community life, local and central government. Whatever the method, if an active interest in the social and political structure can be developed, the first step towards attainment of the aims of citizenship will have been secured.

It may be objected that this kind of teaching involves a danger of bringing politics into education. We would reply that, if a scientific approach to social and political problems be not taught, young people will be left unprotected, both now and in later life. Which is the greater danger?

We would make it very clear, even to the point of what may appear unnecessary reiteration, that we have no wish to make dogmatic suggestions as to subjects or to their treatment. It is desired only to emphasize that the social sciences must, in some way, be made to keep pace with the other sciences, which are setting expected, as well as unexpected, problems to our civilization. Articles in these columns from time to time have underlined the fact that, in spite of the advances of science and the obvious advantages which these have brought to us, we stand in the face of vast dangers all of which point urgently to the need of adapting our social life to the new and changing environment which men's activities have produced. The technologist and the scientific investigator should not be allowed to work in specialized compartments with no picture of how their work is related to the rest of the community. For want of a better name, we call the presentation of that picture 'citizenship', which Aristotle saw as "the most synthetic of sciences" and, as a practice, "the most architectonic of the Arts". His notion of civics was expressed under the four types of co-operation between the labour of the people, the public functions of citizens, the meditations of philosophers, and the efforts of teachers. It is a notion which we moderns, in our present dangers, should not neglect. For that reason, we welcome the publication of the report prepared by the three technical associations, and we look forward to its implementation in no matter how experimental a form.

Man and the Machine Age

Die Tragik des technischen Zeitalters
Mensch und Maschine im 19. Jahrhundert. Von
Otto Veit. Pp. 226. (Berlin: S. Fischer, 1935.)
n.p.

THE book under notice deals with a problem which has become very familiar to the German philosophers, sociologists and others since the days of Nietzsche. To put it very briefly, it comes down to this: the victory of rationalism, materialism, liberalism, individualism, and the achievements of the 'technical age' which originated from the victory in question, have become a fatal gift for the human race. It is true that the introduction of machinery into productive processes enabled the population to grow more rapidly and to be supplied with material goods more abundantly than ever before; but, at the same time, there opened a wide gulf between the 'objective' and the 'subjective' culture. Mankind has become richer in material wealth; man has become poorer.

Strange as it may seem, this judgment is justified in regard not only to man's emotional but also to his intellectual qualities; the philosopher who commanded all the knowledge of his time and was able to lift it up on a higher plane has been supplanted by the specialist who confines himself to a more or less narrow sphere of scientific comprehension. The political and economic freedom for which our forefathers fought so enthusiastically has changed into a universal dependency; the maintenance of liberal institutions in some major imperialistic countries does not alter this fact, but makes it still more impressive.

Finally, liberty of thought has become a rather negative character; we know the chains from which we are free (or from which we desire to be free), but we do not know exactly for what purpose we are free. Religious dogmas have lost that influence over the human mind they formerly exerted; the same fate has befallen the belief in reason, freedom, humanity and progress, which seemed to replace the religious creeds in the period of the bourgeois revolutions. This intellectual development inevitably results in a radical relativism which may discuss every thinkable opinion without taking sides with or against any one of them, and in scepticism and nihilism.

Two roads widely differing from each other seem to lead out of the cultural crisis; the first of them was indicated at the end of the eighteenth and beginning of the nineteenth centuries by thinkers like Burke in England, de Bonald, de Maistre, Chateaubriand in France, Adam Müller in Germany. These authors held the view that not the rational analysis but the somewhat irrational intuition ought to be regarded as the supreme method of scientific research; they placed emphasis on the fact that the genuine rights of the community are superior to those of the individual; they responded to the liberal admiration of progress and future with their worship of the past, the Middle Ages in particular. Consequently, they opposed the destruction of the traditional technique by modern machinery; they wanted the application of the latter to be kept down so far as possible, if not prohibited altogether.

The second attempt at a solution of the crisis has been made by socialism. The socialists did not lag behind the romanticists in acknowledging the damages inflicted upon culture by the bourgeois revolution. But the romantic criticism is reactionary and therefore, after all, it remains hopeless; the socialists, on the other hand, try to overcome the capitalist society in a progressive manner; they do not base their verdicts on the past but on the future. The socialists demand that those regions of social life which are centred upon technique and economics ought to be organized as rationally as possible; the predominant claim of socialism, namely, the replacement of private ownership in the means of production by common ownership, means in reality that the principle of rational organization which—under capitalism—is necessarily restricted to the individual factory or trust, is to be extended over the whole field of economic relations. Nevertheless, socialist rationalism is not an end in itself; the underlying motive is the settled conviction that technique and economics, if they are to be made to serve man instead of being served by him, form the appropriate foundation of a "realm of real freedom" as it has been called by Marx.

It is very characteristic of the book under notice that Veit accepts neither the romantic nor the socialist solution. As regards his attitude towards the 'romantics', he is in accord with the vast

majority of the philosophers in fascist countries, who are in agreement upon many points with the feudal and clerical enemies of the bourgeois revolution but, at the same time, do not become 'romantics' in the strict or proper sense of the word. It is obvious why. The romantic flight into the Middle Ages, the veneration of the feudal monarchy, the nobility, the church and the corporations, have never been anything else but a counter-move against the use of liberal capitalism; and even in this respect their practical significance was limited to the period when modern technique and large-scale production were at their very beginning. Such currents like national socialism (or fascism in general) have sometimes been regarded as a set-back into a precapitalist state of society from which the present civilization is to be protected. People who argue along these lines are inclined to confound the ideological veil with the social reality that the former has to cover. National socialism, in the very interests of rearmament and imperialistic expansion, is forced to develop the applied sciences; and the big profits which have been made in Germany, Italy and other fascist countries have not benefitted the peasants, the handicraftsmen or the small shopkeepers but the heavy industrialists, who invest them either in their own or in similar undertakings, thus enlarging the domain of machinery and rational technique.

The charges made by Veit against his second and more dangerous adversary, dialectical materialism, testify to the fact that Marx has been more frequently criticized than understood. Veit is of the opinion that—according to Marx—the worker has been enslaved by the machine. Even a very superficial knowledge of the Marxian system gives ample proof that the above-mentioned representation of the Marxian philosophy is utterly misleading. Marx never speaks of 'the machine' without further specification, that is, without regard to the social system in which 'the machine' is being conducted, but he draws a clear and sharp distinction between the results brought about by the machine in capitalism on one hand, and in socialism on the other; this differentiation may be right or wrong, but it is impossible to criticize a thinker for ideas he never propounded.

Since Veit neither shares the romantic nor the socialist point of view (each of which is consistent in itself), his own literary contribution towards the solution of the cultural crisis remains exceedingly vague and unprecise. He does not cross the border which had already been reached by Nietzsche and others; logically he lags far behind his predecessors. Against the will of the author, his book has become a justification of that critical stage of development in the overcoming of which he wishes to co-operate.

ALFRED MEUSEL.

Palæocene Mammals

Paleocene Faunas of the San Juan Basin, New Mexico

By W. D. Matthew. (Transactions of the American Philosophical Society, New Series, Vol. 30.) Pp. viii + 510 + 65 plates. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1937.) 22s. 6d. net.

GREAT strides have been made in recent years in the field of mammalian palæontology, and the evolution of some at least of the orders of mammals are now set out with a great wealth of detail. Osborn's great monograph of the Titanotheres, for example, or his history of the Proboscidea, of which the first volume has recently appeared, show in a very striking manner not only how great is the amount of material on which to work, but also how complex has been the course

of evolution of the mammalian orders. These works, however, and others similar, do not, as a rule, begin their story before the Eocene, by which time the orders dealt with had become well established. Their 'pre-history' and inter-relationships, therefore, are not elucidated.

Simpson's classical monographs on the Mesozoic mammals have given us all the information that is as yet possible as to the dawn of mammals from their reptilian ancestors and of their evolution up to the, as yet little known, Cretaceous period; but thereafter until the Lower Eocene, by which time the mammalian orders had for the most part become defined, there has been a serious gap in our knowledge. At one time, this hiatus seems to have been considered as a comparatively small affair termed merely the 'Basal Eocene'. Now, as the Palæocene, it takes rank as one of the

major divisions of the Tertiary, equivalent in importance with the Eocene, Oligocene or other of the periods.

The late Dr. W. D. Matthew's monograph on the Palaeocene faunas of the San Juan Basin of New Mexico, as a résumé of previous information and a great addition of new, is a most important contribution to the early history of mammalian evolution. The San Juan formations yield a series of deposits ranging from the Upper Cretaceous, separated by an unconformity from the Puerco, Torrejon and Tiffany beds of the Lower, Middle and Upper Palaeocene respectively, to the Wasatch beds of the Lower Eocene. This covers a great range in time, and the faunal list of mammals (a smaller list of reptiles is also included) is impressive with its forty, or more, genera distributed among fourteen families and no less than seven orders. A few of these, such as the Multituberculates, are remnants of the earlier Mesozoic radiation that were dying out, but among the Creodonts, Condylarthra and Insectivora may be sought the foundation members of our modern mammals, and by implication some picture may be made out of the centralized common ancestors all of which must have flourished during the little-known Cretaceous period. A diagram is here reproduced (Fig. 1) which shows, in a summary form, the author's conclusions as to the relationship of the mammals of the period and, incidentally, where our knowledge is still lacking. The bulk of the volume, after a short explanatory introduction, is devoted to a systematic and descriptive revision of the Palaeocene mammals of New Mexico, and is followed by some general observations and conclusions. The descriptions of the various species, the eighty text figures and sixty-four quarto plates leave nothing to be desired.

No one familiar with Matthew's numerous other contributions would expect the general observations and the discussion which conclude the work to be other than stimulating. The origin and evolution of the multitubercular tooth, the characters of the feet and limbs from their primary types and of the skull and

skeleton generally, all receive illuminating treatment, as also does the account of the correlation of the different faunas and the origin and evolution of the tertiary mammals as a whole. The last word on this great assembly of early mammals has yet to be said. Many species are still known only from fragments, and the patient collecting which began under Cope so far back as 1880 must still go on in order to fill up the gaps in our knowledge. All future workers in this field will turn to the present volume

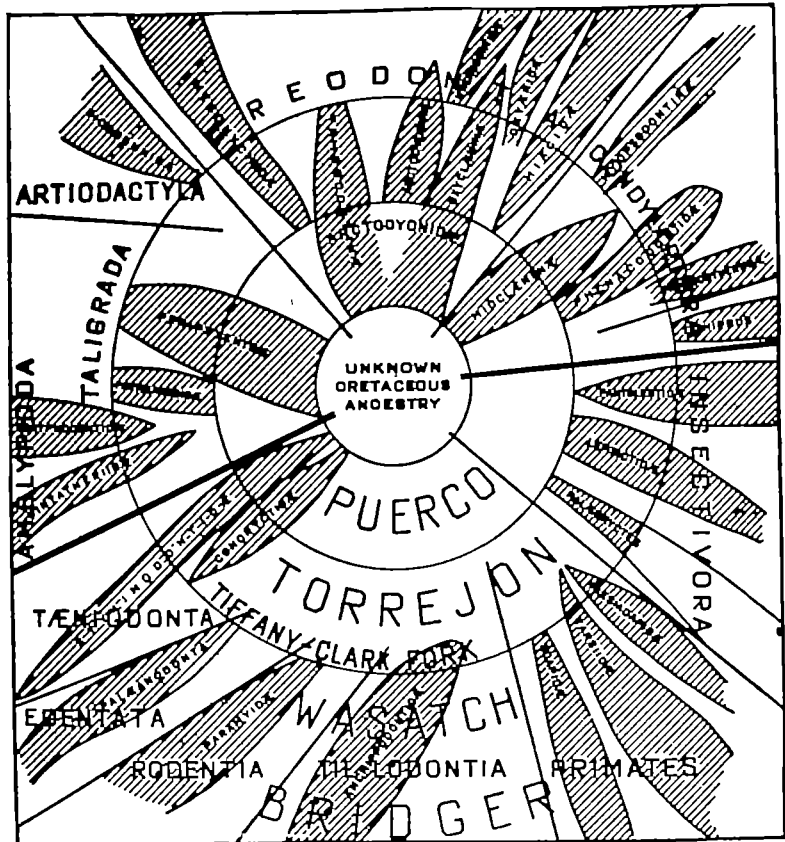


Fig. 1.

RELATIONSHIP OF THE MAMMALS OF THE CRETACEOUS. FROM MATTHEW'S "PALAEOCENE FAUNAS OF THE SAN JUAN BASIN, NEW MEXICO".

as a classic for guidance and inspiration.

Although the editors (Prof. W. K. Gregory, Dr. Granger and Dr. Colbert with the assistance of Dr. Simpson) state that their work has been limited to an "addition of references", the thanks of all workers in mammalian palaeontology are due to them for the labour of seeing the volume through the press so efficiently, and to the Trustees of the American Museum and to the American Philosophical Society of Philadelphia for their public spirit in making possible the publication of so useful and important a work.

C. F. C.

Adsorption Columns

Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen. Von Prof. Dr. L. Zechmeister und Dr. L. v. Cholnoky. Pp. xi+231. (Wien: Julius Springer, 1937.) 14.40 gold marks.

WHEN Tswett, to whom the authors of this book refer as "genialer russischer Botaniker", first used the chromatographic absorption method for the separation of chlorophyll *a* from chlorophyll *b*, he was probably quite conscious of having introduced at least a novel application of physical phenomena that themselves may have been already known to many. He can, however, have had no conception of the extraordinary variety of compounds to the separation of which the method was to be applied in the following thirty years; indeed the very existence of these compounds was in many instances unknown in Tswett's time.

The adsorption of a solute upon a solid insoluble in the solvent of the solution had been recorded many times, and even used as a means of separation, when Tswett conceived the idea of making the solution flow in one direction—vertically downwards—through a column of the adsorbent, so that the adsorbed material might afterwards be desorbed; or 'eluted', by the same or some other more suitable solvent.

The solutes then arrange themselves in a series of bands, the distance of which from the top of the column is primarily determined by the 'adsorption potential' of the solute, the less easily adsorbed being found in the lower band. By the subsequent use of other suitable solvents, the bands may be 'developed', that is, the distance between them is increased, so that the column can then be cut, and the bands separated mechanically from each other. Alternatively, the principle of the 'liquid chromatogram' may be employed; in this application, the undeveloped bands are washed out *seriatim* into different containers, by using an eluent with solvent properties suitably related to the adsorption potentials of the materials in the various bands.

It is of more than historical interest to note that one of Tswett's original columns consisted of sucrose, his solvent being a suitable organic liquid. We have come to-day to think of adsorbents so much in terms of acid clays, alumina, calcium carbonate or hydroxide, and so on, that we are apt to forget the relativity of adsorbent, solvent and adsorbate.

The first, or general part of this book is divided into two chapters, on fundamental principles and

methods respectively. The special, or second, part is divided into three chapters, covering in turn natural colouring matters (including chlorophyll, prophyryns, carotenoids, naphthaquinone and anthraquinone dyes, flavones, pterines, anthocyanins, etc.), synthetic or artificial colouring matters, and various colourless or slightly coloured substances—among which occur terpenes, glycosides and aglycones, alkaloids, vitamins, enzymes, and so on.

The information given about the application of chromatographic methods to such diverse substances is remarkably complete for a volume with only 190 pages of text (the rest of the book consists of a table of contents, some plates of photographic records, a bibliography with nearly 400 references, and both author and subject indexes). Moreover, the value of the book is further enhanced by some unusual tables, "thrown in", as it were, with a pound of chromatography. The complete list of carotenoids of known constitution, with their formulæ, in order of their adsorption-potentials, and, later, the list of all known carotenoids and derivatives, with their sources, show where the authors' personal special interests have lain, but there are no other signs of predilection in the book.

Since chromatography is essentially a method of *analysis*, it is rather surprising that analytical chemists have so far made very little use of it. In this book, the authors have only been able to cite a few isolated applications, as for example to the detection of falsification in the colour of wines, and even here the method is qualitative only, or at best semi-quantitative. When, however, the analyst has to separate two solid substances the chemical constitutions of which are sufficiently close to make separation by precipitation or crystallization either incomplete or impossible, precision chromatography would seem to offer a possible technique, provided the substances are reasonably stable in solutions of appropriate strength.

This admirable and comprehensive monograph by Prof. Zechmeister and Dr. v. Cholnoky, of the University of Pees, both well-known exponents of chromatography, to the literature of which they have themselves made valuable contributions, is about as good as such a book can be. Clearly produced, logically arranged, painstaking in its presentation of detail, exhaustive in its citation of examples—it is the complete handbook for the practising or would-be chromatographer. An English edition is urgently needed.

A. L. BACHARACH.

Reports of the Progress of Applied Chemistry
Vol. 21, 1936. Pp. 876. (London: Society of Chemical Industry, 1937.)

THIS volume appears so punctually year by year soon after the end of the period surveyed, and is so consistently full of well-digested reports, that every English-reading chemist must now be fully aware of its value; indeed, with many its appearance is reckoned an event. One reason for the welcome which always attends its arrival is evident; for after twelve months' struggle to keep one's head above the flood of chemical literature in which one is even mildly interested, a raft on which one may float awhile and contemplate the scenery is not to be despised. These surveys of progress in the several branches of technological chemistry appeal also to those who, having sufficient chemistry to follow their purport, are however not engaged in the work they describe, and perhaps would not regard themselves as chemists at all.

Among the new contributors are Mr. M. B. Donald (general, plant, and machinery), Dr. J. Grant (pulp and paper), and Dr. J. A. Sugden (refractories, ceramics, and cements), while Prof. W. E. S. Turner (glass) and Dr. D. F. Twiss (rubber) are old friends who have returned. This year the biennial report on explosives is included. There are 26 sections in all, with general name and subject indexes, and of course the information presented is lavishly documented, references being given both to original sources and to abstracts. It would probably be fair to describe the Report as a whole as "better than ever"; which means that it reflects steady progress both in technical achievement and in presentation. A. A. E.

Polychromatic Plates for Color Sense Examination
By Dr. E. B. Rabkin. Pp. 40+xx plates. (Kharkov: State Medical Publishing Board, 1936.) 30 roubles.

THIS series of tests for colour defect issues from the laboratory for colour vision of the Hirshman Memorial Ukrainian Central Ophthalmic Institute, of which Dr. Rabkin is the director. The tests are composed of coloured figures on coloured backgrounds, such as are found in the Stilling and the Ishihara tests. A number of the plates contain also 'hidden' figures, which are visible only to the dichromate. Triangles, circles and squares appear on some plates instead of figures, and so can be used for testing children and illiterates. A diagnosis can be made from the tables of dichromasy in general, and of protanopia, deuteranopia, and tritanopia in particular. The author claims, too, from the tests that "the simpler forms of anomalous trichromasy" can also be detected. Plates are added to detect simulation.

The series itself has been tested out in the Experimental Ophthalmic Clinic of the Institute of Experimental Medicine at Kharkov, and has proved successful. It seems, if one can judge from a preliminary survey, to give satisfactory results, and can be recommended. The book contains detailed and clear instructions in both Russian and English, although the English translation contains some curious phrases and sentences, and the spelling is not always of the best. MARY COLLINS.

Organic Syntheses:

an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. L. F. Fieser, Editor-in-Chief. Vol. 17. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 8s. 6d. net.

PRODUCED on the plan now familiar to organic chemists and biochemists, the latest addition to this series contains details of thirty preparations. Among the open-chain substances are γ -aminobutyric acid, made by a modification of Gabriel's method; ϵ -aminocaproic acid, prepared from 2-ketohexamethylenimine; and 1,3-butadiene. It is stated that between 25 gm. and 30 gm. per hour of crude butadiene may be produced by passing the vapour of cyclohexene over a cracking element, in an ingenious apparatus which is here fully described with the aid of a diagram.

Of interest in carbohydrate chemistry is the account of the acetolysis of cotton, and of the hydrolysis of the resulting α -cellobiose octa-acetate according to Zemplén's method. Biochemists will also welcome the details given for the hydrogenation of cholesterol to dihydrocholesterol (β -cholestanol) and the oxidation of this to cholestanone. Under the heading of 2-carbethoxycyclopentanone (prepared from ethyl adipate) may be found a description of the useful Hershberg stirrer for pasty mixtures. Finally, the stereochemist is catered for in the precise directions given for the synthesis and complete optical resolution of that useful stereochemical agent, α -phenylethylamine. J. R.

Mechanistic Biology and Animal Behaviour

By Theodore H. Savory. Pp. xv+182. (London: Watts and Co., 1936.) 7s. 6d. net.

MR. SAVORY's book gives an eminently lucid and readable description of tropistic behaviour in some invertebrate organisms. The book, however, is largely devoted to an unconvincing exposition of certain well-worn theoretical issues. Mr. Savory defines his aim as the purely objective description of behaviour, which for the purposes of deterministic analysis he regards as the "visible response of an animal to some kind of stimulation which originates most frequently from a disturbance of its environment". He strays, however, from the logical demands of his definition, which is generally accepted by scientific students of behaviour, when he leaves the field of straightforward description. Thus, when he departs from the world of invertebrate organisms with which he is familiar, and discusses mammalian forms such as dogs, he accepts *a priori* concepts such as 'mind' and 'intelligent' as opposed to 'sub-intelligent' behaviour, and fails to realize that to the student of behaviour these concepts are somewhat empty. It is clearly illogical for the experimental investigator to ask whether spiders that lurk under stones have mind and self-awareness, and then to answer 'no' merely because the particular tropisms which drive spiders under stones have been defined.

The book closes with an uncritical statement about the influence of acquired habits on the course of arachnid evolution.

Measurement of Submarine Daylight

By Dr. H. H. Poole.

SUBMARINE measurements of solar radiation are of interest to oceanographers, who are concerned with such problems as the rate of rise of temperature of the water, the rate of photosynthesis, the movements of zooplankton, or the depth limits of daylight vision for fish. They also enable us to measure the opacity of the water, which, being an index of the amount of matter in suspension, may give valuable evidence as to its previous history, and is likely to be of importance in connexion with the nutrition and migration of fish.

A thermopile with suitable colour filters has been used by Birge and Juday to measure the total radiation, and that in different spectral bands, at various depths in American lakes, but for work at sea the measurement of the very small potential differences presents difficulties. As the spectral sensitivity range of the selenium rectifier photo-electric cell covers the band showing appreciable penetration through sea-water, it appears to be the most convenient instrument at present available for submarine work.

This cell has a range of sensitivity extending somewhat beyond both ends of the visible spectrum, with a maximum about $595\text{ m}\mu$ (that of the eye being about $555\text{ m}\mu$). It appears to be permanent, apart from temporary fatigue or temperature effects, which may amount to a few per cent in strong illumination. For small illuminations the current generated is proportional to the light, but in strong light the ratio current/illumination falls appreciably, and the necessary corrections must be found if the cell is to be used to measure intense illumination. The fall in this ratio with increasing illumination becomes much more important with a high-resistance external circuit, so that a low-resistance measuring instrument is always desirable, and sometimes essential.

The Weston selenium cell which has been used by Utterback, and also by Atkins and Poole, gives, when exposed under a sheet of opal-flashed diffusing glass, a current of one microampere for about 20 lux. With a 10 ohm galvanometer the sensitivity would fall to about 1 μ amp. per 25 lux in full sunlight. The Lange selenium cell used by Pettersson is more sensitive, giving 1 μ amp. for about 5 lux in weak light. The fall in sensitivity in strong light is, however, so great that the

cell must be protected by a suitable reducing screen when used to measure bright daylight. This screen must be removed for weak light readings.

The choice of a suitable instrument to measure the current presents certain difficulties, as the claims of current sensitivity, lowness of resistance, quickness of reading, and insensitivity to the motion of the ship, are not easily reconciled. Utterback has used a special marine galvanometer, Atkins and Poole a modified form of their potentiometer method previously used with emission cells, adapted so as to include the principle and advantages of the zero-resistance circuit devised by Campbell and Freeth, while Pettersson, aided by the greater sensitiveness of his Lange cells and the comparative steadiness of his ship, has found simpler pointer and light-spot galvanometers satisfactory in his work.

The cell mounted behind a strong glass window in a watertight case is lowered to any required depth by means of a wire and a spar projecting over the ship's stern, thus minimizing the shading effect of the ship and the vertical movements due to rolling. Utterback uses a case large enough to contain a set of colour filters, which can be interchanged by an electromagnetic device. This is a great advantage, but the size and complication of the apparatus are drawbacks, and most workers have contented themselves with the use of external filters laid on the window, which is generally horizontal, and changed by hauling the photometer on board. Above the colour filter is placed the opal diffusing glass, the use of which is rendered necessary by the varying obliquity of the illumination to be measured. The transmission of the colour filter is not affected by such variations in obliquity, as the filter is below the opal, and submarine light the obliquity of which is greater than 48° , and which would be prevented by internal reflection from reaching the cell if the diffusing glass were absent, can reach the internal diffusing layer in the opal glass and be duly measured.

The use of colour filters to limit the range of sensitivity is rendered necessary by the differential absorption of the water, which entirely alters the average composition of the radiation with depth, and thus alters also the sensitivity of the cell, so

that it is very difficult to interpret the submarine readings of a selenium cell without filter. The following Jena glass filters, each 2 mm. thick, seem to be suitable for general work: red, 720–600 m μ , RG 1; green, 600–480 m μ , VG 9; blue, 480–360 m μ , BG 12. The limits are only approximate and are affected by the falling sensitivity of the cell towards both ends of the spectrum.

The variations in the surface light must be observed by a second cell exposed under a similar filter and opal glass in a position on deck as free as possible from shading by spars and rigging. The photometer is directly compared side by side with the submarine photometer, and the simplest means of expressing the submarine illumination is as a percentage of the surface light in the same spectral band at the same instant.

It is more difficult to express the submarine illumination in definite units. The selenium cell, being more sensitive than the eye to both ends of the visible spectrum, does not differ very greatly from the latter in its estimate of common illuminations of different predominant colours. Thus, if it is standardized with a filament lamp at a colour temperature 2,360° K., it appears to under-rate average sunlight by some 10–20 per cent. The use of a higher temperature source for standardization reduces this discrepancy, and some workers have used for this purpose the Davis-Gibson colour filter, reproducing with fair accuracy average noon sunlight. We can then express in 'lux' the reading of a cell exposed without colour filter in air, without introducing any serious error, by the use of a term which is strictly only applicable to visual measurements. With colour filters, however, or under water, which acts as a colour filter, this quasi-visual scale becomes meaningless and misleading.

The ideal procedure is evidently to express the results in terms of the radiant power in the different spectral bands, say, in microwatts per square centimetre. Clarke has used this method of presentation for his work with emission cells in the western Atlantic, and Atkins and Poole have also standardized some of their cells in power units. The lowness of the colour temperature of all ordinary sources, however, limits the accuracy of the standardization, and has led Angström to suggest a method of standardization by means of sunlight which may prove to be the best available.

There is general agreement between the results obtained by workers on both sides of the Atlantic and in the north-eastern Pacific, the large variations in the opacity of the water found by all being obviously due to local conditions. The clearest water so far recorded was found by Clarke in the Sargasso Sea. Working down to 180 metres,

he found a value as low as 0.03 for the extinction coefficient of blue light. This means that the fall in the illumination on a horizontal surface was only 3 per cent per metre, the light falling to one tenth of its value at about 80 m. depth. In this water both green and violet light gave coefficients close to 0.05, while for the light passing through an RG 1 filter Clarke found a coefficient 0.08 for depth range 20–80 m. This is an extraordinarily low coefficient for 'red' light, and may possibly be due to the action of the overlying water layers (in which the absorption was much more rapid) in removing all wave-lengths much longer than 600 m μ , leaving only a very narrow spectral band of orange-red.

In coastal waters higher coefficients are always found, the absorption of the shorter waves increasing more rapidly than that of the longer. Thus, in both the English Channel and in the north Pacific the coefficient for blue and green is generally about the same, and not far from 0.1 at a distance of 20 miles off shore, the illumination falling to one tenth of its value every 23 m., the corresponding average figures for red being 0.4 and 5.75 m. Closer inshore, green becomes the most penetrating colour, the coefficients for all colours rising with the increased turbidity of the water.

In considering the variation of opacity with depth, one must remember the 'hardening' effect of absorption on polychromatic radiation, although this effect is greatly reduced by the use of colour filters. It is still probably of importance with the RG 1 red filter, as the longer wave-lengths of the range covered are absorbed even more rapidly than those near the 600 m μ limit. The effect is probably of much less importance with the green and blue filters.

Real variations of opacity with depth are often met with. As a general rule, ocean water becomes clearer below the surface layers, but inshore waters often show irregular variations, which may be very useful for studying their stratification. For exploring these rapid changes of opacity the use of Pettersson's transparency meter, which measures the intensity of a beam of artificial light reflected through 2 metres of water, is almost certainly preferable to the deduction of the opacity from the ratio of the daylight illuminations at two different depths, but it is not easy to correlate the results obtained by the two methods.

It is evidently highly desirable that oceanographers should be provided with a standardized method suitable for routine measurements of submarine daylight, and with this end in view the International Council for the Exploration of the Sea arranged for a special meeting of workers in the subject at the 1936 meeting at Copenhagen. It would seem that some further experience of the

available cells and modes of measurement is desirable before any definite specification of apparatus and methods can be drawn up. In the meantime, a fairly full review by different authors of the work done up to date, with extensive

bibliographies, will be found in the report of the 1936 meeting of the Council, and a report of the special sub-committee then appointed to consider the question is being presented at the meeting this month in Copenhagen.

Greenland Culture: (I) The Norsemen*

ACCOUNTS of the ill-fated Norse settlements in Greenland in medieval times, such as that recently published by Dr. Nörlund (see NATURE, 133, 949) have been based hitherto on the evidence afforded by the eastern settlement (now the district of Julianehaab), in which, thanks to the researches of the last fifty years, most problems of topography have been solved and the cultural history elucidated in no little detail by archaeological discovery. Of the western settlement, however, in the Godthaab District little was known either from literary sources or from archaeological investigation before the expeditions of the Commission for Scientific Research in Greenland, of which the results have been described recently by Dr. Aage Roussell. It was inferred, however, with reasonable certainty that the place now known as Kilaussarfik, visited by Daniel Brunn in 1904 and the site of Dr. Roussell's excavations in 1930, 1932 and 1934, was to be identified with Sandnes, and Ameralik Fjord with the ancient Lysufjördr, not least, perhaps, on account of the rarity of such a sandy formation on the rock-bound coast of Greenland. As, however, the area is being submerged rapidly, and the coast-line has changed considerably since the Middle Ages, this is by no means indisputable evidence.

Historical records relating to the west settlement are few. Apparently it was established simultaneously with, or just after, the east settlement, shortly before A.D. 1000. The Saga of Eirik the Red mentions a serious epidemic there in the first decade of the eleventh century. By the middle of the fourteenth century, Skraelings (Eskimo) had occupied all the west settlement, "so there are many horses, goats, cattle and sheep run wild, and no people, neither Christian nor heathen". All archaeological finds, in default of

evidence to the contrary, are to be regarded as prior to 1365.

In addition to the church at Sandnes and the neighbouring farm, of which the name is unknown, Dr. Roussell excavated in 1934 two other farm sites on the opposite side of the fjord. Of these, Umiviarssuk alone has been described, the important results obtained at Ujaragassuit still awaiting publication.

The site investigated at Sandnes included church and churchyard, house, smithy, and two large stable complexes. The store-house—invariably part of a Norse farm—presumably stood on the fjord bank, but, if so, it had been washed away. The central part of the farm had been built on sloping ground and a constant movement of soil has covered the whole site with midden, making it impossible to arrive at any accurate idea of stratification. At times, objects were found above others which obviously were of later date.

Since the date of Daniel Brunn's visit, the church ruins at Sandnes have suffered much damage owing to submergence and climatic conditions. Consequently it was found impossible to determine the extent of the churchyard; but accumulations of stones on the fjord beach indicate the probable limit of interment. Only in the westerly part of the churchyard were interments uncovered.

No less than forty-two burials were found huddled in a confined space. They lay under the midden in coarse yellow gravel and only just below the original surface. Owing to crowding, older graves frequently had been disturbed in digging new, and half skeletons, or skeletons with lower limbs hewn off, were found. As is usual in Christian burials, the body lay on the back with the head towards the west and arms crossed on the breast. One interment in the south end of the area contained two adults, presumably man and wife, with the skeleton of a child lying on each. Alongside and evidently buried at the same time lay a fifth skeleton, not fully grown, and beside the skeletons was a small crudely fashioned wooden cross, the only piece of grave furniture found *in situ*. It may be presumed that these five burials were the result of an epidemic, such as is mentioned in the sagas of Eirik and Thorfinn.

* Researches into Norse Culture in Greenland—Sandnes and the Neighbouring Farms. By Aage Roussell. Appendix: Greenland Runic Inscriptions, 4. (Meddelelser om Grønland, Bind 88, Nr. 2.) Pp. 223+6 plates. 11.00 kr.

Researches into Norse Culture in Greenland—Animal Remains from the West Settlement in Greenland, with Special Reference to Livestock. By Magnus Degerbøl. (Meddelelser om Grønland, Bind 88, Nr. 3.) Pp. 55+1 plate. 2.50 kr.

Researches into Norse Culture in Greenland—Evidence of Iron Extraction at Sandnes, in Greenland's West Settlement. By Nels Nielsen. (Meddelelser om Grønland, Bind 88, Nr. 4.) Pp. 14+1 plate. 0.75 kr.

(København: C. A. Reitzels Forlag, 1936.)

What was from the artistic point of view the most important find made in the course of this investigation may be mentioned here, as it came from the churchyard, though not found *in situ*. This was a carved slab of wood of unknown use, though it may have been part of the cover of a pyx. The wood has been identified as fir and driftwood. On it is carved in relief a representation of the Crucifixion showing the figures of the Virgin Mary and St. John in a pose and with attributes characteristic of medieval Scandinavian art. The figures are Gothic; but the ornament is still Romanesque. Though unquestionably of Scandinavian origin, it is not of local workmanship, and may derive from thirteenth century Iceland, or possibly Norway. Examples of local workmanship are to be seen in representations of the Crucifixion, rough in character, in which the figures in metal had been nailed on in a technique familiar in examples known from Iceland.

The important site at Umiviarssuk afforded fuller detail than Sandnes of the cultural level of the Norse farm, though here in the excavation of the house itself the work of clearing the plan was complicated by the fact that a later building overlay one and possibly two earlier structures. The farm buildings of the west settlement were substantial erections of stone. It was possible to ascertain the disposition of living rooms, sleeping rooms, hearths, etc. Immediately behind the farm-buildings at Sandnes was a series, or rather two complexes, of outbuildings for cattle, sheep, pigs, and goats and the farm workshop. In one of these, stone divisions provided 'boxes' for tethering the cattle; while in another, small finds suggested that one or more of the humbler female servants had slept here. Sandnes also had a small forge, which afforded samples of the iron used in working.

An interesting building at Umiviarssuk was a bath house, which, though the bath is frequently mentioned in the records, is the first to be found in Greenland. It is of the usual vapour-bath type, with furnace and shelves, on which the bathers reclined. It was apart from the house, and if the bathers did not follow the modern practice in high latitudes of a cold plunge in the snow, they at least had to pass through the cold air in returning to the house. Another find on this site of an unusual character was a movable bed. Although there are references to such beds in the sagas, its use had died out in the Middle Ages in favour of the bed fixed to the wall. It was not reintroduced until the sixteenth century; but its survival in Greenland points to the backward state of the community.

The most noteworthy feature in the work of Dr. Russell's expeditions is the very large number

of small objects found, which has thrown a flood of fresh light on Norse culture in Greenland. The character of the soil enabled the preservation of a number of objects, especially in wood, bone and baleen, which had perished on sites previously excavated. Nearly twelve hundred objects in all were found. The state of preservation may be judged from the fact that in some the original colour of the wood can still be discerned. Among the small objects, one of the most interesting is a toy model of a boat, which reproduces its original in accurate detail. Comparison with earlier known examples of the Norse boat dating from the sixth century shows that the form of ship virtually suffered no change over a period of six hundred years.

Other finds included tools, weapons, implements, household utensils, clothes, games such as chess, dice and draughts, toys and objects of unknown use. Trinkets were rare. In addition to the objects of art already mentioned—the wood-carvings of a religious character—there was a number of small objects in bone, wood and ivory, including two lively representations of animals, a bear and a walrus, and two of the human face, of which one in walrus ivory with its wide mouth, long upper lip, heavy jaw and coarse skin gives anything but a favourable impression of the physical type of some, at least, of the Greenlanders.

The animal bones indicate that the inhabitants of the western settlement kept cows, sheep, horses, pigs and dogs and hunted the same wild animals, reindeer, seals, whales, arctic foxes, arctic hares, and polar bears, as the settlers on the east coast. For the first time, the bones of the dog are available for comparison with representations of the animal of this period. The surprising feature is the length and slenderness of the legs, which suggest a breed of something of the greyhound type.

Although there is evidence to suggest that the Norsemen had extracted iron in Greenland, the number of iron objects found is small. The material from Sandnes is the most considerable find that has been made, consisting of fifty lumps of slag and a small piece of hammered iron of prismatic form. The material has been subjected to detailed examination and is very heterogeneous. Two types of iron are present, which agree with what is known of Middle Age practice of producing iron in hearth pits, and shows the difficulty experienced by the ancients in producing iron capable of hardening. While some samples consist of a soft iron, practically devoid of carbon, others are a medium hard carbon steel. The evidence from Sandnes is taken to show that the Norsemen did produce a form of steel, but that their methods of working and exposure to the air reduced the product finally to nothing but a soft iron.

Belgian Stratosphere Balloon Experiment

THE most difficult part of the planning of a large stratospheric balloon is how to control the rate of descent in the upper atmosphere. If a balloon is large enough to reach about 19 miles (1/100 atmosphere) the hydrogen must contract during the descent, and the bag will be only 10 per cent filled at 10 miles: it is then difficult to avoid a dangerous flapping of the bag, except by controlling the speed by a continuous dropping of ballast; incidentally, the weight of that extra ballast would have reduced the maximum altitude reached.

If air is allowed to flow into the bag through

long as before, and about twenty times as heavy, which weight is prohibitive. To calculate the minimum diameter admissible, it is necessary to know exactly the amount of heating inside the bag due to the sun. As it depends on the thermal air eddies inside and outside the bag, it is useless to try to determine that quantity by extrapolation from experiments made on models a few feet in diameter. In order to measure the heat transfer on a model as large as possible, an experimental ascent was planned by A. Piccard and M. Cosyns with the old *F.N.R.S.* filled with hot air. At an

altitude of about 5 miles, the heating power of the sun is not very far from its maximum value, and the temperature is about the same as at 20 miles. Knowing the total weight of the balloon, and the amount of supplementary heat necessary to balance it, the temperature rise due to the sun could be deduced with a precision of a few tenths of a degree.

The supplementary calories were to be furnished by a burner placed inside the bag (Fig. 1b) using pure propane, 150 lb. of which was carried in the liquid state in an aluminium bottle weighing 60 lb. The burner was able to burn 2 lb. of propane each minute, with good efficiency, and twice as much in emergency (the

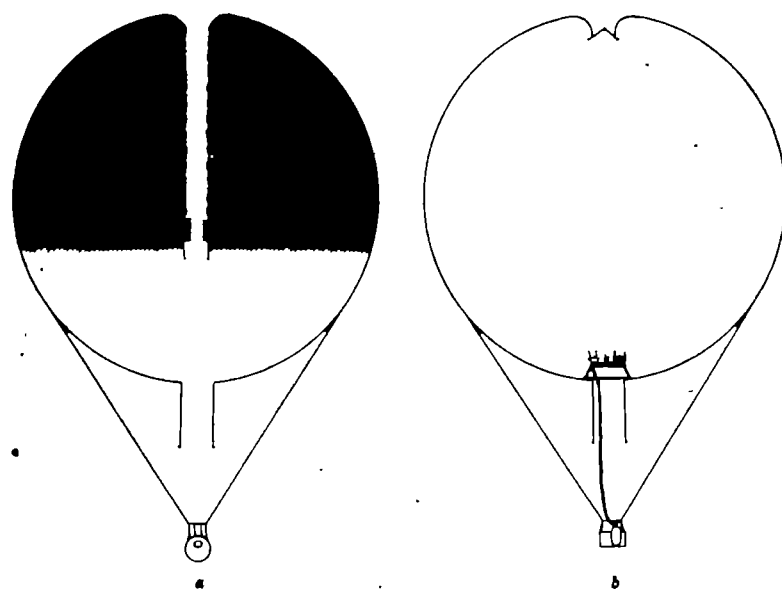


Fig. 1.

the appendix, the flapping danger disappears; but, during the daytime, the sun heating the air in the bag causes sufficient expansion to stop the descent, even if all the hydrogen is removed. A better solution seems to be to admit air, but to remove it automatically as soon as it is warmed. That method was tested by Max Cosyns during his 1934 ascent, by replacing the valve of his balloon by a collapsible fabric tube, about six feet in diameter, distended by wooden rings, and stretching down the axis of the balloon (Fig. 1a). If the opening of that tube is set near the limit between the hydrogen and the air, the air flows continuously upwards as soon as it is warmed. The method worked perfectly well on the *F.N.R.S.*, the diameter of which was 100 ft.

For a 200-ft. balloon, the use of the same principle would require a tube 17 ft. in diameter, twice as

lifting power given by a pound of propane is about 160 lb.). It was composed by 42 batwing-burners placed on a ring 7 ft. in diameter, to ensure a good mixture of hot and cold air, and to prevent a flow of gases at too high a temperature from reaching the top of the balloon. The flow of propane was measured by a diaphragm 'déprimomètre,' and by weighing at intervals the aluminium bottle.

Unfortunately, just before starting on May 25, the twisting of some ropes obliged the land crew to release some of the slings, and an unforeseen squall shook violently the bottom of the balloon, upturning the burner before it was possible to shut off the flame; the bag of the balloon was destroyed by fire in about a minute. The material loss was not important, as the *F.N.R.S.* was getting old and was about to be dismantled.

M. COSYNS.

News and Views

Prof. F. W. Thomas, C.I.E.

PROF. F. W. THOMAS of Oxford has been elected president of the ninth All-India Oriental Conference, which will be held at Trivandrum in December next. He has also been elected a corresponding fellow of the Philosophical and Historical Section of the Prussian Academy of Sciences. Prof. Thomas, who has been Boden professor of Sanskrit in the University of Oxford since 1927, and is a fellow of Balliol College, was librarian of the India Office from 1903 until 1927, and was awarded the C.I.E. in the honours list of 1928 on his retirement from that office. He is chairman of the Section of Oriental Studies of the British Academy, and represents that body as a governor of the School of Oriental Studies of the University of London. He is also reader in Tibetan and lecturer in comparative philology in the University of London. Prof. Thomas has long been known as one of the foremost scholars in the classical languages of the East, in which he has acted as examiner not only in all the universities in Great Britain which offer a course in those languages, but also in the principal universities of India. His outstanding knowledge of Buddhist art and literature received the signal recognition of the award of a medal in 1934 at the Tokyo celebration of the two thousandth anniversary of the birth of Buddha. He is the author of a large number of publications on the philology and literature of Sanskrit, Pali and other oriental languages, as well as on the art and literature of Buddhism.

Prof. Walter G. Cady

THE Council of the Physical Society has awarded the fourteenth Duddell Medal to Walter G. Cady, professor of physics at the Wesleyan University, Middletown, Connecticut, U.S.A., for his work on piezo-electric resonators and oscillators as standards of frequency. Prof. Cady's pioneer work on the subject was published in 1922 (*Proc. Inst. Radio Eng.*, 10, 83) and the value of the device may be judged from the fact that it stimulated research work on the subject in all parts of the world, more than a thousand papers having been published on the properties of piezo-electric crystals since the appearance of Cady's first paper. Of course, these are not all due to Cady's work, for Langevin had previously used piezo-electric crystals as vibrators for underwater signalling, but Cady's particular contribution—the use of the quartz resonator as a standard of time or frequency—has quite obviously inspired most of the work. The use of these resonators as standard vibrators has made it possible to measure frequency and intervals of time with an accuracy not previously attained. It is scarcely necessary to emphasize the importance to physics of increased accuracy in such fundamental measurements. Among the applications which have already been made the following may be

mentioned: (1) The quartz-clock now used as standard in some observatories. It is in some respects superior to the pendulum clocks, and in any event is a most valuable supplement to them. (2) The measurement and control of the frequency of alternating currents in connexion with measurements of dielectric constant, 'absolute' electrical measurements, etc. (3) The measurement of the velocity of ultrasonic sound waves. Duddell, who was responsible for so much elegant instrumental work, would have been the first to recognize the beauty of Prof. Cady's device, and it will be a source of great satisfaction to all scientific workers to know that the value of Prof. Cady's work has been recognized in such an appropriate manner.

Centenary of the University of Durham

THE University of Durham, though now well over a hundred years old, has just celebrated its centenary. It was originally intended to hold the celebrations five years ago, since the Act of Parliament which provided for the foundation was passed in 1832. Owing to the economic depression, however, it was felt inappropriate to enter into rejoicings under the cloud of industrial stagnation which, in 1932, was locally responsible for widespread distress. The present year has a historical claim to recognition, apart from the atmosphere of returning prosperity, for it was in 1837 that the University was granted its charter by William IV. Moreover, as a result of the recent Royal Commission, the University is about to enter upon a new phase of its history. The main celebrations were held at Durham on July 1, and were attended by delegates from all the other Universities of the British Isles and from several in Canada, Australia, New Zealand, South Africa, India and the United States. Learned societies were represented by, among others, Sir William Bragg, Lord Dawson of Penn, Dr. H. Spencer Jones, Prof. F. G. Donnan and Prof. O. T. Jones. After a morning visit to the Colleges, including the Castle, a centenary service was held in the Cathedral, where the preacher was the Bishop of Durham. The keynote of Dr. Henson's discourse was that universities are the "watchdogs of human liberty". "The new universities," he said, "were born and cradled in an atmosphere of freedom. They surely must stand in the forefront of the championing of academic liberty against the aggressions of the totalitarian State or the subtler assaults of racial fanaticism". After the service, the delegates were entertained to luncheon, some in the Great Hall of the Castle (by the University), and others at the Town Hall (by Lord Londonderry, Chancellor of the University and Mayor of Durham).

In the afternoon, a Centenary Convocation was staged in the picturesque surroundings of the Castle quadrangle. Each delegate was introduced to the

Chancellor, to whom addresses of congratulation were presented. The Chancellor then conferred the honorary degree of D.C.L. upon nine distinguished men: Dr. C. A. Allington, Dean of Durham; Prof. P. P. Bedson, emeritus professor of chemistry; Lord Cadman, an old graduate of the University; the Hon. J. A. Hanan, chancellor of the University of New Zealand; Sir John Jarvis, the promoter of many schemes to help the distressed area of Jarrow; the Rev. S. R. P. Mouldsdales, until recently principal of St. Chad's College; Mr. Tracy Philipps, explorer and war correspondent; Sir Cuthbert Wallace, president of the Royal College of Surgeons; and Mr. G. H. A. Wilson, master of Clare College and vice-chancellor of the University of Cambridge. Convocation was followed by a garden party in the adjoining Fellows' Garden. Later, the delegates were entertained to a banquet in the Great Hall, after which they were received by the Council of the Durham Colleges.

It is interesting to record that so early as 1650 a petition to Parliament that a college be established at Durham was approved by Cromwell. When university powers were applied for, however, the proposal was thought to be prejudicial to the older universities and the Great Seal was withheld. No more was heard of a northern university until a draft scheme was drawn up in 1831. The necessary Act was passed in 1832, and the first students came into residence during the following year. Among the first members of staff was J. F. W. Johnstone, lecturer in chemistry and mineralogy. About the same time (1834) the Newcastle-upon-Tyne College of Medicine originated, though it did not become connected with the University of Durham until 1852. Durham College of Physical Science was founded in Newcastle in 1871. It had then four professors—mathematics, physics, chemistry and geology—but by the time its name was changed to Armstrong College, in 1904, a very wide range of university subjects had long been incorporated. Now, both the College of Medicine and Armstrong College are about to be united, under the revised constitution of the University, as a new corporate body to be known henceforth as King's College. At Durham itself, science seems to have lapsed after the death of Johnstone in 1855. Since 1924, however, when the first block of the present Science Laboratories was opened, several very flourishing schools have developed. Under the new regime, the University of Durham (consisting of the Durham Colleges, together with King's College, Newcastle-upon-Tyne) enters the most promising period of its history, with every prospect of expanding achievement and prosperity.

The World's Air Altitude Record

THE world's air altitude record was regained for Great Britain by the Royal Air Force on June 30, by a flight to an altitude of 53,937 feet (more than ten miles). The previous record of 51,362 feet was held by Lieut.-Colonel Mario Pezzi for Italy, who beat the then British record of 49,944 feet last autumn. The flight was made from the aerodrome

of the Royal Aircraft Establishment, Farnborough, by Flight-Lieut. M. J. Adam, using the Bristol 188 experimental high altitude aircraft. This was the same machine as used by Flight-Lieut. Swain, R.A.F., for the previous record, but was fitted with a special Bristol Pegasus engine. It had various detail improvements as suggested by experience. The pilot wore the actual high-pressure suit that was prepared as a reserve for the previous record flight, with small improvements. These included precautions against 'frosting up' of the Celestroid windows of the headpiece, and an emergency breathing pipe to lead air direct from the outside when necessary, instead of having to slash open the front of the headpiece as did Flight-Lieut. Swain, upon landing, after his flight. The transparent material forming the cabin roof was observed to crack upon reaching an altitude of about 48,000 feet, but this was not serious enough to interfere with the continuation of the flight.

THE ascent was made in 1 hr. 35 min., and the total time of the flight was 2 hr. 15 min. The minimum pressure and temperature were 77.8 mm. of mercury and -48.9°C . respectively, both occurring at the maximum height. The pilot experienced a good deal of navigational trouble due to cloud-layers at intervals, at one time being forced to fly east, facing the sun, which at 6 a.m. was low enough to blind him. A steady north-westerly wind, estimated by the pilot to be of about 100 miles an hour velocity, was encountered in the upper regions. It is understood that the aircraft will continue to be employed upon researches into conditions of flight in the upper atmosphere.

Atlantic Air Mail Service

THE first test flight of the Atlantic air mail service began on July 5 when the Imperial Airways flying-boat *Caledonia* left Foynes, Ireland, for Botwood, Newfoundland, and two and a half hours later the Pan-American Airways *Clipper III* took off from Botwood on the easterly crossing. The two boats alighted at their destinations within a quarter of an hour of each other on July 8. The *Caledonia*, under Captain A. S. Wilcockson, flew mostly at a height of 1,500 ft. to avoid the worst of the head-wind; she followed a rhumb line course at an average speed of about 132 miles an hour and was in the air for 15 hr. 28 min. The *Clipper III*, under Captain H. Gray, flew most of the way at 10,000 ft. to make the most of the following westerly wind; she kept roughly to a great circle course and her average speed was 156 miles per hour and flying time 12 hr. 37 min. Both commanders described the crossing as comparatively uneventful, and paid high tribute to the work of the wireless stations on both sides of the Atlantic in assisting their navigation.

Centenary of the General Register Office

AN exhibition which opened on July 1 at the General Register Office, Somerset House, Strand, London, W.C.2, for a duration to be announced later,

marks the centenary of the establishment of the general registration of births, deaths, and marriages in England and Wales, by illustrating the work of the Office, as well as the character of the records which are in its charge. Although the system of civil registration was established only one hundred years ago, its origins in England go back no less than four hundred years. Such statistical material relating to the population, outside the parochial records, as was recorded before 1837 was transferred to the custody of the Registrar General under the Marriage and Registration Acts of 1836. The earliest form of record, the parochial register of baptisms, marriages and burials, was established by Thomas Cromwell in 1538; but so long ago as the sixteenth century the value of demographic data and the inadequacy of the parochial system for this purpose were appreciated.

In 1590, Lord Burleigh put forward a proposal for the establishment of an office for a general register to summarize "how many christenings, weddings and burials were every year in England and Wales". The proposal was not adopted; and subsequent attempts to secure some measure of systematic collection of facts were both unsatisfactory in working and incomplete, owing to increase in the number of nonconformists, who did not avail themselves of the services of the parish church. It was owing to this latter factor that the earliest records now preserved at Somerset House are those which did not come within the established order, belonging to the refugee churches of Walloons and French, the Chapels Royal, the Independents, and the Society of Friends of the sixteenth and seventeenth centuries. It is interesting to note that the last-named body, with characteristic precision, was the first to register births and deaths, rather than baptisms and burials. The official guide to the exhibition ("The Story of the General Register Office and its Origins from 1538 to 1937". Pp. 30+6 plates. London: H.M.S.O. 6d.) deals with these and other matters of much sociological interest, especially in the light thrown by the registers on the early history of nonconformity and the scandalous 'Fleet' marriages.

Ethnological Museums: Methods and Limitations

DR. H. S. HARRISON, in his presidential address to the Royal Anthropological Institute delivered on June 29, played the part of a wandering sceptic, to use his own term, to excellent effect in setting out some of the more striking shortcomings of the ethnological museum as a place of exhibition of material objects bearing on man's cultural development. As he pointed out, there is a considerable body of exhibits, such as, for example, musical instruments, personal ornaments, money and currency, which find their place in a museum as 'material objects', but of which the real significance is non-material and is lost on either the distributional or comparative method of arrangement, as their interest lies not in form or material, but in their sociological functions and meanings. Practical considerations limit the use of labels, quite apart from the danger of the museum

becoming what Dr. Harrison said has been described as a collection of labels illustrated by exhibits. Dr. Harrison also showed himself a keen but kindly critic of the evolutionary method of display, pointing out its weaknesses in the scanty evidence and uncertainties relating to origins, the necessary, but at times excessive dependence upon inference, and the ambiguities of direction, including the possibility of degeneracy. Among the instances quoted in support of the argument he cited an interesting example in the uncertain development of the canoe and the relation of the plank and dug-out forms.

With a sympathy born of experience, Dr. Harrison recognizes the limitations imposed by space on experiment to meet defects inherent in present museum methods, but hopes for their alleviation in a National Anthropological Museum, which would be sufficiently spacious and catholic to deal with such problems. Notwithstanding his criticisms, as a museum man himself he believes firmly in the importance of the museum as a technological laboratory, forming an essential part in a school of ethnology. While anthropologists will warmly endorse his plea for a national anthropological museum, they will trust that his anticipation of its foundation before the close of the present century is a playful euphemism for "at no distant date".

Proposed Rhodes-Livingstone Memorial

To mark the jubilee of the foundation of the two Rhodesias by Cecil Rhodes in 1890 and the centenary of the setting out of David Livingstone for Africa in 1840, it is proposed to found a Rhodes-Livingstone Institute for Central African Studies in Northern Rhodesia. The main purpose of the Institute will be the study of the effect on native African society of the impact of European civilization and the urgent problem of establishing permanent and satisfactory relations between native and non-native. The proposal has the support of the Archbishops of Canterbury and York, the Right Hon. W. G. A. Ormsby-Gore, Lord Lugard, Lord Hailey, Dr. Henry Balfour, Sir William Bragg and others. It is proposed to purchase at a cost of £15,000 the premises now housing the Museum at Livingstone, the old capital of Northern Rhodesia, with the adjoining old Government House. The Museum contains objects of historical interest relating to David Livingstone and the nucleus of an important ethnographical collection. It was formed by the Government of Northern Rhodesia with assistance from the Beit Railway Trust, the Royal Geographical Society, the Scottish National Memorial at Blantyre and a number of individual benefactors. The premises will be vested in a trust, which will be responsible for administration and financial control. As a preliminary to the foundation of the Institute and the incorporation in it of the existing Museum, the Government of Northern Rhodesia has appointed an expert in applied anthropology, to whom an assistant will be added later if funds permit. Although the Rhodesian Government will bear its full share of the cost, an

appeal is made for contributions towards the capital cost of the Institute and the endowment of the Trust to enable admirers of Livingstone and Rhodes to give material expression of their interest in them and the future of the country with which they were connected. Contributions may be directed to any branch of Barclay's Bank or the Standard Bank of South Africa.

British School of Archaeology at Athens, 1935-36

IN accordance with the new arrangement for the publication of the "Annual of the British School of Archaeology at Athens", the formal matter, which includes the report of the director covering the activities of members of the School during the year, the accounts, and the summary of archaeological operations in the Greek area of the eastern Mediterranean in the preceding year, will in future be issued separately to subscribers, the report for the session 1935-36 being the first occasion on which the decision of the Committee takes effect. In the chronicle of the session precedence is taken by a reference to the lamented and untimely death of the director, Mr. Humphrey Payne, on May 9, 1936. Mr. A. H. G. Megaw, who took charge of the School as acting director, left in the following July to take up his duties on appointment as director of antiquities in Cyprus. Owing to the temporary closing of the British School of Archaeology at Rome, a number of its students worked in the School at Athens. Excavations by members of the School were carried on at Monasteri in the Perachora, at Siphnos and at Trapeza in eastern Crete. Miss W. Lamb excavated at Kusura in Anatolia. Supplementary excavations in the Heraeum of Perachora, which had been planned by Mr. Payne, were postponed until the following season. The manuscript of the account of the excavation of this important site was left in an advanced state by the late director, and it is anticipated that publication of the first volume will not be long delayed. In the chief descriptive notes of the activities of the School reference is made to some interesting discoveries in Crete. Although no further investigation of the Roman villa was possible, surface finds east of the basilica indicate that this was an important residential quarter of the Roman town in the first and second century A.D.

Speleological Conference at Bristol

FURTHER particulars of the second annual conference of the British Speleological Association to be held at Bristol on July 23-26 next (see NATURE, May 29, p. 919) are now available in the advance programme which has been issued. Through the hospitality of the University of Bristol the conference and exhibition will be held in the Great Hall of the University. The exhibition will include contributions from nearly all the important caves in the world, as well as some unique illuminated transparent photographs. Probably the largest and most valuable collection of 'Blue John' will be exhibited. On the evening of July 24 an illustrated public lecture will be delivered by the Abbé Breuil on some aspects of the

French and Spanish caves. Among the lectures announced is a brief account by Mr. C. R. Hewer of some of the caves to be visited on the Continental tour on July 27-August 7 when members will have the opportunity of visiting caves not as a rule accessible to the public. At Nurnberg, after a visit to the Museum for Prehistory, the party will proceed to Teufelshöhle, Maximiliansgrotte, and other caves of archaeological, geological and palaeontological importance at Pottenstein, where also a mesolithic cave shelter has been especially excavated for the visit by the "Gaukulturamt". At Brno, Czechoslovakia, Prof. C. Absolon will conduct the party over the Museum, with its unique collection of archaeological finds from the Moravian caves, which include remarkable examples of palaeolithic plastic art; and in the afternoon of the same day the caves, which are the centre of the great mammoth hunters' culture of Moravia, will be visited. Passing through Vienna the party will proceed to the famous 'Drachenhöhle' from Mixnitz, the Lower Lurhöhle from Peggau and the Eisriesenwelt—ice cave from Werfen, the last place of call being Salzburg.

The Swiss Society of Natural Sciences

THE recent issue of the *Verhandlungen der Schweizerischen Naturforschenden Gesellschaft* contains an account of the annual meeting of the Society held at Solothurn in August 1936 and also reports of the work of the previous year. The object of the Society is to promote the study of all branches of natural science in Switzerland. Between the annual meetings for the presentation and discussion of papers, the work of the Society is carried on by a number of commissions. Some of these are concerned with the administration of endowments, while others undertake field work in various sciences. The latter are financed partly from members' subscriptions, but mainly from Government grants. Among the commissions performing work of national importance is the Geological Commission, which is engaged in the publication of a geological survey of Switzerland on scales of 1 : 25,000 and 1 : 200,000. In addition to the purely scientific commissions, there is a Commission for the Preservation of Nature, which is doing valuable work in preserving sites of scientific interest or scenic beauty, as well as in promoting legislation for the protection of forms of wild life which are in danger of extermination. Besides administering Government research grants, the Society also acts as the official representative of Switzerland on international scientific unions, and the volume under notice contains the reports of the Swiss delegations to a number of such unions.

THE presidential address at the annual meeting in 1936 was given by Dr. Karl Dandliker, who took as his subject, "Birth-Rate Decline and Surplus". He showed how, in spite of the excess of births over deaths, the population of many countries in Europe is bound to decrease before long. A paper was read by H. Brockmann on "Swiss Farm-Houses", in which two types of buildings were distinguished: one type

has evolved from the use, by primitive man, of caves as shelters, while the other has evolved from tree shelters. Other papers read before the general meeting were "Inheritance by Labile Genes", by A. Ernst; "The Sting of the Bee", by M. Rooh; "Ontogenesis of the Bird as a Problem in Evolution", by A. Portmann. These papers are all printed in full. In addition, abstracts are given of some 150 more specialized papers, dealing with nearly all branches of science, which were presented to the sectional meetings of the Society.

Royal Cornwall Polytechnic Society

THE one hundred and third annual report of the Royal Cornwall Polytechnic Society, besides containing the usual list of members, financial statements and an account of the work of the Falmouth Observatory, has several contributions of general interest. One of these is by Miss R. Beckett, who, in a paper on "Public Library Service", traces the growth of public libraries due to the Library Acts of 1850, 1855 and 1919. The Act of 1850 limited the rate to be levied to $\frac{1}{4}$ d. in the £ and that of 1855 to 1d. These sums proved quite inadequate, but it was not until 1919 that the penny rate limitation was abolished. In practice to-day, the average expenditure is 1s. 4d. per head of population, though some authorities expend as much as 2s. 6d. In another contribution, Mr. S. Furze deals at length with the operations involved and the machinery used in tin dressing, while in a third, Mr. J. H. Rowe gives the early history of Hayle Foundry, which was founded by John Harvey (1730-1803) and developed by his son Henry Harvey (1775-1850). This foundry was the earliest in Cornwall, and became ultimately the most important engineering works in the west of England. The well-known engineer Arthur Woolf (1766-1837), the pioneer of the compound steam engine, was at one time superintendent of this works, and it was there that he built some of the finest Cornish pumping engines of the time. The history of the Royal Cornwall Polytechnic Society inevitably recalls the Fox family, and the report has a tribute to Mr. Wilson Lloyd Fox, who died on February 10, 1936. He gained one of the Society's prizes in 1860, became a member in 1865, served as president in 1922-24, and was secretary of the Committee of the Falmouth Observatory from 1877 until 1931.

Intelligence, Character-training and Civilization

A LUDWIG MOND LECTURE entitled "Intelligence and Civilization", delivered at the University of Manchester last October by Prof. G. H. Thomson, of the University of Edinburgh, has been published in the first issue of the new *Journal of the University of Manchester*. After a preliminary discussion of some aspects of recent researches in the field of intelligence measurements, Prof. Thomson proclaims his belief (which was also H. T. Buckle's) that the history of the advance of civilization has been the history of the conquest of the world by intelligence. He preaches the salvaging of civilization "through the cultivation by an education proper to each of

the intelligence of all". Of character-training he is profoundly distrustful. A clear vision of truth is, he assumes, to be attained solely through cultivation of the intelligence and "the schoolmaster's sole business is to lead his pupils to see truth clearly . . . and . . . that is the only character-training the school may lend itself to, if it is to refrain from serving party or class . . . but is to serve civilization". He does not think much of civilization's debt to the poets ("far more dangerous than scientists"), notwithstanding that he holds intelligence to be based on imagination, and he makes a point of registering disagreement with Earl Baldwin's hope, confided to the Congress of Universities of the Empire, that from those universities may presently come forth "poets who will inspire Europe and the world once more with a sense of unity and a sense of freedom".

The Utilization of Wood as Fuel for Motive Power

IN the *Bulletin* of the 'Société d'encouragement pour l'Industrie Nationale' of January is printed an abstract of a paper by R. Vaultrin on the utilization of wood as fuel for motive power. Towards the end of the Great War, the French Ministry of Inventions made experiments on carrying heavy loads between Paris and Rouen by motor-lorries provided with suitable gas generators using wood for fuel, but the results obtained were not good. In 1928, after a further rally with 'camions à gazogène', the problem was completely solved; but at that time the price of the wood fuel was too high to make it profitable. A notable rally was made in 1930 between Paris and Rome, crossing the Alps and the Apennines, and another was made through the Landes where resinous fuel was used and found suitable. Recent results for tourist vehicles gave 50 miles per hour consuming about 70 lb. of firewood, costing six francs for a sixty miles run. Heavy motor-lorries can run at 30 miles per hour, the cost for sixty miles being fifteen francs. In France, there is an annual over-production of thirteen million cubic yards of firewood. This would be sufficient for 60,000 motor-vehicles using gas generators. At the moment, the difficulty is to obtain, on the road, supplies of suitable wood with constant humidity. This double problem has been solved between Frankfurt and Cologne. In France there are already large stores on a 'national' road, and all the main routes on the east are being supplied with stores. The control of the humidity of the wood distributed is being studied.

Electric Furnaces

DURING last year the use of electricity for the melting and heat treatment of iron and steel in Great Britain considerably increased. There has been a revival in the demand for arc furnaces, a number of which, varying in capacity from 500 to 6,000 kilowatts, are being installed. In the *Electrical Review* of April, Mr. D. Campbell states that the furnaces ordered from a single manufacturing company during last year would consume about a 100 million electric units a year. The cost of the annual power bill for these furnaces alone would be about £200,000. A

furnace of 6,000 kilowatt capacity, probably the largest electric melting unit in Europe, has just begun operation in Sheffield. Within its small area of furnace hearth (13 ft. diameter), as much energy is consumed per day as the aggregate loads of Cambridge, Salisbury and Tonbridge. Unfortunately, the requirements of larger and interconnected power stations make it essential to install higher rupturing capacity switch-gear, and this constitutes a heavy charge on small firms which may want to use electric furnaces. Seeing that the cost of the energy consumed by the furnace during its average life (ten years) is about thirty times the original cost of the complete installation, the companies should offer attractive conditions to steel manufacturers. The extreme purity of arc furnace steel owing to the absence of slag inclusions is now generally recognized, and for many types of forging this steel is specified. The choice between high-frequency furnaces and arc furnaces is difficult to make. Although the capital expenditure for high-frequency furnaces is much higher, yet when melting operations only are required they are cheaper to work.

Astronomy in Japan

THE Kyoto Imperial University has accepted a donation equivalent to about £10,000 from the Osaka Electric Railway Co. towards the building of an observatory on the southern peak of Ikomasan at a height of 640 metres. The observatory will include a main building with a 9-metre dome, a solar laboratory, housing for a reflector and a dormitory. The equipment of the solar department of the Kwasan Observatory is to be transferred to this new site, in addition to other instruments including the 80-cm. Tomkins reflector. Later a large museum devoted to astronomical exhibits and those of allied sciences will be built near the Ikomasan Observatory. Prof. Yamamoto will be the director of the group. The Kwasan Observatory will then become a purely academic institution. The Osaka Municipal Electric Museum, which has recently been completed, includes a Zeiss planetarium, which is installed under an 18-metre dome on the sixth floor of the Museum. *Bulletin* No. 326 of the Kwasan Observatory directs attention to a daily series of sun-spot observations made for fourteen years by Mr. Katue Misawa, whose failing eyesight now prevents the series from being carried on. The observations, which have been made regularly under excellent weather conditions, have been of great use in supplying data with the minimum delay to Japanese investigators. Observations of the zodiacal light are receiving special attention in Japan, and it is planned to establish a special observatory at Onomiti, Hiroshima-Ken, at a height of 150 metres. The observed longitude of the Kwasan Observatory, deduced from 74 observations made with the 90 mm. Bamberg transit in conjunction with the reception of Greenwich wireless time signals, is $-9^{\text{h}} 3^{\text{m}} 10.815^{\text{s}} \pm 0.002^{\text{s}}$ or E. $135^{\circ} 47' 34.72'' \pm 0.03''$. The elements of latitude variation for the epoch 1934.0-1935.9 computed by Dr. Kimura from data provided by five northern stations are given in *Bulletin* No. 322.

Hygiene in the Bacon Factory

WITH this title, *Bull.* No. 1, published by the Bacon Development Board, Thames House, London, S.W.1 (1s.), lays down certain standards of sanitation as a condition of every licence to produce bacon, and describes in some detail a system of sanitation which, if adhered to, will assist curers to comply with the conditions of their licence, and help them, in their own interests, to reduce the risk of spoilage of their products. The construction, maintenance and equipment of the factory are first discussed, after which the daily and the periodical cleaning of the premises are described. Next, the keeping of the meat and bacon clean and wholesome, and the personal hygiene of the employees are dealt with. Data are given in an appendix upon sources and reduction of contamination and the use of sodium hypochlorite as a disinfecting agent.

Brown-Firth Research Laboratories

A BROCHURE of some seventy pages deals with the equipment and work of the Brown-Firth Research Laboratories in Sheffield. The various types of research undertaken are described briefly, and the apparatus used is illustrated. A long list of original papers which have been published is appended, together with a catalogue of books, manuscripts and reports available in the library. To all who are concerned in any way with the development of modern steels, this publication cannot fail to be of interest.

1851 Exhibition Studentships and Scholarships

THE science scholarship committee of the Royal Commission for the Exhibition of 1851 has recently awarded the following senior studentships and overseas scholarships, upon the recommendations of the universities and other institutions named: **SENIOR STUDENTS.** Dr. H. J. Bhabha (University of Cambridge), for research in theoretical physics at Cambridge; Dr. H. N. Rydon (Imperial College of Science and Technology), for research in organic chemistry at Oxford; Dr. J. L. Harley (University of Oxford), for research in mycology at Oxford; Dr. A. H. S. Holbourn (University of Oxford), for research in experimental physics at Oxford. A fifth Studentship was given to Dr. T. S. Westoll, who was a palaeontologist recommended by University College, London, but he has been appointed to a lectureship at Aberdeen and therefore will not take up the award. **OVERSEAS SCHOLARSHIPS.** *Canada:* Mr. A. J. C. Wilson (Dalhousie University, Halifax), for research in physics at the Massachusetts Institute of Technology and the University of Cambridge; Mr. D. M. Roes (Dalhousie University, Halifax), for research in experimental zoology at the University of Cambridge; Dr. H. Rudoff (McGill University, Montreal), for research in organic chemistry at the University of Oxford; Dr. J. L. Morrison (McGill University, Montreal), for research in physical chemistry at the University of Cambridge; Mr. A. G. Ward (Queen's University, Kingston), for research in physics at the University of Cambridge. *Australia:* Mr. R. D. Hill (University of Melbourne), for research in physics at

the University of Cambridge; Miss K. L. Prendergast (University of Western Australia), for research in palaeontology at the University of Cambridge. *New Zealand*: Mr. I. Lander (University of New Zealand), for research in physical chemistry at the University of Manchester. *South Africa*: Mr. F. Sebba (University of Cape Town), for research in inorganic chemistry at the Imperial College of Science and Technology. *Irish Free State*: Mr. D. A. Webb (Trinity College, Dublin), for research in zoology at the University of Cambridge; *India*: Mr. N. S. Nagendra Nath (Indian Institute of Science, Bangalore), for research in theoretical physics at the University of Cambridge.

THIS is the first occasion on which a scholar from India has been included in the Overseas scheme of the Royal Commission for the Exhibition of 1851: and the award of the scholarship has been made possible by the action of H.M. Treasury in extinguishing the balance of the liability for contributions to the cost of new buildings for the Science Museum. The following preliminary selection committee was appointed by the Government of India to sift applications in India for the scholarship: Mr. J. E. Parkinson, Educational Commissioner with the Government of India (chairman); Dr. S. S. Bhatnagar, professor of physical chemistry, Punjab University; Sir C. V. Raman, director of the Indian Institute of Science, Bangalore; Dr. Birbal Sahni, professor of botany, Lucknow University. The names of three candidates for the scholarship were submitted by the committee to the Commissioners, who decided on June 30 to award the scholarship to Mr. Nath. In addition, it is worth mention that though Indian students, like all other British subjects, have always been eligible for Senior Studentships, if recommended by a university in the United Kingdom, Dr. H. J. Bhabha is the first native of India to be awarded such a studentship. He has made several original contributions to the correspondence columns of NATURE and is well known among workers in theoretical physics.

Rockefeller Travelling Fellowships in Medicine

THE Medical Research Council has awarded Rockefeller fellowships to the following for the academic year 1937-38: D. L. C. Bingham, clinical tutor, Surgical Outpatient Department, Royal Infirmary, Edinburgh; E. G. L. Bywaters, assistant clinical pathologist, Middlesex Hospital, London; P. R. Evans, registrar, Medical Diseases of Children, King's College Hospital, London; J. G. Slater, tutor in clinical medicine, Royal Infirmary, Edinburgh; Dr. E. F. Soowan, assistant director, Medical Professorial Unit, St. Bartholomew's Hospital, London; Dr. C. H. Stuart-Harris, Sir Henry Royce research fellow in influenza, London; G. W. Hayward, ~~resident~~ medical officer, National Hospital for Diseases of the Heart, London. All these fellows propose to work at centres in the United States. In addition, the Rockefeller Foundation has awarded fellowships, on the recommendation of the Medical Research Council, to the following candidates in the

special field of psychiatry, neurology and related subjects: Dr. E. W. Anderson, medical director, Cassel Hospital, Penhurst; Dr. A. Kennedy, assistant medical officer, Maudsley Hospital, London; A. S. Kerr, surgical registrar, Royal Infirmary, Liverpool; Dr. D. J. Williams, resident medical officer, Hospital for Nervous Diseases, Maida Vale, London; Dr. A. F. Rawdon-Smith, senior student, Royal Commissioners for the Exhibition of 1851, working in the Psychological Laboratory, University of Cambridge. Dr. Anderson proposes to work in Germany, the others at centres in the United States.

Announcements

THE following have recently been elected honorary fellows of the Royal Society of Edinburgh: *British*: Dr. W. T. Calman, lately keeper of zoology, British Museum (Natural History); J. L. Baird, inventor of the "Televisor". *Foreign*: Prof. C. U. Ariens Kappers, director of the Central Institute of Brain Research, Amsterdam, and professor of comparative neurology in the University of Amsterdam; Prof. M. T. Bogert, professor of organic chemistry in Columbia University, New York; Prof. Max Planck, emeritus professor of theoretical physics and director of the Institute for Theoretical Physics in the University of Berlin.

DR. G. W. SCOTT BLAIR, of the physics department, Rothamsted Experimental Station, has been appointed head of the chemistry department at the National Institute for Research in Dairying, Shinfield, near Reading. Dr. Scott Blair, who is a chemistry graduate of the University of Oxford, joined the Rothamsted staff in 1926. He has worked on the physico-chemical properties of various agricultural materials such as soil, flour, honey and cheese. During one part of his Rothamsted service he held a Rockefeller Fellowship at Cornell University.

DR. F. W. EDWARDS has been appointed a deputy keeper in the Department of Entomology of the British Museum (Natural History). Dr. Edwards was born in 1888 and entered the Museum service in 1910. He is an authority upon Diptera. He undertook very successful collecting expeditions on behalf of the Museum to Patagonia in 1926-27 and to East Africa in 1934-35, as well as several smaller expeditions.

THE fourth Congress of the Medical Woman's International Association will be held on July 13-18 at the McEwen Hall in Edinburgh. Further information can be obtained from the Local Congress Secretary, 2 Chester Road, Edinburgh.

MESSRS. JAMES TENGASKIS AND SON, 66 Great Russell Street, London, W.C.1, have issued a catalogue of old works on medicine and biology (Caxton Head Bulletin 21). It includes a copy of the rare first edition of Darwin's "Origin of Species", Gesner's "Treasure of Eponymus" (1559), Laennec's "Traité de l'auscultation médiate" (Ed. 4, 1837), the "Opera" (1582) of A. Paré, the great medieval surgeon, and other rare volumes.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 71.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Heat Conduction in Liquid Helium

It was found by Rollin¹ and by Keesom and Keesom² that liquid helium II shows an extraordinarily high heat conductivity, of the order of

the capillary. For example, at 2.10°K ., a level difference of 1 cm. corresponds to a temperature difference of 1.32×10^{-2} deg. Since, on the other hand, the heat flow through the capillary is equal to the heat produced in the wire, one can determine the conductivity.

It is essential for this method that one should actually obtain equilibrium, but it is easily estimated from the observed conductivity that equilibrium should be established in a fraction of a minute, and it was indeed observed that the level followed a change in the current very rapidly and reversibly. It is also easy to see that the heat conduction in the glass, in the leads carrying the current, etc., is negligible. In order to avoid convection, the warm end of the capillary was arranged to be lower than the cold end (the expansion coefficient of helium is negative).

Preliminary experiments showed the un-

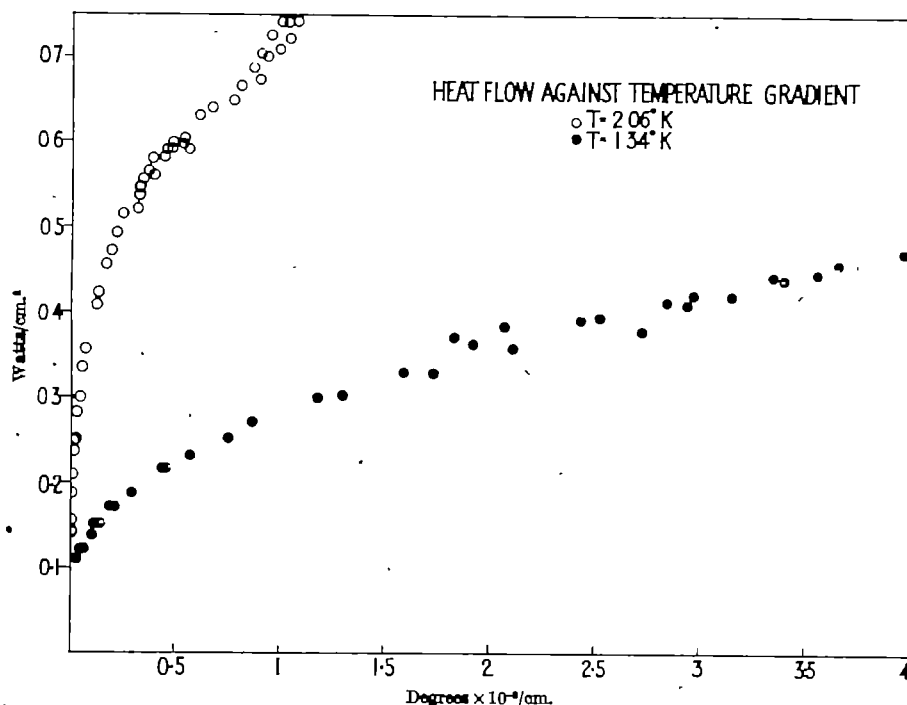


Fig. 1.

10^6 cal./deg.cm.sec. We have measured the heat conductivity with the following method, which is essentially a combination of a vapour-pressure thermometer with a liquid-helium manometer. (The method was developed in discussion with Dr. J. D. Cockroft.)

An evacuated glass vessel is immersed in a helium bath. It contains a vertical cylindrical bulb, the bottom of which communicates with the outer bath through a glass capillary. The bulb also contains a heater wire through which a current can be passed. This current is so adjusted that part of the helium in the bulb evaporates, and only part of the bulb is filled with liquid. The level of the liquid is observed in a telescope and its height compared with the level of the bath. In equilibrium, the difference in height is such that the difference in hydrostatic pressure is equal to the difference in vapour pressure. In this way one obtains the temperature difference between the bulb and the bath, and this is practically also the temperature difference between the two ends of

the capillary. For example, at 2.10°K ., a level difference of 1 cm. corresponds to a temperature difference of 1.32×10^{-2} deg. Since, on the other hand, the heat flow through the capillary is equal to the heat produced in the wire, one can determine the conductivity. It is essential for this method that one should actually obtain equilibrium, but it is easily estimated from the observed conductivity that equilibrium should be established in a fraction of a minute, and it was indeed observed that the level followed a change in the current very rapidly and reversibly. It is also easy to see that the heat conduction in the glass, in the leads carrying the current, etc., is negligible. In order to avoid convection, the warm end of the capillary was arranged to be lower than the cold end (the expansion coefficient of helium is negative). Preliminary experiments showed the un-

expected result that the conductivity depends on the temperature gradient. We therefore used an arrangement in which the level difference could vary from 12 cm. to about 0.3 mm., and measured the heat flow as a function of the temperature difference ΔT between the ends of the capillary. In this case the capillary was 16.8 cm. long and had an internal diameter of 1.45 mm. The results are shown in Fig. 1, for bath temperatures of 2.06° and 1.34°K . It is clear that the heat flow is far from being proportional to ΔT , even for the lowest temperature differences we used. The ratio of heat flow to temperature gradient, which one may call conductivity, increases with decreasing ΔT . It reaches the value 1.1×10^6 cal./deg.cm.sec. at $\Delta T = 5 \times 10^{-3}$ and $T = 2.06$. It appears, however, to rise still further and a refinement of the method is required to decide whether it tends to a finite value as ΔT tends to 0.

Qualitative measurements at a number of different temperatures between 1.34° and 2.19° showed the same general behaviour. At constant ΔT , the

conductivity is relatively small near the λ -point (2.19°), reaches a maximum in the neighbourhood of 2.0° and decreases again at lower temperatures.

We cannot suggest an explanation for these results, for which there is no analogy in the behaviour of other substances. It seems impossible, however, to account for them by any errors in the experimental method; the effect seems actually to be a property of the liquid helium II.

J. F. ALLEN.
R. PRIEBELS.
M. ZAKI UDDIN.

Royal Society Mond Laboratory,
Cambridge.
June 22.

¹ *Physics*, **2**, 557, (1935).

² *Physics*, **2**, 359, (1935).

Analysis of Ternary Gas Mixtures by Thermal Conductivity Measurements

It frequently happens in the course of exchange reactions with deuterium and hydrogen that a third gas is present initially, or is produced during such experiments (for example, nitrogen in exchange reactions with ammonia and deuterium). If this gas is non-condensable in liquid air, the deuterium content of the gas cannot be estimated by the convenient thermal conductivity methods, unless a trap cooled with liquid hydrogen is employed to freeze out the third constituent of the mixture. The gases concerned are oxygen, nitrogen, carbon monoxide and methane and the inert gases. The only alternative method is to burn the gases and measure the deuterium content of the water so produced.

The thermal conductivity method described below surmounts this difficulty. Its operation depends on the fact that the thermal conductivity of hydrogen decreases rapidly below 200° K., owing to the decrease in rotational specific heat of the molecule. The thermal conductivity of deuterium, on the other hand, only decreases slowly, since the rotational specific heat remains practically constant down to

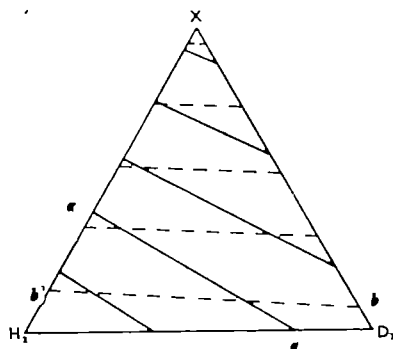


Fig. 1.

about 80° K. For example, at 250° K. the ratio of the thermal conductivities is 1.584 : 1; at 75° K. it is 1.095 : 1. Consider now a ternary mixture containing hydrogen, deuterium and a third gas (X). At high temperatures (c. 250° K.) a whole series of mixtures will have the same thermal conductivity—as is exemplified by the full lines on the ternary

diagram (Fig. 1). At 75° K., however, the isothermal conductivity lines will be more nearly parallel to the hydrogen-deuterium side of the triangle, as is indicated by the dotted lines. To perform an analysis of an unknown mixture, then, it is only necessary to measure the thermal conductivity at these two temperatures: if, for example, the respective thermal conductivities correspond to the lines *aa* and *bb*, the point of intersection at once gives the composition of the mixture.

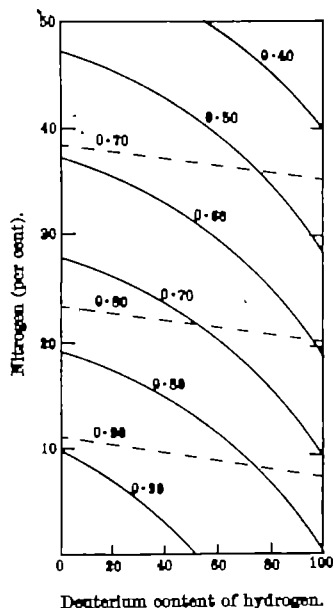


Fig. 2.

In practice, the analysis may be carried out by compressing the mixture to a standard pressure, for example, 50 mm., into a micro thermal conductivity cell, of volume 0.05 c.c. (that is, requiring about 0.01 c.c. gas at N.T.P.), dipping into liquid air and attached to the compression capillary of a McLeod gauge¹. The voltages required to maintain the filament at the two chosen temperatures are determined. The isovolt lines obtained for hydrogen-deuterium-nitrogen mixtures are shown in Fig. 2. The filament temperature was 300° K. and 110° K. in the case of the full and dotted lines respectively. The observed voltage value, relative to that required for pure hydrogen, corresponding to each isovolt line is indicated. The observed curvature of the high-temperature lines is attributable to mixture effects. For mixtures of nitrogen-content not exceeding 50 per cent, the accuracy of the method is about 1 per cent deuterium.

It is evident that this method may be applied to any ternary mixture, one component of which is hydrogen and the other two, gases of different thermal conductivity. Mixtures of ortho- and para-hydrogen and a third gas may likewise be analysed.

J. L. BOLLAND.

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H. W. MELVILLE.

Colloid Science Laboratory,
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May 21.

¹ Melville and Bolland, *Proc. Roy. Soc.*, in press.

Artificial Slip Formation in Crystals.

WHAT is the cause of the plasticity and low elastic limit of crystals? No satisfactory answer has as yet been found to this fundamental question in crystal

All the photographs show the artificially created slips in polarized light. The axes of the Nicols are parallel to the cube axes. The scratches are made in the direction (100) normally to the plane of the

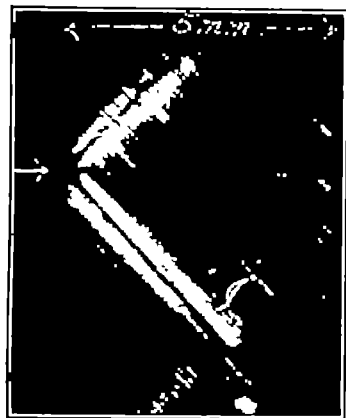


Fig. 1.

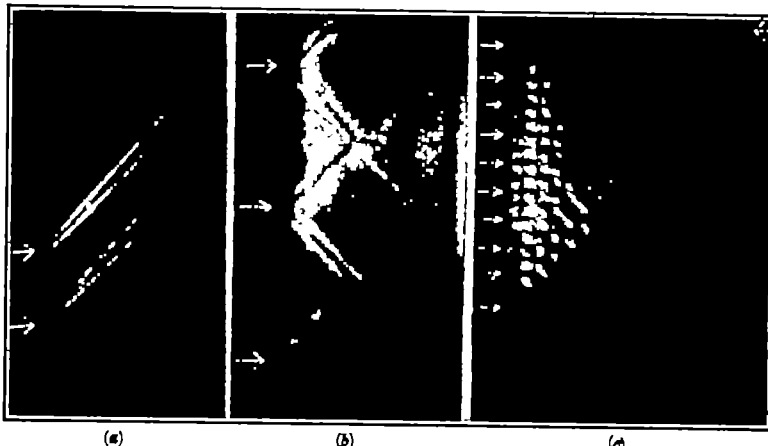


Fig. 2.

physics. The results of experiments, briefly described in the present note, establish one of the factors determining the course of the plastic deformation.

A scratch was made on a rectangular specimen of rock salt with faces parallel to the cube faces. The scratched crystal was placed between crossed Nicols and stretched. The influence of the scratch on the process of slip formation was observed with polarized light.

The main result may be summarized in the statement that a scratch is the source of the slip.

The gradual propagation of the slips beyond the region of the scratch, and their growth throughout the bulk of the crystal, were observed directly. The bright rays in Fig. 1, Fig. 2 *a* are artificially produced slips. They were especially pronounced when the scratches were made on specimens the original surfaces of which had been previously dissolved away.

The picture formed by the artificially produced 'slips' depends upon the experimental conditions. With different positions of the scratches on the surface of the crystal, we could obtain any desired slip patterns. Fig. 2 *b* corresponds to three parallel scratches at a distance of 5 mm. from each other. Fig. 2 *c* corresponds to 10 parallel scratches at a distance of 0.5 mm. from each other.

A number of details in the photographs may be noted, such as (1) the increased illumination in the parts lying along the locus of the intersection of the slips, with a straight line drawn at an angle of 45° to the axis of the specimen from the scratch (see Fig. 1, dotted in the upper ray); (2) the direction of the slips deviates considerably from 45° (see Fig. 2 *a*); (3) the interference of several scratches (see Fig. 2 *c*), etc. Fig. 3 shows a part of one of the rays reproduced in Fig. 1 at a greater magnification.

It appears that the plastic deformation of crystals cannot be explained by a simple slipping mechanism. The rupture takes place along the scratch. The process of rupture proceeds as follows: the surface defect gives rise to the appearance of slips, which in their turn lead to the development of a surface defect, which ends in fracture.

The state of the surface and local deformation are probably also of importance in twinning.

picture. The arrows indicate their position. The scratches were produced by means of a Martens sclerometer.

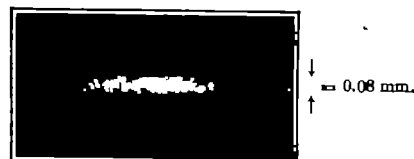


Fig. 3.

A detailed account of these experiments will shortly be published in the *Phys. Zeitschrift der Sowjetunion*.

A. W. STEPANOW.

Physico-Technical Institute,
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Coupling of Dismutations with Esterification of Phosphate in Muscle

THE disappearance of free phosphate during glycogenolysis in muscle extract is a striking phenomenon. One mechanism by which this occurs has recently been elucidated by Parnas and his colleagues¹, who showed that, even in long-dialysed extracts, phosphate and glycogen can react together giving hexosemonophosphate. This reaction is poisoned by *M*/100 phloridzin, but not by *M*/400 iodoacetic acid. We have observed a second method of phosphate esterification.

A certain dependence of esterification of carbohydrate upon dismutation has from time to time been observed, for example, by Meyerhof and Kiesel² in yeast and muscle extract, by Schaffer and Berl³ in yeast extract, and by Dische⁴ in red blood cells and haemolysed blood. Dische mentions having found an increase in easily hydrolysable phosphate during this esterification, and suggested that the synthesis of adenylypyrophosphate might be an intermediate step. We now show that in the second method of phosphate esterification in muscle extract

the dismutation of triosephosphate with pyruvic acid (giving phosphoglyceric and lactic acids) is coupled with a synthesis of adenylypyrophosphate from adenylic acid and free phosphate.

As enzyme preparation we used extract of acetone muscle powder (rabbit) prepared according to Meyerhof's technique. In order to destroy adenylypyrophosphatase (the activity of which would have masked any adenylypyrophosphate synthesis) we kept the extract at 0° for five days before use; the extracts were also dialysed for four hours to remove any remaining traces of substrate. Typical results are given in Table 1. It will be observed that (1) iodoacetate, which inhibits the dismutation, inhibits also the esterification, (2) phloridzin does not inhibit either dismutation or esterification, (3) arsenate inhibits the esterification without affecting dismutation.

TABLE 1.

1 c.c. extract made up to final volume of 2.5 c.c. with *M*/100 hexosediphosphate, *M*/50 pyruvate, *M*/50 fluoride, *M*/50 phosphate, *M*/200 adenylic acid, present in each sample. 0.4 mgm. co-enzyme present in each. 30 min. incubation at 37° C. The figures give increases and decreases in mgm.

Exp.		Lactic acid	Phosphoglyceric P	Inorg. P.	Pyro P.
IV		+ 1.58	+ 0.57	- 0.62	+ 0.66
V	No iodoacetate	+ 1.80		- 0.73	+ 0.73
	+ iodoacetate	+ 0.32		0	0
XVIII	No phloridzin	+ 4.56		- 0.51	+ 0.57
	+ phloridzin	+ 3.87		- 0.45	+ 0.66
XIX	No arsenate	+ 4.26		- 0.60	
	+ arsenate	+ 4.06		- 0.18	

Iodoacetate *M*/400; phloridzin *M*/100; arsenate *M*/75.

The dismutation of α -glycerophosphate with pyruvate, and the dismutation of hexosediphosphate to give glycerolphosphate and phosphoglycerate can be coupled with the phosphorylation of adenylic acid.

As regards the mechanism of the coupling, it can be said (1) that we have tested our extracts for adenylypyrophosphatase activity and found it to be nil. It seems, therefore, that the coupled esterification cannot be dependent upon a reversed reaction catalysed by this enzyme. (2) We have examined the ratio of lactic acid formed to phosphorus esterified. The results indicate that, according to the conditions, a greater or less proportion of the dismutation can be coupled with adenylypyrophosphate synthesis, but that however favourable the conditions, probably not more than one atom of phosphorus can be esterified per molecule of lactic acid formed.

This coupled esterification of phosphate probably plays an important part during the anaerobic recovery period when creatinephosphate is resynthesized, free creatine and free phosphate disappearing. Making use only of the Parnas mechanism of esterification of glycogen by free phosphate, and of the mechanism whereby phosphate is transferred from phosphopyruvic acid to adenylic acid, it seems possible to account for the resynthesis of only $\frac{1}{2}$ mol. creatinephosphate per mol. lactic acid produced. Both Meyerhof² and Parnas³ have pointed out that Lundsgaard⁴ has actually observed a much greater synthesis than this—2 mol. creatinephosphate per mol. lactic acid formed. By taking into account the coupled esterification, synthesis of $1\frac{1}{2}$ mol. of creatinephosphate per mol. lactic acid can be expected. This is a value much nearer Lundsgaard's observed results. Further, during anaerobic recovery there is very little heat output; this can only be explained if the energy of dismutation is not evolved. We here

suggest that it is retained and used to make possible the endothermic synthesis of adenylypyrophosphate.

These considerations will be dealt with in detail elsewhere.

DOROTHY M. NEEDHAM.
R. K. PILLAI.

Biochemical Laboratory,
Cambridge.

June 3.

- ¹ Parnas and Baranowski, *Comptes rend. Soc. Biol.*, **130**, 307 (1935).
² Ostern, Guthrie and Termakowicz, *Z. physiol. Chem.*, **243**, 9 (1936).
³ Parnas and Mochnicka, *Comptes rend. Soc. Biol.*, **132**, 1173 (1936).
⁴ Meyerhof and Klemm, *Biochem. Z.*, **251**, 449; **253**, 83 (1935).
⁵ Schaffner and Berl, *Z. physiol. Chem.*, **238**, 111 (1935).
⁶ Dieck, *Naturwiss.*, **22**, 775 (1934); **24**, 402 (1936).
⁷ Meyerhof and Lehmann, *Naturwiss.*, **23**, 337 (1935).
⁸ Parnas and Ostern, *Bull. Soc. Chim.*, **18**, 1471 (1936).
⁹ Lundsgaard, *Biochem. Z.*, **223**, 332 (1931).

An Oxyporphyrin Haematin Compound as Intermediate between Protohaematin and Verdohaematin

In our letter on "Coupled oxidation of ascorbic acid and haemochromogens"¹, we had observed the formation of a haematin compound with an absorption band at 639 m μ during the coupled oxidation of pyridine-haemochromogen and ascorbic acid. The same compound was formed by action of hydrogen peroxide on the haemochromogen in presence of ascorbic acid. On reduction it gave a haemochromogen with the bands of protohaemochromogen. From these observations we had concluded that the compound was a hydrogen peroxide compound of protohaemochromogen.

We have now found that the haemochromogen, obtained by reduction of the compound with the absorption band at 639 m μ , is not protohaemochromogen, but a haemochromogen of a new type. The position of its absorption bands is almost the same as the position of the protohaemochromogen bands (557.4 and 526.3 m μ), but the second band is stronger than the first, whereas in protohaemogen the first band is the stronger of the two. A haemochromogen of a similar type is that of phylloporphyrin², a porphyrin carrying methyl on one methene group. By atmospheric oxygen the new haemochromogen is rapidly oxidized to verdohaemochromogen, a haemochromogen with open tetrapyrrolic chain. On splitting with hydrochloric acid in absence of oxygen, the new haemochromogen gives rise to an oxyporphyrin, which resembles the oxyporphyrins obtained by H. Fischer and collaborators by action of hydrogen peroxide on porphyrins in concentrated sulphuric acid³. The absorption spectra of the oxyporphyrins of Fischer and also of our oxyporphyrin are similar⁴ to those of chlorins and rhodins, but whereas the copper and iron complex salts of Fischer's oxyporphyrins are also chlorin-like, the complex salts of our oxyporphyrin are of the phylloporphyrin type.

The most likely explanation appears to be that our haemochromogen is the iron complex salt of an oxyporphyrin carrying a hydroxyl group on the α -methene group. By action of molecular oxygen on the oxyporphyrin-haematin, this carbon atom is then removed and the porphyrin ring opened. Fischer's oxyporphyrins carry their hydroxyls probably not on the methene group, but in the β -positions of a hydrogenated pyrrole nucleus⁵. The compound with the absorption band at 639 m μ is the ferric haemochromogen of the oxyporphyrin, and not a haem-hydrogen peroxide compound.

The conclusions, drawn from the existence of the supposed hydrogen peroxide compound with regard to the reaction mechanism of the coupled oxidation of haemochromogen and ascorbic acid, remain, however, correct. Hydrogen peroxide plays a part in this reaction, transforming porphyrin-haematin into oxyporphyrin-haematin. There is also evidence in favour of the existence of a haem-hydrogen peroxide compound during the reaction. Whereas catalase completely prevents the formation of the oxyporphyrin-haematin from haemochromogen and hydrogen peroxide, catalase inhibits the formation of this compound (and of verdohaemochromogen) by atmospheric oxygen only partially. The most likely explanation is that the 'nascent hydrogen peroxide' is protected from the action of catalase by its combination with the molecule with which it is to react afterwards (that is, the haem), and that the partial inhibition of the reaction by catalase is due to a partial dissociation of the haem-hydrogen peroxide compound and catalytic destruction of the hydrogen peroxide set free by the dissociation.

R. LEMBERG.

Institute of Medical Research, B. CORTIS-JONES.
Royal North Shore Hospital, M. NORRIS.
Sydney. May 15.

¹ NATURE, 139, 1016; 1937.

² Treibs, A., and Wiedemann, E., *Liebigs Ann.*, 406, 264 (1928).

³ Fischer, H., Halbig, P., Walach B., *Liebigs Ann.*, 453, 368 (1927).

⁴ Fischer, H., Gebhardt, H., and Rothhaas, A., *Liebigs Ann.*, 458, 1 (1930).

⁵ Fischer, H., and Lautech, W., *Liebigs Ann.*, 536, 247 (1937).

Mechanism of the Glass Electrode

It is a well-known fact that new glass electrodes are not suitable for exact measurements until they have first been allowed to stand in water for some time. The continuous variation in potential observed with a new electrode may be connected with the property of the glass of taking up hydrogen ions. I have demonstrated¹ that hydrogen ions are exchanged for calcium and sodium ions in the glass electrode. The following experiments demonstrate the relation of the potential to the hydrogen ion uptake.

A series of bottles containing 2 gm. each of glass powder and 30 ml. of 0.1 *N* HCl were shaken at 25°. At different times bottles were removed and the liquid titrated with 0.1 *N* NaOH. From these data the amount of 0.1 *N* HCl (*C*₁) disappearing, equivalent to the amount of H taken up by the powder, after various lengths of time were found. The results of the titrations are given in Curve A (Fig. 1).

In order to determine whether measured potentials agree with those calculated from consideration of the chemical changes which occur, the following experiment was performed.

A spherical glass electrode was placed in each arm of a U-tube containing 30 ml. 0.1 *N* HCl and 2 mgm. glass powder in order to approximate the conditions in the experiment previously described. The inside of both electrodes and the outside of one of them had been in contact with 0.1 *N* HCl for a month, but the remaining outer surface had never been in contact with any solution. Silver wires covered with silver chloride were placed in contact with the inner liquid of both electrodes. The potentials of this system were measured periodically and the data obtained are represented by Curve B (Fig. 1).

In order to correlate the hydrogen ion uptake and the above-mentioned change in potential of new electrodes, the following assumptions have been

made. The initial hydrogen ion activity of the glass is assumed to be Pc_0 , where P is a constant, and c_0 is the number of hydrogen ions in the untreated glass per arbitrarily chosen unit of glass surface. At any time, t , after the immersion of the new electrode in hydrochloric acid, the number of hydrogen ions taken up is α , and the activity is now assumed to be equal

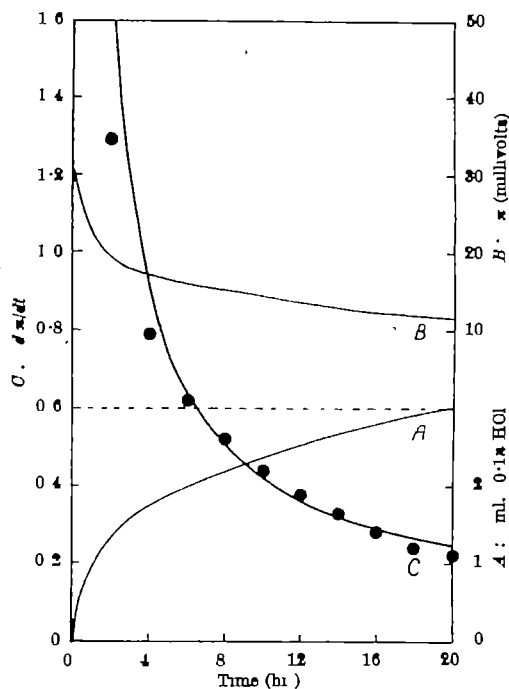


Fig. 1.

to $P(c_0 + \alpha)$. Hence the variation of potential with time of the system is, when π is measured in millivolts, given by the equation:

$$\frac{d\pi}{dt} = \frac{RT}{F} \cdot 1,000 \frac{1}{c_0 + \alpha} \frac{d\alpha}{dt}$$

The values of $d\pi/dt$ and $d\alpha/dt$ at definite times are found graphically from Curves A and B in Fig. 1. The value 2.51 was found to be an approximation for c_0 . The details of the method of determining this value will be published elsewhere. This value means that 2 gm. of glass powder at the start of the experiment has a H ion content equivalent to 2.51 ml. 0.1 *N* HCl.

In Fig. 1, Curve C was constructed from the data obtained in the glass powder experiment and the points represent the values of $d\pi/dt$ derived from potential measurements.

From these experiments it appears that the suitability of a glass as an electrode depends upon its ability to exchange sodium and calcium ions for hydrogen ions. These experiments also confirm the hypothesis of Horowitz² published in 1923. From this point of view it should be possible to produce sodium, calcium and potassium electrodes by choosing a glass of the proper composition or a mineral of the permutit type. I am carrying out further investigations of these possibilities.

Carlsberg Laboratory,
Copenhagen.
May 12.

G. HAUGAARD.

¹ *Tidsskr. Kemi og Bergvesen*, No. 4 (1937).

² *Z. Phys.*, 15, 369 (1923).

Controlled Cathode Sputtering

THE object of these experiments is to obtain accurate measurements relating to the phenomenon of cathode disintegration in gaseous discharges.

The apparatus consists essentially of a strong ion-source of the Lamar-Sameon-Compton type¹, capable of delivering 2 milliamperes of singly-charged argon ions, and of an adjacent 'sputtering chamber' maintained at about 2×10^{-4} mm. mercury pressure, where the material to be tested is sputtered and measurements relating to that process are made.

The first objective is to obtain measurements of the amount of material sputtered per unit time as a function of the ion-current density and ion-energy. As shown in the diagram (Fig. 1), the ions emerging

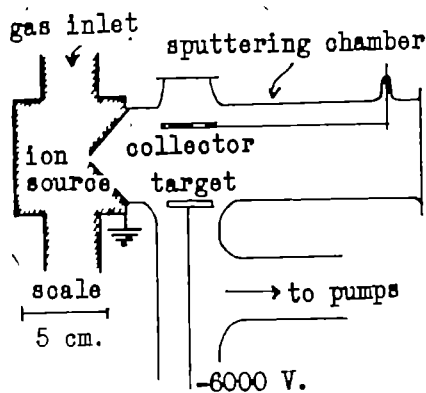


Fig. 1.

from the source (which is earthed) are allowed to impinge on and sputter a target maintained at a negative potential. Some of the material sputtered is deposited on a mica collector placed in front of the target, and supported by a horizontal fine quartz fibre. The weight of the deposit collected (a few milligrams) can readily be determined by observing the deflection of the fibre by means of a microscope. This allows measurement of the relative rates of sputtering. The total amount of material sputtered can be computed in cases where the law of angular distribution of sputtered deposit over a sphere is known².

The rate of sputtering of gold by argon ions of 6,000 volt energy has been determined. The sputtering rate is sufficient to deposit measurable amounts in $3\frac{1}{2}$ hours. With decreasing ion energy the rate of deposition decreases, and for ions of 2,000 volt energy, about 10 hours would be required to deposit a measurable amount. This is the maximum period over which the apparatus has been operated steadily. Because of the complicated nature of the apparatus, it seems impracticable to extend the time of the test. Therefore to obtain the rates of sputtering at lower voltages a construction of the sputtering chamber has been achieved, which still allows weight determinations, and in addition permits light transmissivity measurements of sputtered deposits.

The determination of the rate of sputtering of a given substance is complicated in some instances by a copious secondary electron emission from the bombarded target. Thus the apparatus is used at present in a somewhat modified arrangement for study of

this secondary electron emission from solid metals bombarded by argon ions.

GREGORY TIMOSHENKO.

Department of Electrical Engineering,
Massachusetts Institute of Technology.

April 20.

¹ *Phys. Rev.*, **43**, 886 (1935).

² Seebiger and Sommermeyer, *Z. Phys.*, **83**, 602 (1935).

X-Ray Intensifying Screens adapted to Structure Analysis

THE intensifying screens in use for medical radiography cannot be employed to reduce times of exposure when working on tissue fibres, as they are not sensitive to the radiation used in structure analysis. However, Messrs. Ilford, Ltd., London, have now produced a screen, the Ilford Fluoraxure intensifying screen (Levy-West), which proves to be very suitable for this purpose; this screen was put at our disposal by Mr. Chr. J. Bruno Wittgreffe, of the X-Ray Section, Ilford Co., to whom our best thanks are due for this kindness.

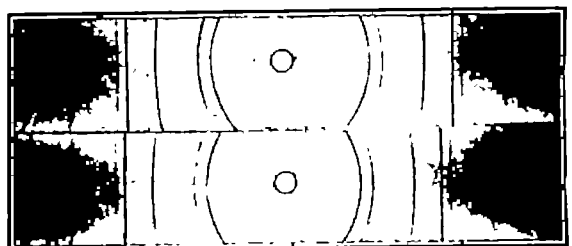


Fig. 1.

X-RAY PHOTOGRAPH OF A COPPER WIRE, TAKEN AT 40 kV. (a) ILFORD FILM WITHOUT SCREEN; EXPOSURE 45 MIN. (b) ILFORD FILM WITH A FLUORAXURE SCREEN AT THE BACK; EXPOSURE 15 MIN.

While we expected that increase of line width would counteract the advantages from eventual intensifying to such an extent that the photographs obtained would only be suitable for approximate work and not for exact measurements, we were quite astonished to find not only actual intensifying (3 times at 40 kV.) but moreover practically no increase of width, which seems a very important feature in the new screen. As appears from the photographs reproduced herewith (Fig. 1), it has proved possible to obtain films suitable for exact measurements. The photographs were taken with a Philips Metalix tube with copper-anticathode and a nickel filter of 0.01 mm. The Debye-Scherrer camera had a radius of 2.77 cm., while the diaphragm consisted of two pinholes 0.5 mm. diameter, separated by 6 cm. A copper wire of 0.6 mm. diameter was taken as a sample. Unless otherwise stated, the photographs were taken at 40 kV. and 15.5 mamp.

First a photograph was taken on an Agfa-Laue film, the usual material for structure analysis. Proper blackening was obtained after 75 min. exposure. Then the experiment was repeated using an Ilford film. To get the same blackening as in the former case, an exposure of 45 min. proved to be necessary. The grain of the Ilford film is slightly coarser, but still within admissible limits (see Fig. 1, a). Thirdly,

we made a photograph on an Ilford film on the back of which a Fluorazure screen (Levy-West) was placed (Fig. 1, b). Identical results were now obtained with exposure reduced to 15 min., while there appeared to be practically no increase of width.

While at the ends of Fig. 1, a, the subdivision into α_1 and α_2 lines is fairly visible, Fig. 1, b still gives some slight evidence of their presence.

Other experiments were made at 30 kV. with an Ilford film at the back of which was a Fluorazure screen; the exposure was 15 min. While giving better contrast, blackening proves to be less; so that here the disadvantage seems to outweigh the advantage.

As usual in medical radiology, we also placed screens in front of and at the back of the film, but this gave, as might be expected, less blackening in the same time than with a screen at the back only; moreover, increase of width becomes manifest in that case.

We suggest that the use of Fluorazure screens is helpful in structure analysis; especially with the long exposure necessary in fibre research, it has evident advantages. Meanwhile, further research is being conducted along these lines.

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X-Ray Department,
Van 't Hoff Laboratory,

Histological Laboratory,
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April 14.

C. J. KROM.

H. KUNST.

Living Animal Cases of Congenital Porphyrinuria

SOME time ago, in a single herd of grade short-horn cattle, running with one bull, on a farm in Swaziland, five living cases of congenital porphyrinuria were discovered. From the account given by the farmer, there had been seven other cases in the herd. Only one bull (a pure-bred, roan shorthorn)

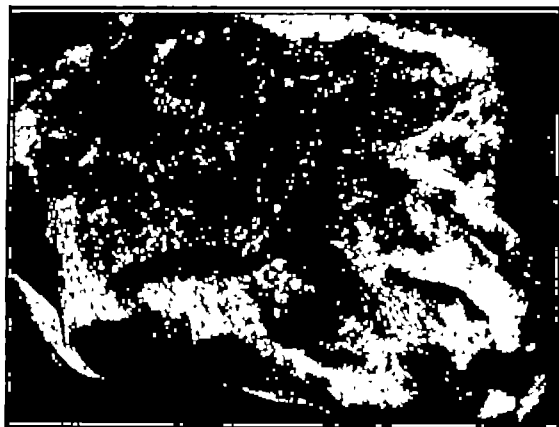


Fig. 1.

PHOTOSENSITIZATION LESIONS ON BACK OF 'ORDARA',
A COW SUFFERING FROM CONGENITAL PORPHYRINURIA.

had been used during this period, and on an adjoining farm where he had also been employed, one case had occurred with certainty. The bull himself is normal but his dam was said to have been an unthrifty animal; possibly she, also, may have been a porphyrinuric.

The bull, four of the affected cattle and others, most of which are descended from him but normal, have been acquired by this Laboratory with a view to intensive study of the clinical features of the disease and its mode of inheritance. The fifth affected animal was slaughtered and a detailed chemical investigation carried out *post mortem*. In the forthcoming number of the *Onderstepoort Journal of Veterinary Science* (7, No. 2) papers are contributed by the writers of this note describing in full their findings. The two most severely affected animals each excrete about 0.6 gm. coproporphyrin and 0.06-0.07 gm. uroporphyrin daily, the others about half these quantities only. They show signs of photosensitization.

We also wish to record that a female calf which suffers from the disease has now been born at the Laboratory. It was the progeny of the bull with one of his normal daughters. The animal was seen approximately two hours after its birth, and the teeth were then distinctly pinkish-brown in colour. It is red-coated and although small is not apparently seriously handicapped in any way. It passes about 7.7 mgm. coproporphyrin per 100 gm. dry weight of faeces and about 40 γ per 100 ml. in the urine. A second heifer calf, born on the same day, sired by the bull out of another normal daughter, is perfectly normal in every respect. It excretes 0.41 γ coproporphyrin per 100 ml. of urine and but traces, only recognizable fluoriscopically, in the faeces.

Yet another case has recently been discovered, quite unrelated to the herd described above. This is a black-and-white cow about eight years of age. She shows marked lesions of photosensitization, involving only the white areas of skin on the back (see Fig. 1). This cow is in calf to a normal bull. She has reared one calf previously (apparently normal) but has also aborted.

A histopathological study of the bones and organs taken from the porphyrinuric animal which was killed is being made with the aid of an ultra-violet fluorescence microscope, and these findings will be published shortly. The bones, it may be mentioned, show on cross-section annular zones of pigment of varying intensity.

We believe these to be the first living cases of porphyrinuria in animals ever to be described, and the wealth of our material makes it highly probable that by breeding experiments we may be able successfully to elucidate the mechanism of inheritance of this very rare metabolic anomaly.

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CLAUDE REMINGTON.

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May 4.

Sex-Biology of the Oyster and the Salmon

THERE are similarities in the sex-biology of the oyster, *O. edulis*, and the salmon, *Salmo salar*, which may prove to be fundamental in character.

It is known that very young salmon remain in fresh-water as parr a variable time. Very rapid growth in the first year of life is often followed by development of the sea-migratory instinct, when the young fish acquires the attributes of, and departs for the sea as, a smolt. On the other hand, slow-growing parr may remain in fresh-water two, three or four years¹.

Just as certain smolts become sexually mature after one year in the sea and return as grilse to fresh-water to spawn, so in certain warm seasons in England, and more frequently in warmer and more southerly latitudes, do oysters mature as females at an age of one year¹. Other individuals of *Salmo salar* and others of *O. edulis* do not mature sexually until they are older, or rather other *O. edulis* certainly do not mature as females until they are older. In the case of this oyster there can be little doubt that environmental conditions govern the first onset of female sexual maturity, and it is considered a reasonable hypothesis to assume that the same conditions are operating on salmon.

In the oyster, all the factors operating in the attainment of sexual maturity at an age of one year are not known, but relatively high temperature (accompanied doubtless by a correlated type of metabolism), rapid feeding and rapid growth are known factors. But rapid feeding and growth result in the sea-migratory impulse in parr, and there are indications that the same factors may be operating in inducing sexual maturity in certain salmon after one year in the sea. It is known, however, that grilse are largely those fish which have had a long life as parr, and it is at this point where 'excess metabolism' or 'physiological reptition' does not quite account for the assumption of the sexual phase, as there appear to be good grounds for the deduction that younger fish may grow at a greater rate than grilse and yet not return to fresh-water to spawn. At least two primary factors are therefore involved: (1) relative adolescence and (2) rate—and perhaps nature—of metabolism.

The attainment of the adult organization in free-living animals may be presumed to be generally essential for the assumption of a preparation for female sexual maturity. In the oyster, again, it is stated that sexual maturity in a female may be delayed in colder localities until the animal is three years old², although the oysters at this age may be far bigger than the one-year-old females found in the warmer hydrographical localities.

It would seem that in these considerations may be found a solution of the problem of the varying ages of sexual maturity in the salmon and the oyster. Among invertebrates, growth in spring may be relatively great before larvae are produced and a much larger size attained than in the summer broods³, hence the temperature and rate at which good feeding occurs in these forms is more important for breeding than the amount of food consumed, and good growth may take place without the production of genital products. The oyster appears to conform to the same principle, but whether the same holds for the salmon must await further information. There is, however, nothing at variance with known biological phenomena in the possibility of homogenetic eggs from one salmon giving rise to smolts of different ages and also to either grilse or first spawning salmon of different ages.

The interesting facts regarding the high proportion of males among grilse, the change in proportion of grilse and salmon and the decline of grilse taken generally, are explicable on the varying opportunities smolt may have of feeding under different conditions in the sea. Loss of feeding grounds, for example, would entail a longer sojourn in the sea to build up the body requirements, so that the decline of hake, for example, might be correlated with the reduction in the proportion of grilse now taken; and in general,

unknown fluctuations of salmon food in the sea may be related to fluctuations in the sea-life of smolts.

Fundamental researches on the biology of insignificant invertebrates may therefore reveal principles applicable to important food fishes such as salmon and—by a modification of the argument given above—also to herring.

J. H. ORTON.

Department of Zoology,
University, Liverpool,
June 4.

¹ Menzies, W. J. M., "The Salmon: its Life Story" (1931).

² Orton, J. H., NATURE, 139, 108 (Jan. 16, 1937).

³ Späček, B., Report Danish Biol. Station, 30 (1924).

⁴ Orton, J. H., J. Mar. Biol. Assoc., 18, No. 2, 359-366 (July 1933).

Nocturnal Habits of *Platyedra gossypiella* Saunders

In the course of investigational work on *Platyedra gossypiella*, the pink bollworm of cotton, in the West Indies, observations were made on its nocturnal habits, concerning which but little is known. On the question of light attraction, for example, there has been a stalemate of opinions. Wilcocks¹ in Egypt found that both sexes came to light readily; while Busck² in Hawaii states that the moth is not attracted to light "but is on the contrary shy of all light, natural and artificial". "The idea", he writes, "that moths were attracted to light is based on very un-

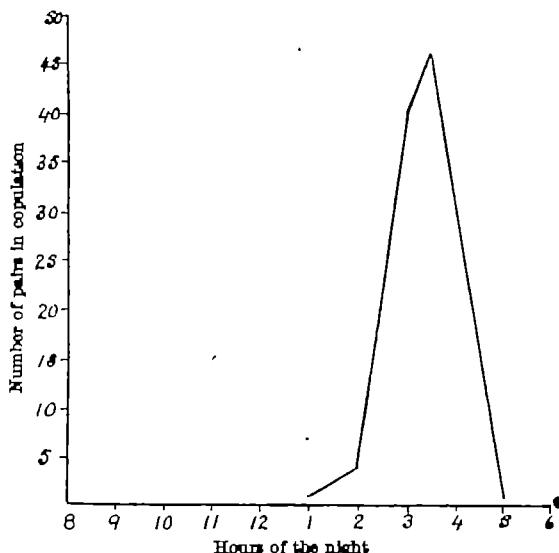


Fig. 1

satisfactory evidence and is probably due to a misidentification of material collected in the traps³. In St. Vincent, B.W.I., light attraction is evident from 8 p.m. to 4 a.m., when it falls rapidly. By 5 a.m., though it is still dark, the moths are hiding as by day. In Egypt, Ballou⁴ found that there were always some moths that were not attracted. This difference has also been observed in St. Vincent and is not due to age, sex or condition. Attraction is strongest during the mating period. Wedded pairs are readily attracted, but in all cases prolonged exposure tires the response. There is no noticeable difference between the behaviour of long- and short-cycle moths.

Copulating moths take up the end-to-end position. Mating is curiously restricted to the last two hours of the active period (Fig. 1). The couples are docile

and do not readily separate. Copulation takes place soon after emergence (Fig. 2), lasts for 1-2 hours, and is not repeated.

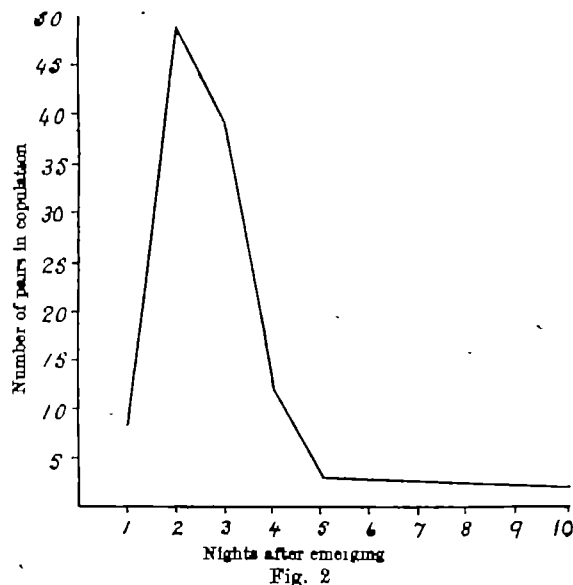


Fig. 2

The moths feed at all hours of the active period on sugar solution, fruit or on the secretion of the nectaries at the base of the cotton bolls. Oviposition, which usually commences on the third day after copulation, likewise takes place at any time of the night.

F. A. SQUIRE.

Imperial College of Tropical Agriculture,
St. Augustine, Trinidad, B.W.I.

¹ Wilcocks, F. C., "The Insect and Related Pests of Egypt Injurious to the Cotton Plant", Ministry of Agriculture, Egypt (1916).

² Busck, "The Pink Bollworm (*Pectinophora gossypiella*)", *J. Agric. Res.*, 9, No. 10 (1917).

³ Ballou, H. A., "Cotton and the Pink Bollworm in Egypt", *West Indian Bull.*, 17, No. 4.

A Double Refraction Effect in Certain Fatty Materials

THE projection refractometer is particularly suitable for the examination of some doubly refracting materials, the properties of which do not appear to be widely known.

Certain fatty materials the refractive indexes of which are known have, in fact, two refractive indexes. On the ordinary refractometer in which the light is transmitted through the material to be tested, the border line of total reflection due to the higher index is not usually seen, since there is much greater contrast at the border line due to the lower index. The space between the two border lines is plane polarized, the vibrations taking place in a direction parallel to the border lines. Thus, these materials appear to behave as though they were doubly refracting.

It has been known for some years that soap gives these two border lines under certain conditions. Recently some other materials were investigated, and it was found that

vaseline, lanoline; rubber lubricant, ordinary yellow soap, and the pure green soft soap, all give the two border lines referred to. On the other hand, various thick lubricants give only one border line.

It was found that vaseline, lanoline and the rubber lubricant, if melted and dripped on to the refractometer prism, give only one border line, that due to the lower index; but if the material is then smeared while it is still upon the prism, thus removing any possibility of micro-crystals being orientated in a particular direction, the second border line appears, and in the case of lanoline treated in this way, there is a trace of a third border line. In the case of moistened yellow soap, the difference in refractive index is about 50 per cent greater than the difference between the ordinary and extraordinary rays of quartz.

The projection refractometer has a single horizontal prism surface upon which material is placed. Light from an internal source is totally reflected at the interface of the prism and the material being tested. None of the materials mentioned above gives a sufficiently sharp border line to allow of readings closer than the third decimal place.

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Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop

It has been found that the oil drops used in our investigation on the determination of the electronic charge show large variations in the time of descent, t_p , and ascent, t_r , with time, and consequently the greatest common divisor e_1 . This is true of all oils experimented with, such as Apison A and B, Nye's superfine clock oil and others, except our newly prepared animal oil (which shows little or no change). Nevertheless, it makes necessary the careful study of the time variations of these three quantities. The results may be stated as follows:

There are four distinct classes of drops.

(1) 50 per cent of the total number are spherical drops which behave normally.

(2) With a few drops, collision of two unequal spheres forms a pear shape drop, showing very large

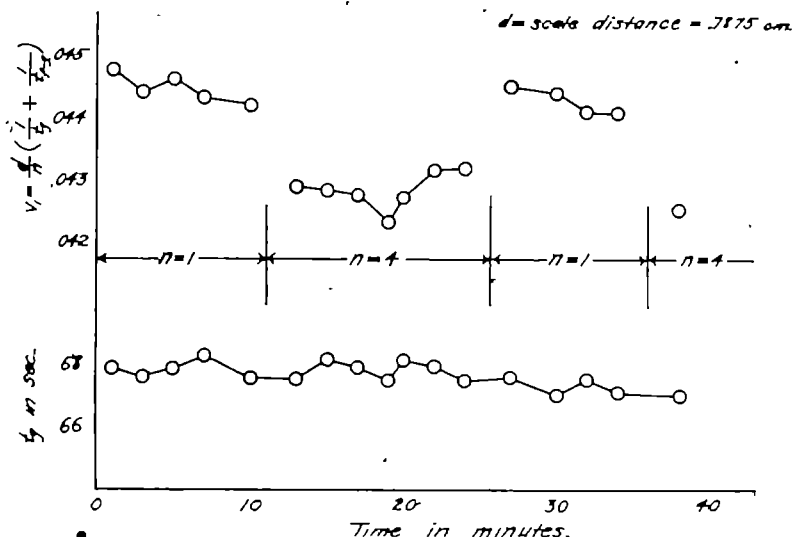


Fig. 1.

discontinuities in the curves. The resulting drop becomes a sphere within a short time.

(3) For 20 per cent of the drops t_f and t_{f-s} increase for the first five minutes at the same percentage rate. These drops are found to be oblate spheroids with eccentricity gradually decreasing with time, and becoming spheres.

(4) For 30 per cent of the drops, as shown in Fig. 1, while the time variation curve of t_f is very regular, that of the greatest common divisor τ_1

shows discontinuities which depend upon the number of charges on the drop, and the greater the number the smaller the common divisor. This class of drop is stable for hours. They are presumably prolate spheroids.

YOSHIO ISHIDA.

Institute of Physical
and Chemical Research,
Tokyo.
May 15.

Points from Foregoing Letters

THE heat conductivity of liquid helium II at 1.34° and 2.06° K. has been measured by Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, by means of a new method consisting essentially of a combination of a vapour-pressure thermometer with a liquid-helium manometer. The results show that the heat conductivity of liquid helium II depends upon the temperature gradient, an unusual behaviour for which, the authors state, they can offer no explanation.

A convenient method of analysing ternary gas mixtures, containing hydrogen as one component, by means of thermal conductivity measurements, is described by J. L. Bolland and Dr. H. W. Melville. The volume of gas required may be reduced to 0.01 c.c. at N.T.P., by using a suitable micro-conductivity cell.

Photographs showing slip-formation in crystals of salt the surfaces of which have been scratched and then stretched, are submitted by A. W. Stepanow. The photographs, taken in polarized light, show that the surface scratches give rise to slips; these in turn increase the surface defect, which ends in fracture.

From the effect of iodoacetate, phloridzin and arsenate upon the lactic acid formation in muscle extract, Dr. Dorothy M. Needham and R. K. Pillai deduce that the oxidation-reduction of triosephosphate with pyruvic acid is coupled with a synthesis of adenylypyrophosphate from adenylic acid and free phosphate. They suggest that this coupled esterification of phosphate may play an important part during the anaerobic recovery period in the muscle, when there is little heat output. The energy developed by the first reaction, they consider, may be taken up by the second.

A substance with absorption band at 639 m μ , which Dr. R. Lemberg, B. Cortis-Jones and M. Norrie recently deemed to be a hydrogen-peroxide compound of proto-haemochromogen, appears, according to further tests by the same authors, to be the ferric haemochromogen of an oxyporphyrin carrying a hydroxyl group on the α -methene group.

A graph showing the amount of hydrochloric acid taken up by powdered glass after given periods of time, and another giving the change in electric potential of a new glass electrode with time, are submitted by G. Haugaard. From these, the author infers that the suitability of a glass as an electrode depends upon its ability to exchange sodium and calcium ions for hydrogen ions, and that it should be possible to produce sodium and calcium electrodes by choosing a glass of proper composition or a mineral of the permutit type.

An apparatus has been built at the Massachusetts Institute of Technology by Dr. Gregory Timoshenko for studying controlled sputtering of metals under the impact of positive ions. The apparatus in its present form allows accurate measurements of the rates of sputtering and of secondary electron emission from various solid metals bombarded by argon ions having an energy of 8,000–2,000 volts.

Photographs are submitted by Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst to show the usefulness of the Ilford 'Fluorasure' screen in shortening the exposure time needed to obtain X-ray photographic patterns of fibres for the analysis of their structure.

Several cases of animals suffering from congenital porphyrinuria, a rare disease in which porphyrin (a red decomposition product of haematin, but containing no iron) is excreted, are described by P. J. Fourie and Dr. Claude Rimington. Some of the animals are living, and the authors hope, by means of breeding experiments, to elucidate the mechanism of this peculiar metabolic anomaly, which also renders the skin of the animals sensitive to light.

Prof. J. H. Orton finds that, in the oyster, environmental conditions (that is, higher temperature, rapid feeding and rapid growth) influence the first onset of female sexual maturity. He points out that similar conditions result in the sea-migratory impulse in parr (young salmon in fresh-water). The sexual maturity in salmon, which induces them to return from the sea to fresh-water, appears to depend both upon age and size, which is a factor of environment. This may explain the varying ages of sexual maturity in the salmon and the oyster.

The nocturnal mating habits of the pink bollworm of cotton (*Platyedra gossypiella*) are described by F. A. Squire. The author points out that the moths are attracted by light only during certain hours of the night, which may account for the divergence of opinion expressed on the subject by different observers.

L. Bellingham finds that vaseline, lanoline, rubber lubricant, and certain soaps, have two refractive indexes when tested by the projection refractometer. If melted and dripped on the refractometer prism, the lower index is observed, but if smeared upon the prism so as to prevent orientation, the higher index becomes effective.

During experiments on the fall of electrified oil drops (for the determination of the electronic charge), Y. Ishida has identified four types of drops, according to their shape and the variation in the time of their fall.

Research Items

Prehistoric Archaeology of North-Eastern New Mexico

PROF. E. B. RENAUD, in his ninth report on the archaeological survey of the High Western Plains, which he is carrying out on behalf of the University of Denver, deals with the north-eastern area of New Mexico, which has been visited in summer field-work on various occasions since 1930. For archaeological purposes, the region has been divided into six districts covering the three areas of drainage—the Dry Cimmaron, the Canadian River, and the Pecos River. The region as a whole contains a large number of archaeological sites, of which 211 have been reported. Of these, the most common is the camp site, but other indications of the presence of man are tipi rings, grinding stones, potsherds and factory sites. No less than 86 camp sites have been recorded. 'Scattered finds' number 67. An important but difficult source of material is the 'blow-out'—hollows in sandy soils and dunes caused by various agencies, natural and other, at the bottom of which archaeological and sometimes paleontological material has collected. The region is of archaeological importance as the peripheral area of two cultures, the Plains culture and the Pueblo. This is reflected in the pottery, which has been examined, classified and discussed in detail. The distinctive character of the two types and their subdivisions are clearly shown. The lithic industry, however, in this area is of more importance than the ceramic. Two successive cultural phases are distinguished—the Basket-makers and the Pueblo. Of the former, the earliest phase is the 'Fumarole' culture, first discovered by Prof. Renaud and Mr. H. J. Cook. The 'fumaroles' or mounds then examined were found to cover rock shelters. The stone implements from the 'fumaroles' fall into three classes. Of these, the largest and most important, constituting the true 'fumarole' industry, is of quartzite, flaked by percussion and Mousterian in appearance. This 'Fumarole' culture is clearly anterior to the Basket-makers of the caves of Oklahoma and New Mexico, and may represent the nomads who are postulated as preceding the true Basket-makers.

Longevity of Monkeys

Two aged macaques are described by Prof. W. C. Osman Hill, both of which lived in Ceylon (*Spolia Zeylanica*, 20, Pt. 2, 255; 1937). One, a male toque macaque, *Macaca sinica*, was an experimental specimen of the Government Bacteriological Institute, Colombo, and had been used by Sir Aldo Castellani in his experiments on yaws which were published in 1907. It died on March 2, 1936, when it was known to be at least thirty years of age, and was probably thirty-five. Thus it exceeded the recorded age of any of its congeners, although the macaques are outstanding amongst monkeys on account of their length of life. The second specimen, a male Celebesian black macaque, *Macaca nigra*, was full-grown when purchased for the Trivandrum Zoo on June 15, 1907. It died in 1933 after twenty-six years of captivity, and must have been several years older. Flower states that the black ape seldom lives more than ten years in captivity; but gives two unusual examples of survival to fourteen and eighteen years—a limit considerably exceeded by the Trivandrum specimen.

Cheek Bones of Teleostomes

TAKING the sensory organs of the lateral line as a criterion, T. S. Westoll (*J. Anat.*, 71, Pt. 3; 1937) has endeavoured to clear up the confusion that exists in regard to certain of the cheek bones in teleostome fishes. In recent years, it has been shown that the bone in the most primitive tetrapods which is homologous with the mammalian squamosal is associated with the horizontal part of the jugal canal. This provides a starting-point from which to work backwards to the fish. It is found that in the Choanata generally, allowing for modifications resulting from the adoption of different feeding habits, a squamosal bone can be recognized to be lost perhaps only in certain late dipnoans. On the other hand, in all known Actinopterygii the canal has degenerated, and in consequence the squamosal bone has disappeared.

Decapod Crustacea of Japan

A ZOOGEOGRAPHICAL survey of the decapod Crustacea of the Seas of Okhotsk and Japan carried out by Z. I. Kobjakova shows that in both areas boreal forms predominate to the extent of up to seventy per cent of all the decapod species occurring in the seas (*Trav. Soc. Nat. Leningrad*, 65, 185; 1936). Next in order follow the arctic-boreal forms, followed by subtropical, and the poorest representation, particularly in the Japanese Sea, is of true arctic species. In this Sea there is no abyssal fauna, because of the shallowness of the straits, and the history of the Sea, which to the close of the Pliocene was an inland sea separated from the Pacific by a strip of land, is also that of a shallow basin the floor of which has sunk up to 4,000 metres only in recent times. The isolation from the Pacific accounts for the large number of endemic forms (21 per cent of *Macrura*), for the smaller number of Pacific forms, and partly for the influx in relatively large numbers (12.3 per cent) of typical southern sub-tropical and even tropical forms. The decapod fauna of the Japan Sea is richer (113 species) than that of the Sea of Okhotsk (81 species), but in the latter there is a true abyssal fauna derived from the Pacific Ocean; on the other hand, southern sub-tropical representatives are much fewer in number.

The Millipedes of India

No. 4 of vol. 11 of the *Memoirs of the Indian Museum* (1936) consists of a long memoir by Dr. C. Attems of Vienna on the Indian Diplopoda. Under the term "India" are included the whole of the Indian Peninsula, Ceylon, Burma, Indo-Chinese countries and China, excepting the Malay Peninsula. The author states that systematic and faunistic knowledge of the Indian Diplopoda is still very incomplete, and in fact we are only at the beginning of a faunistic explanation. In the present paper, 62 new species and 15 new genera are described. The most characteristic feature of this fauna is the great number of Sphaerotheridæ present, all the genera, excepting *Zephronia*, being endemic. Altogether, 290 species and subspecies of Diplopoda are known from the region dealt with and, excepting five, they are all endemic. Of the 92 Indian genera, 64, or nearly 70 per cent, are endemic. Only South India can be

regarded as at all properly explored with reference to these animals, while China, with only 21 known species of Diplopoda, is least explored of all. Dr. Attems's contribution is likely to remain as the basis for the study of the oriental Diplopoda for many years and is, consequently, a work of importance to all students and workers on that class of myriapods.

Classification in the Amaryllidaceae

THE four genera of the Amaryllidaceae, *Zephyranthes*, *Pyrolirion*, *Hippeastrum* and *Habranthus* have been encumbered with a confused taxonomy for the last fifty years. Their numerous species have made an ever-increasing contribution to garden beauty, and it is therefore most fortunate that Mr. J. R. Sealy has recently reduced their classification to order (*J. Roy. Hort. Soc.*, 62, Pt. 5; May 1937). Characters of the spathe, the androecium and the gynoecium, have confirmed Dean Herbert's original descriptions of the four genera in 1821, and discount more recent tendencies to include them in two groups. The outlook of the paper is that of a 'splitter', but the descriptions now given are exact and clearly defined. They should effect the exact correlation of the name of a plant species with its degree of beauty or utility, which is the necessary contribution of taxonomy to horticulture.

Rust-Resistant Antirrhinum

THE severe attack of antirrhinum plants by the rust-fungus *Puccinia antirrhini* in 1934, turned the attention of gardeners to possible methods of control. Mr. D. E. Green has shown that the fungus cannot reasonably be kept in check by fungicides, and he has recently described his trials with resistant plants (*J. Roy. Hort. Soc.*, 62, Pt. 5; May 1937). A number of strains of the antirrhinum of American origin have been found to possess varying capacities for resisting attack by the rust fungus. The best of them is 62 per cent resistant; but resistance is not as yet combined with horticultural excellence. The attainment of such a combination presents the urgent problem of the future.

Gold in Plant Ash

AN announcement was made some time ago B. Němec, *Ber. deutsch. bot. Gesell.*, 53, 560; 1935) that traces of gold had been found in the ash of *Sea Mays* grains from plants grown in the Žitný ostrov (the so-called Rye Island between the arms of the Danube in south Slovakia). Danube sand from this district is known to contain gold (about 0.1 gm. per ton) and plants are able to accumulate it. According to analyses, the metal concentrates in the seeds and fruit of flowering plants, whilst the whole plant of *Equisetum palustre* is found to accumulate gold to the extent of 610 gm. per ton of ash. It is found that the gold content is related to the silica content of the ash. Among the ashes examined the following percentages of gold were recorded:

<i>Sea Mays</i> (fruit)	0.00015-0.0002
<i>Urtica dioica</i> (plant)	0.00168
<i>Datura Stramonium</i> (fruit)	0.00202
<i>Helianthus annuus</i>	—
<i>Monarda arvensis</i>	0.030
<i>Chenopodium vulgare</i> (stem)	0.011
" (fruit)	0.06
<i>Salix caprea</i> (wood)	traces

Plants grown at other places where gold has been found were also found to contain recognizable amounts of the metal in the ash, but none was found in the

same species grown where gold was known to be absent. The metal was first detected by its reaction with dimethylamino-benzylidene thiocyanate, and later some of it was actually isolated by reduction and fusion into an ingot. Prof. Němec, in collaboration with Drs. J. Babička and I. Smoler, on February 27, read before the Czech Academy of Sciences a paper on the spectroscopic identification of gold in these plant ashes and gave further chemical evidence of the accumulation of the metal in the ashes of many plants growing in auriferous soils. The spectrograms are said to confirm the presence of gold in those plants in which the metal was detected by chemical means.

Geological Aspects of Deep Drilling Problems

THERE are three main differences between drilling a deep well and an ordinary well to a depth of only two or three thousand feet: in a deep well, the distance between points of development and application of mechanical power is increased, and temperatures encountered are higher and pressures greater. W. E. V. Abraham, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, considered the geological aspect of these three differences. The increased length of transmission shaft is on the whole an engineering problem, though geological forecasts as to depths at which particular horizons will be met are correspondingly less certain at greater depths; the strata drilled through are liable to be harder, tougher and more compact, and coring is a more difficult operation at depth. A point of interest to the geologist is that the depth/temperature gradient varies in different places depending on the nature of the strata encountered, that is, whether folded, synclinal or anticlinal. Sufficient data are not, however, available for the formulation of any theory of temperature/gradient variation. Other problems resultant upon increased temperature are concerned chiefly with cementation and mud control, and do not therefore come within the purview of the geologist. Increased pressure with depth, however, concerns the geologist vitally, and the problem is no simple one, since it has been proved that as a general rule fluid pressures do not increase in accordance with the corresponding hydrostatic head, but in some cases, after a certain depth has been reached, are more than twice the corresponding hydrostatic head. Several theories have been advanced to account for abnormal pressures encountered at depth, all of which are based on the assumption that free movement of the fluid is in some way prevented, with the result that high pressures are incapable of dissipation. The most probable cause of such abnormal pressures seems, on the evidence now available, to be the weight of overlying strata.

Hydrography of the River Severn

THE flow of the River Severn during the fifteen years 1921-1936 was the subject of a paper read before the Institution of Civil Engineers on April 20 by Prof. S. M. Dixon, Mr. G. Fitzgibbon and Dr. M. A. Hogan and now published. The Severn was selected for the purpose of flow investigation because it was the only large river free from artificial controls and river traffic within convenient distance from London. The portion of the Severn Valley dealt with lies above Bewdley and has an area of 1,632 sq. miles. The present course of the river seems to be the result of glacial action, and there are indications

that the pre-glacial valley ran northwards and is now covered by drift. It seems possible that a considerable quantity of water may be lost to the river by percolation along the direction of its old channel, particularly at low stages of flow. After discussing the selection of gauging stations, the methods of discharge-measurements and their accuracy, the paper (as reported in the *Journal of the Institution of Civil Engineers*, No. 7, 1936-37, June 1937) gives the results in graph form of 59 discharge measurements carried out during the years 1925-32 and one flood discharge in 1922. The largest discharge, 17,400 cusecs, was measured at the Elan Aqueduct bridge on December 11, 1929. Daily discharges for each of the fifteen years covered by the records have been plotted as hydrographs, of which five selected examples have been filed in the Institution library. Hydrographs of two floods (May 31-June 1, 1924 and February 16-22, 1928) are reproduced in the *Journal*. The difference between the average annual rainfall and the run-off (for the year commencing October 1) is 19.24 inches, or slightly more than half the rainfall. The largest loss, 23.80 inches, was in the year 1926-27, which had a high rainfall fairly evenly distributed throughout the year. The smallest loss was 18.63 inches in 1932-33, a year of low rainfall.

Borine Carbonyl

As is known, the simple hydride of boron, BH_3 (borine), has not been obtained, the simplest known hydride being diborane, B_2H_6 . A. B. Burg and H. I. Schlesinger (*J. Amer. Chem. Soc.*, 59, 780; 1937) find that a gaseous compound BH_3CO , which they call borine carbonyl, is obtained by the interaction of B_2H_6 with carbon monoxide in great excess and under pressure. The reaction reaches equilibrium rapidly at 100° ; at room temperature the reaction is slow enough to permit the isolation of the product: $B_2H_6 + 2CO \rightleftharpoons 2BH_3CO$. The formula was checked by the vapour density. The rate of decomposition is held to suggest the transitory existence of molecules of borine, BH_3 , but the isolation of the latter is not feasible. With ammonia, borine carbonyl forms a solid, stable at room temperature, having the empirical formula $BH_3CO(NH_3)_2$. Trimethylamine, on the other hand, rapidly and completely displaces carbon monoxide from the carbonyl at room temperature according to the equation $BH_3CO + (CH_3)_3N = (CH_3)_3NBH_3 + CO$, which is held to justify the conclusion that the reaction $BH_3CO \rightleftharpoons BH_3 + CO$ is far more rapid than the association of borine to form diborane. It is suggested that in borine carbonyl the borine and carbon monoxide are joined by a co-ordinate link consisting of electrons furnished by the carbon monoxide. The compound $(CH_3)_3NBH_3$ is remarkably stable and can be heated for some hours at 125° without showing any change in physical properties.

Response of the Ear to a Phase Reversal

C. S. HALLPIKE, H. Hartridge and A. F. Rawdon-Smith (*Proc. Phys. Soc.*, 49, 190) have studied the response of the mammalian ear to a sudden phase reversal in a sustained tone of sinusoidal wave-form. The tone was obtained from a photo-electric cell siren feeding an amplifier and loud-speaker, and an investigation with a piezo-electric microphone and cathode ray oscillograph showed that the phase reversal was present in the output from the loud-speaker. The effect of the phase reversal on a listener was that of a sudden temporary depression of the

sound intensity, sometimes accompanied by a tap or thud. The tone was then led to the ear of a decerebrate cat, and electrodes were applied to the auditory tract. The electrical disturbances were amplified and recorded. The record shows, instead of the phase-change, a temporary fall in response, which indicates that the aural elements in which these auditory tract potentials originate must be regarded as resonant structures. The electrical potentials obtained from electrodes on the cochlea were, however, similar to those from the microphone, and showed the phase change. It appears that the cochlear response originates in structures different from those responsible for the auditory tract response.

Separation of the Rare Earths

THE difficult problem of the separation of the rare earths has recently been attacked by a different method, employing the principle of distribution. Fischer, Dietz, and Jüßermann (*Naturwiss.*, 25, 348; 1937) have found that it is possible to select liquids between which compounds of the rare earths will distribute themselves, and for pairs of which the distribution coefficients of the various rare earth elements are sufficiently different to enable a separation to be made. Thus, the halides of the rare earths will distribute themselves between water and organic liquids such as alcohols, ethers, and ketones, and the distribution coefficient is different for the compounds of different elements. By the addition of other substances to the system it is possible to alter the degree of separation. The difference in the distribution coefficient of the halides of two rare earth elements differing by unity in atomic number may be as great as 50 per cent, if suitable solvents and added substances are chosen. Automatic distribution fractionating apparatus may be employed, resulting in a much more rapid separation of the rare earths than can be accomplished by the tedious methods of fractional crystallization and precipitation.

A New Harmonic Analyser

THE problem of harmonic analysis arises in many connexions, and the labour of the arithmetical methods is such that several attempts to devise machines for the evaluation of Fourier coefficients have been made. An essential element of them all is, of course, some form of mechanical integrator. Henrici built several models, of which the last enables ten coefficients to be obtained in one operation, from a curve which is followed by a tracing point. A purely electrical instrument has been developed by Prof. Miles Walker and his collaborators which enables harmonics of a voltage or current wave to be separately determined; the integrator in this instrument is a watt-meter. A new instrument, designed by Mr. J. Harvey, of the Imperial College, made by Amslar, and of which an example has recently been added to the mathematical collection in the Science Museum, uses as the integrating device an ordinary planimeter wheel. The various harmonics are determined separately, each order by means of a separate, interchangeable pinion. Harvey's original model went only to the sixth order, but Messrs. Amslar, by added gearing, and without alteration of principle, have extended this number to ten (21 coefficients). With this instrument, results to an accuracy within 1 per cent can be obtained. The instrument can also be used to find areas and their first and second moments.

Development in International Geodesy*

By Dr. J. de Graaff Hunter, C.I.E., F.R.S.

THE increase in the scope of geodetic work accomplished in recent years and planned for the early future is remarkable. The fundamental problem of geodesy is the precise determination of the shape and dimensions of the earth, or what may be described otherwise either as the figure of the earth or the form of the geoid. When this is fully solved, benefits will accrue to geophysics as well as to geodesy.

In the nineteenth century, Colonel Clarke derived values of the elements of the terrestrial spheroid, first in 1866 and later in 1880. In 1866 Clarke used several meridian arcs, namely, Anglo-Gallic 39° – 60° N., Russian 45° – 70° N., Cape 34° – 29° S., Peruvian 3° – 0° S.; and both of Clarke's determinations are utilized in one or other of the great geodetic surveys. They may be considered as the best of those made simply from arcs of triangulation; but all such deductions are vitiated, more or less, by deviations of the vertical. In 1909 Hayford derived a new set of values from the triangulation of the United States, introducing the hypothesis of isostasy so as to avoid the effects of anomalous deviation of the vertical; and his figures were adopted by the International Union of Geodesy and Geophysics in 1924 at Madrid as defining the international spheroid.

Now we are entering a new era. The figure of the earth can be determined either from triangulation arcs or areas, or from gravity surveys; or from a combination of both. The greater the extent of the work of either kind, the higher is the precision which may be looked for in the results, which also become more detailed. In the first method, the weakness of determination has derived from the relatively small scope of the data. Thus Clarke's determination of 1866 was based on a few arcs of meridian of total amplitude less than 60° ; while Hayford's determination rested on an area which is less than two per cent of the earth's surface. Later determinations from the gravity field have also suffered from incompleteness of data. It is in the direction of greater fullness of data that a remarkable change is taking place; and this change is rendered possible and being brought into being by the Union of Geodesy.

There are now triangulation projects of a very comprehensive nature. The first resolution adopted by the Union of Geodesy and Geophysics at Edinburgh contemplates the junction of European and American triangulation across Asia and the Bering Straits; for which collaboration of the U.S.S.R. in Asia, the U.S.A. in Alaska, and Canada is essential. This will lead to a longitudinal arc of no less than 316° , mostly about latitude 52° , from which it deviates for the Asia-America junction. Of this work, 188° have already been finished. There remains to be done 4,800 km. from Irkutsk to Bering, 1,400 km. thence to the Alaska-Canada border and 1,100 km. in Canada.

Work in the U.S.S.R. is proceeding apace, and a great grid of triangulation is rapidly spreading over all that territory. Not only will the work extend to Bering, but, within five years, I am informed, it

will also reach the region of Taashkent and make strong connexion through an existent link with the system of triangulation of British India. A report (of Commission 18) was presented to the Union at Lisbon on the present state and future possibilities of extension towards Australia. Already continuous triangulation exists between India and Siam and thence with French triangulation in Indo-China; and only small gaps exist between the triangulations of Siam and Malaya (four triangles) and that of the Dutch East Indies (250 km.) which extends to Sumbawa in longitude 117° E. There are possibilities of extension thence to Australia.

Again, in Europe there is already connexion between the Arctic Ocean and Crete, where there is a sea-gap of 300 km. to the North African coast. A project for spanning this is envisaged in Resolution XIV. In this or some other way, continuity will be obtained with the meridian arc, Cape to Cairo. Of this latter, of amplitude 65° , more than 60 per cent is accomplished, the main gap of 18° being in the Anglo-Egyptian Sudan. The combined system will lead to a meridian arc of 105° .

Resolution I refers also to the junction of the two Americas. At present the North American system is continuous through Canada, U.S.A. and Mexico down to latitude 17° N.

It will be seen that these schemes will lead to the ultimate connexion of all the main land areas; and it is probable that a decade will see the linking of all the main land areas of the northern hemisphere. It is much to be desired that the African arc should also be completed by that time.

Now consider the gravity surveys. Here activity has been great during the last thirty years, and there are some thousands of reliable gravity stations in various parts of the world. In 1849 Stokes showed how the detailed form of the geoid could be expressed in terms of gravity values; but we are still not in a position to obtain a full solution by this means. This is because the distribution of stations is not complete. It is essential that all portions of the globe should have a certain minimum density of stations. Lack of this cannot be made up by much greater density in special regions. Efforts accordingly need to be co-ordinated. This is well recognized by the Association of Geodesy, and a commission to consider the matter of geoidal determination was formed at Edinburgh. Most of the work required for this end is to be done at sea, though there are also land areas, some difficult of access, which remain to be dealt with. Here again we may confidently expect the situation to develop in the course of a decade, so that it will be possible to make good use of Stokes's method. The best means of combining results of this kind with those based on triangulation requires study.

The position of geodesy will be entirely changed when all geodetic surveys are linked and their results expressible in correct relative terms; and this we now expect to be realized in a reasonably short time, owing to the co-ordinating activities of the Union of Geodesy.

*Report presented at the General Assembly of the International Council of Scientific Unions on April 26–May 3.

Reduction of Fading in Radio Communication

IT is now well known that part of the fading of signals experienced in radio communication is due to the variation of phase difference between the two or more sets of waves arriving at the receiver. These changes in phase difference arise in the course of transmission of the indirect waves through the ionosphere.

Two papers describing experiments demonstrating methods of reduction of this type of fading were presented early this year to the Wireless Section of the Institution of Electrical Engineers and are now available. The first paper, by Drs. A. L. Green and G. Builder, entitled "Control of Wireless Signal Variations", directs attention to the possibility, already known, of reducing variations in intensity of signals by combining the effects of two or more signals which have been transmitted on adjacent frequencies. After outlining the theory of the method, a description is given of experiments carried out between the University of Sydney and Liverpool, New South Wales, a distance of 25 km.

In this case, the fading was due to interference between the ground and ionospheric waves, and the curves accompanying the paper show that this fading could be considerably reduced by modulating the carrier wave at the transmitter, and integrating at the receiver the rectified current produced by the three sets of waves—carrier and two side-bands—so transmitted. The optimum effect is shown to be obtained when 100 per cent modulation is employed at a frequency dependent upon the path difference between the ground and ionospheric waves. A more complete control of the fading is obtained, however, if the carrier waves are suppressed, and only the two side-band waves are emitted at the transmitting station. Experiments carried out with this method have shown that fading, which under some conditions may be of the order of 85 per cent of the received signal amplitude, can be reduced to 5 per cent or less.

The second paper, entitled "Control of Phase Fading in Long-distance Radio Communication", by Drs. A. L. Green and O. O. Pulley, describes the extension of these experiments to greater distances. Measurements have been made at distances of 700 km. (Sydney-Melbourne) and 3,300 km. (Sydney-Perth) from the transmitter, and it was found that the phase fading was due to interference between two main ionospheric rays of comparable intensity. On account of the fact that the path of each of the ionospheric rays was subject to appreciable alteration during the day or night according as reflection takes place from the *H* or *F* region of the ionosphere, it was found desirable in these experiments to employ two modulation frequencies having a ratio of 3:1, the carrier wave being suppressed as previously described. The optimum control frequencies were found to be 200 and 600 cycles per second when the distance between transmitter and receiver was 700 km., whereas at 3,300 km. the best frequencies were 50 and 150 c.p.s.

The concluding portion of the first paper discusses briefly the possible application of these modulation methods of fading control to ionospheric research, to direction finding and to broadcast telegraphy and telephony. In connexion with telephony, it must be pointed out that the fading control does not apply directly to the audio-frequency components of the received waves, and a special additional modulation would be necessary to carry the intelligence. The possibility of the introduction of distortion would appear to make the application of the methods to high-fidelity broadcasting impracticable.

The investigations described in these papers formed part of the programme of the Australian Radio Research Board; in the absence of the authors, the papers were presented in London by Mr. J. A. Ratcliffe.

The Rehabilitation of British Agriculture

THE publication of the Minister of Agriculture's proposals for the assistance of agriculture in Great Britain gives greater pertinence to the three broadsheets on agriculture recently issued by Political and Economic Planning (P.E.P.). These broadsheets have been prompted by the desire to stimulate better informed discussion and the elaboration of a constructive policy in accordance with the position of agriculture in the national economy.

The first broad sheet deals with the demands of agriculture and the difficulties encountered by the various approaches to a balanced view. The Free Trade, Protectionist, Defence, Consumer and Employment approach are all briefly reviewed, as are those based on nutrition, amenities, industry, land maintenance and ownership. The broadsheet suggests that the types of crop and livestock to be produced by British agriculture should be those which the country is naturally best fitted to produce in relation to other countries over a long period. Arrangements are

necessary for the control of imports and for marketing the home output to smooth out fluctuations of supply and prevent sudden changes in prices. Subsidies or reliefs to agriculture are not objectionable in principle, provided they are open and under effective Parliamentary review and directed to the constructive development of permanent assets, not the bolstering up or development of production which is permanently uneconomic or tends to a retrograde type of farming. Great importance is attached to making British agriculture once more a flourishing industry by the achievement of superior competitive efficiency in supplying certain parts of the market. A thorough overhaul of agricultural production and marketing and of land management is required to be applied to technique in order to realize the advantages of a modern industrial structure. A parallel overhaul of country social and utility services is also required to counteract the rival attractions of factory employment and town social services.

In the second broadsheet the problem is approached from the consumer's point of view, and the need for further information about consumption habits in different areas and at different income levels as a basis for market policy is emphasized, as well as the importance of making the necessary economic adjustments to enable British agriculture to take advantage, so far as possible, of demand changes in its favour and to minimize the repercussions of other changes in demand. Needs in distribution are summarized as assembling and placing at the disposal of the consumer a suitable supply of the products demanded, at convenient times, at the lowest possible cost and at prices he can afford, and carrying out a large range of ancillary services such as delivery and credit. The value of concentrating demand where possible and of steady contracts is stressed, as well as the opportunities of developing rival industries, and the importance of efficient organization in the farming units if the good will and support of the urban electorate are to be held. The Marketing Boards have as yet scarcely touched the major problems with which they are confronted of expanding the market for home produce, increasing the return to the farmer, and reducing the cost to the consumer through savings in transport and distribution, or gaining for the farmer a larger share in the profits of processing his output or in reducing the contribution to the profit derived by supplying him with fertilizers, feeding stuffs and seeds.

The third broadsheet, dealing with the farm and of agriculture, emphasizes that the industry has far

too many diverse elements and is affected by too many other activities at home and abroad for any one formula or panacea to offer a solution of its problems. Determined criticism of all one-sided approaches or ideas is indispensable. British agriculture is also regarded as having lost the close touch with the consumer demand which it had when the market was smaller and more static. The necessity for adapting agriculture as an industry in which the landowner and land agent, the farmer, agricultural engineer, the veterinary officer, marketing expert and other specialists can effectively work together is also stressed, as well as that of continuous local leadership. A stable rural basis for agriculture can no longer be assumed, and only an all-round policy of rural reconstruction can save British agriculture as a living and growing organism. Stable prosperity for farmers, it is suggested, can only be secured by types of farm and methods of farming designed to give the maximum net return each year over a long period. Agricultural subsidies and assistance should have for their objects urgent salvage or relief work of an essentially temporary nature for badly hit branches of the industry; permanent re-adjustment of the balance between town and country life, through subsidizing of rural roads, telephones and social services; and long-term development, such as improving farms and buildings, improving stock and eradicating disease, increasing the fertility of the soil, afforestation, land drainage, and information services. Particular stress is laid on the importance of increased expenditure on research.

Bantu Blood Groups

IN a comprehensive study of the blood groups of the Bantu of Southern Africa by Mr. Ronald Elsdon-Dew (*Pub. South African Inst. Med. Research*, 7, No. 39), a suggestion is made, based on this line of research, as to the early racial history of the African peoples.

Five thousand recruits for the Witwatersrand mines, grouped according to Bantu tribal origin, were submitted to the blood test. On this evidence it would appear that the Bantu are not homogeneous from a serological point of view; but as a whole they show a position close to the origin in the predominance of *O*, a position unoccupied except by such races as the American Indian, and indicating a more primitive distribution of the groups than is found in any other black race of which the figures are known. The known crosses of Caucasoid and Negro as exemplified in Algeria and Tunis occupy a position midway between the Caucasoid races and the origin. The Berber peoples show a small proportion of *B*, but they have a proportion of *A*, which gives them a type of distribution found in certain races separated early from the stock of mankind, such as the Australian aborigines. The Bush race shows a similar arrangement, while the Hottentot lies between the black races and the Egyptians.

The Southern Bantu are found to fall into three main groups, a primitive group, an intermediate group and a Caucasoid group. In the Caucasoid group fall the Mpondo and Xhosa. In comparison with other groups, this must have absorbed a con-

siderable proportion of Caucasoid blood. The Bushman-Hottentot complex could have had this effect, and this agrees with the fact that Mpondo and Xhosa show culturally and linguistically the results of Bushman-Hottentot contact to a greater extent than is shown by the other races. The intermediate group comprises Zulu, Shangaan, Tswana and Southern Sotho, corresponding roughly to the Nguni group. The primitive group comprises on one hand the Tshopi and Inyambane, about whose separate entity there is no doubt, and on the other hand the Swazi and Northern Sotho, whose position needs further investigation with reference to the Bantu as a whole, and the alleged primitive black race. If, as is usually held, the Bantu is derived from a Negro stock with Caucasoid (Hamitic) admixture, it is remarkable that serologically it should be more primitive than the Negroes of West Africa, a fact which suggests to the author a revision of early African racial history.

At some early date Africa was inhabited only by a black race, probably living near the west coast, and composed solely of the *O* group, as *A* and *B* had not appeared at the time it separated from the main stock. Africa was then invaded by a light-skinned small race bearing the factors *B* and *A*, which moved south, forming the Bushmen. A taller, light-skinned race with the factors *O* and *A* then arrived, but remained in the north, forming the Berber race. Then came a race with all the blood-groups which

spread all over Africa, pushing the Bushman south and giving rise to the Hottentôts. The black race, still unaffected by *A* and *B*, moved south, following Bushmen and Hottentot and followed by other races with all the groups, who affected the black left behind in West Africa and the rearguard.

The Bantu are thus the result of the interactions between the Caucasoid and a primitive black race showing little or no *A* and *B*. Serologically they are more primitive than the Bushman, while if the Hottentot has had any effect it is only in recent times.

Excavations of the Egypt Exploration Society in Nubia, 1936-37

AN exhibition of archaeological finds by expeditions sent out by the Egypt Exploration Society at Tell el-Amarna and Sesebi on the Upper Nile in Nubia in the season 1936-37 opened in the rooms of the Palestine Exploration Fund, 2 Hinde Street, Manchester Square, London, W.1, on July 5, and will remain open until July 24.

The excavations in Nubia, which have been carried out under the direction in the field of Prof. A. M. Blackman, were undertaken in view of the approaching termination of the Society's operations at Tell el-Amarna, and in the expectation of obtaining a view of the culture of that period at an angle differing from that of the Amarna evidence. Sulb and Sesebi, sites covered by the concession granted to the Society by the Government of the Anglo-Egyptian Sudan, have been known since 1908 to be associated with Akhenaten, when the late J. H. Breasted identified Sesebi with the Nubian Gem-Aten, and recognized that the founder of the temple there had been Akhenaten, and not, as previously supposed, Sethos I, who had covered the inscriptions of the earlier king with plaster and inscribed on them his own name and a rededication of the temple.

Although the official name of the city was doubtless changed after the time of Akhenaten, the former name must have been retained among the people, as it was still known by that name seven centuries later, when the god of the place was recorded as "Amun of Gem-Aten".

The temple was founded about 1370 B.C., before Amenophis IV had changed his name to Akhenaten, as is shown by the foundation deposits. This change took place about the fourth year of his reign, or at Sesebi, owing to its remote situation, perhaps a little later. Scarabs of Tethmosis III and Tethmosis IV from the cemetery suggest that Sesebi was an Egyptian settlement of some importance long before the accession of Amenophis IV.

The fortified town of Sesebi is situated between the Second and Third Cataracts of the Nile, about one hundred and eighty miles south of Halfa. The fortress, which lies about two hundred metres distant from the river on the west bank, enclosed an area of about two hundred and seventy metres long by about two hundred metres broad. Its crude brick walls are about 4.60 m. thick, and in some places still stand to a height of 4-5 m. The width of the buttresses is approximately 3.15 m. and they stand out 2.65 m. from the walls. In each of the four walls is a well-constructed gateway.

Within the walls, the most striking feature is a group of three temples, before excavation thought to be one only, erected on a single and unusually solid substructure, and extending along the western side of a forecourt, once enclosed in massive walls. Four

sets of foundation deposits were found intact under the north-west and south-west corners of the substructure. They comprised among other relics two inscribed blue faience plaques and a large inscribed scarab of the same material, clearly showing that the foundation had taken place before the monarch's change of name. The full significance of this fact was brought out by reliefs on the walls of a subterranean crypt below the central temple, in which the king, sometimes with the queen, is represented seated in the company of various deities. The reliefs, therefore, belong to his polytheistic period, before he changed his religion to the monotheistic worship of the Aten. They are in the ordinary style of the Eighteenth Dynasty and not that of the Amarna period.

The crypt is in itself a remarkable discovery. It is the only known example of such a substructure at so early a date, preceding the well-known crypt of the Ptolemaic temple of Denderah by approximately thirteen hundred years.

What are conjectured to be portions of the sandstone façade of the temple, showing some highly finished reliefs, were found. Of these one shows the head of the goddess Hathor, while on another are the heads of two negro prisoners, possibly part of a much larger war relief, to which belonged a representation of the king slaying captives, not brought to England. The style of this block, with the strongly marked features and masterly line, closely resembles that of the magnificent scenes in the tomb of Horemheb. It is probably to be assigned to the end of the Eighteenth Dynasty. Mention may also be made here of a remarkable head of a granite statue of a king, or possibly of Queen Hatshepsut.

Outside the temple area an important find was a stone structure situated close to the north-east corner, which had undergone at least one reconstruction. In its original form it had been a small colonnaded open court on a stone platform about 11.70 m. square and two metres high. This had been the work of Akhenaten, and possibly was a small sun temple, a view supported by the unusual feature that it was approached by a ramp or stairway on the western side, which would enable the officiating priest to greet the rising sun on entering the temple at dawn.

Immediately south of the temple were found three rows of magazines, and south of these again the south-western portion of the residential area. In the magazines a doorjamb inscribed to a vizir of the reign of Amenophis II supports the earlier dating of the settlement.

Although the area of the town examined had been much disturbed, it produced a quantity of interesting material. It has been possible to make out the symmetrical rectangular planning of the streets.

To the west of the town lies the New Kingdom cemetery, which seems to have been subjected to considerable depredation. Tombs had been plundered, re-used and plundered again. Nevertheless, it supplied a fine collection of scarabs and much pottery, as well as other objects. Three groups included bronze mirrors laid on the chest, one a very fine specimen, and with another was a bronze bowl. A remarkable

example of fine work is a green felspar amulet in the form of a baboon with the moon-disk on its head, and probably from the same string was a *mellefiore* bead in the original gold mount. In one tomb the face painted on the cartonnage has survived. One exhibit of no little interest, though late in date, is a human pelvis still wrapped in its leather loin-cloth.

Association of Technical Institutions

SUMMER MEETING AT BLACKPOOL

THE summer meeting of the Association of Technical Institutions was held at Blackpool on June 24-26.

Two reports having a direct bearing on policy were presented and discussed. The first was the report on policy in technical education, prepared by a joint committee of the Association of Technical Institutions, the Association of Principals of Technical Institutions, the Association of Teachers in Technical Institutions and the National Society of Art Masters. First published in 1932, this report has been twice revised, in 1934-35 and in the form presented to the recent Conference. Its field is wide and includes descriptions of the present system, courses of instruction, regional co-ordination of technical education, examinations, scholarships, libraries, staffing, technical education in small towns, buildings and equipment and social activities. The second report dealt with Education for Citizenship in Technical Institutions and is dealt with in the leading article in this issue of NATURE.

Of special and immediate interest was a paper on education in industrial management prepared by Mr. E. S. Byng, vice-chairman of Standard Telephones and Cables, Ltd., and Mr. G. A. Robinson, principal of the South-East London Technical Institute. This branch of education has grown considerably of late years both in Great Britain and in the United States, and its importance cannot be underestimated. As one expert has put it: "Such training was not to be a substitute for experience. . . . The growing complexity of industrial organizations, the evolution of new techniques, the application of science to industry, the growing size of business units and such items as industrial, economic and technological factors combine to make successful management far more complicated and difficult than it was in the past. Experience plus training are recognized in all professions civil and military. Is management the only profession where training is unnecessary?" The social significance of the subject was well expressed by the authors of the paper when they said: "One of the greatest services which education in regard to management could render would be to imbue the general body of workers with a sound elementary knowledge of the principles affecting the conditions, conduct and direction of the undertaking which they serve. In a democracy, an understanding of the principles by the workers would assist management, whereas in a dictatorship the conditions may be different."

The authors further brought out the vast increase

in the number of persons who are now concerned in management. Modern manufacturing methods actually require a much larger proportion of administrative workers than was necessary under earlier conditions. In a typical engineering organization with approximately 10,000 employees, those engaged in one phase or other of management may represent as much as twenty-five per cent of the total staff. It is not to be wondered at, therefore, that many of those in control of industry feel the need for a constant supply of young men not only proficient in the technology of departmental functions, but also trained in the principles of administration. Appendices to the paper included a list of schools where instruction in management is given, and syllabuses of "Fundamentals of Industrial Administration", "Workshop Organisation and Management", and "Works Supervisory Course".

Dr. E. Benson, headmaster of the Blackpool Grammar School, read a paper on "The Grammar Schools and Technical Education". He admitted that he approached the subject from the point of view of the grammar schools. During the discussion, it was made clear that technical educationists, while differing sometimes with the educational views put forward by those connected with grammar schools, have no quarrel with grammar schools and their work as such. At the same time, they spoke their minds with some freedom when they thought the grammar schools were claiming a kind of monopoly in educational powers. Dr. Benson quoted Sir Josiah Stamp's saying that education to-day might be considered to have three main objects. It trains individuals to get a living, to live a life and to mould a world—in other words, it is education for work, leisure and responsibility. Dr. Benson's claim that the grammar school "does its best to give this complete education" may be true; but there are not lacking many who would challenge it. Neither are there lacking many who would demand to hear much more argument before they could be convinced that none of the types of post-primary schools "has succeeded so far in sharing with the grammar schools the most important of the vital qualities which the grammar schools possess. . . ." The same people would probably think that Dr. Benson had only appreciated a part of the work when to that remark he added ". . . except that junior technical schools, especially in conjunction with senior technical institutions, have, although they are comparatively few in number, established high standards for example in accuracy and craftsmanship".

University Events

BIRMINGHAM.—At the annual degree congregation held on July 3, the Chancellor (Viscount Cecil of Chelwood) conferred the honorary degree of LL.D. on the following: The Right Hon. Lord Austin, Sir Harry Gilbert Barling, Mr. Edward Cadbury, The Right Hon. Sir Wilfrid Arthur Greene, and Sir Percival Perry. The honorary degree of D.Sc. was conferred on Mr. C. C. Paterson.

The ordinary degree of D.Sc. was conferred on D. A. Howes for a treatise on "The Principles of Motor Fuel Preparation" (in collaboration with Prof. A. W. Nash) and for a paper on "The Use of Synthetic Methanol as a Motor Fuel" and other papers on allied subjects (*J. Inst. Pet. Tech., J. Soc. Chem. Ind.* and elsewhere).

The degree of M.D. (*ex officio*) was conferred on Prof. H. P. Newsholme.

CAMBRIDGE.—Dr. A. D. Thackeray, of King's College, has been appointed assistant director of the Solar Physics Observatory for five years from July 1.

An appointment to a research studentship at Christ's College will be made at the end of July 1938. Candidates must be men who will have graduated before October 1, 1938, at some University other than Cambridge, and they must be not more than twenty-six years of age on that date. Preference will be given to those who have already devoted at least a year to research. Further information can be obtained from the Master, Christ's College, Cambridge. Detailed information about the admission of research students to the University will be found in the "Student's Handbook to the University of Cambridge", published annually by the Cambridge University Press. It may be estimated that the total annual expenses, including vacations, of a research student at Cambridge, is about £350 a year.

Sir David Chadwick has been elected to an honorary fellowship at Sidney Sussex College, not at Christ's College, as stated in *NATURE* of July 3, p. 38.

EDINBURGH.—At a graduation ceremonial on July 2 the honorary degree of LL.D. was conferred on the following, among others: Prof. L. H. Baekeland, hon. professor of chemical engineering, Columbia University, New York; Sir William Bragg; Dr. N. M. Butler, president of Columbia University, New York; Sir Herbert Grierson, rector of the University; Dr. Alexander Morgan.

The Principal, Sir Thomas Holland, referred to the sense of loss felt by the University on the death of its Chancellor, Sir James Barrie, who in a letter written only three days before he was taken seriously ill, had expressed his intention of presiding at that graduation. It was at a similar ceremonial, as the Principal recalled, that Barrie was 'capped' fifty-five years ago.

ST. ANDREWS.—It has been decided to confer the honorary degree of LL.D. on the following: Prof. G. F. Stout, professor of logic and metaphysics in the University from 1903 until 1936, and Dr. W. T. Calman, president of the Linnean Society, lately keeper of the Zoology Department, British Museum (Natural History).

Science News a Century Ago

Musket's Discovery of Blackband Ironstone

DAVID MUSKET (1772-1847) was among the foremost metallurgists of his day, and besides contributing articles on iron manufacturing to the "Encyclopædia Britannica" and "Rees' Cyclopædia", he contributed some thirty papers to the *Philosophical Transactions*. On July 12, 1837, he wrote a letter from Coleford, Gloucestershire, to the editor of the *Scotsman*, in which there had been a communication on the iron trade of Scotland and the blackband ironstone. In this letter he said: "As this ironstone has now become an object of considerable national importance, perhaps you will allow me room to allude more particularly to the circumstances of its discovery. Thirty-six years ago this summer, in attempting to cross the river Calder on foot, in the Old Monkland Parishes, I obtained nearly a dry footing upon what appeared to be a continuous black pavement, from the upper edge of which I struck off a piece of substance resembling coal, which upon closer examination, was found interlaminated with yolks of brownish matter, about three-eighths of an inch in thickness. These when separated from the carboniferous schist, proved to be good ironstone, but so small in quantity, that the average of the mass did not exceed 13 per cent. Next day I returned to the black pavement, better prepared to ascertain its extent and thickness. On removing a portion of the entire bed, I found it to be fourteen inches in thickness, viz., three and a half of coaly schist with the before-mentioned yolks, and ten and a half of more compact and solid matter. . . . In a short time from making this discovery I had ascertained the existence of the Blackband in 2,000 acres of land, including the Airdrie estate (for right of working in which, to a limited extent, £12,000 a year is now to be given) and determined it to be a regular member of the coal formation. . . ."

Advancement of Medical Science

AN editorial article in the *British Annals of Medicine* of July 14, 1837, contains the following passage: "Reform in institutions is advancement in the sciences, and the latter is not the least deserving attention at the present time. Our practice is based on physiological indications, and much of the current physiology is false; in this country it is not yet on a line with the actual state of the science. We have too much metaphysical reasoning about functions and about diseases, too little systematic observation. . . . Could not the Association encourage the invention of some systematic form by which the observations of a great number of members may be collected and compared? If we are to believe a contemporary, Dr. Haviland rebuked the College of Physicians in very elegant Latin—not for their scientific apathy, not even for forgetting their mathematics, or for not applying them to vital phenomena, but for selecting fellows unversed in Latin and Greek. Better things may have been expected from Dr. Haviland, but it is as difficult for an Oxford and Cambridge professor as for an Irvingite to raise his thoughts above the 'tongues'. The University of London will, we understand, reduce languages to their subordinate place as instruments in the general scheme of education."

Thomas Graham at University College, London

ON July 15, 1837, the *Mechanics' Magazine* said: "The Chemical Chair of the London University College, vacant through the lamented demise of Professor Turner, has been conferred on Mr. Graham, the Andersonian Professor of Chemistry at Glasgow. A better selection could scarcely have been made. Mr. Graham was first made favourably known to chemical philosophers by his discovery of the laws of gaseous diffusion. He established by well-devised experiments, the conformity of gases flowing through minute orifices, to the universal physical law that determines the issuing velocities of non-elastic fluids. During the last five years he has been diligently engaged in elaborate inquiries into the constitution of salts, with special reference to the functions of their watery element, and has already published some results that are considered by good judges to affect materially the higher doctrines of chemical philosophy."

Medical Schools in Russia

THE issue of the *London Medical Gazette* of July 15, 1837, contains the following account of the contemporary medical schools in Russia: "There are three principal universities in Russia proper, those of Moscow, Harkoff and St. Petersburg; and each of these universities has a large school of medicine. Those of Moscow and St. Petersburg are the most considerable, but there is still a good school at Harkoff, situated in the southern part of the empire, and destined for the convenience of the nations of the conquered provinces on the Asiatic borders. Each university which has a faculty of medicine has also an institute of medicine of the same kind; the students who attend the latter are educated at the expense of the Government, and are subsequently obliged to serve six years, at least, in the civil or military service. Although the first rudiments of a medical school at St. Petersburg are to be found in the establishment of the naval school by Peter the Great in the year 1715, yet the merit of organizing a medical faculty is due to Catherine the Second. In 1764 the Empress founded a medical college which with but few alterations from its first instalment is still recognised in the Medico-Chirurgical Academy of St. Petersburg. To the jurisdiction of this institution were subjected then, as at present, all the medical institutes and all medical practitioners, with the exception of court physicians, in the Empire."

Ploughing by Steam

THE issue of the *Gentleman's Magazine* of July 1837 contains the following announcement: "A very successful and interesting exhibition of ploughing by steam, invented by Mr. Parkes, took place at Red Moss, near Horwich, Lancashire. The engine is not locomotive, but remains stationary while the plough is at work. The plough is set in motion by means of two long, flexible belts of iron, revolving round two wheels attached to the engine, and round another wheel in a frame firmly fixed on the moss, at such a distance from the engine as may be proposed to make the furrow. The ends of these belts are fixed to the two ends of the plough, and pull it to and fro, for it does not turn in working, but cuts a furrow both when it recedes from and returns to the engine. This operation is most satisfactory, the plough turning a furrow eighteen inches broad, nine inches thick, and more than 300 yards long in less than four minutes."

Societies and Academies

Dublin

Royal Irish Academy, April 12.

P. G. GORUMLEY: The zeros of Legendre functions. The number of zeros of the function $Q_n^m(x)$, n and m being real, is determined by considering the change in phase due to a complete circuit round the plane, the number which are situated on each axis being given. Those zeros of the function $P_n^m(z)$ which lie to the right of the imaginary axis are considered.

A. C. FORBES: Some climatic theories in connexion with tree remains in and under peat. The stump layers in lowland bogs, which various observers from Geikie onwards have attributed to secular changes in rainfall, merely represent vegetative features in the development of marsh peat. They are the remains of trees which originated, matured and died on a saturated or water-logged substratum induced by topographic features, and neither normal nor periodic fluctuations in rainfall could have affected them to any material extent as is shown by their characteristic root development. The stump remains under mountain (soligenous) peat represent the final generations of pine and birch which gradually disappeared at high elevations, resulting in forest being replaced by peat, which, in its turn, is disappearing above 2,000 feet or so. These changes must be correlated with lower temperatures during the growing season, and the general tendency during the last 2,000 or 3,000 years in the British Isles has apparently been in the direction of cooler and moister summers and milder winters, and the altitudinal tree limit during that period has been lowered to about 1,000 feet. The rainfall and temperature conditions for peat formation are still in operation at the lower levels, and these do not differ in any important respect from those necessary for forest growth.

Paris

Academy of Sciences, May 19 (*C.R.*, 204, 1449-1516)

JULIUS DRACH: The logical integration of linear differential equations.

NICOLAS KRYLOFF and NICOLAS BOGOLIOUBOFF: The ergodic properties of series of probabilities *en chaîne*.

SOLOMON MANDELBOJT: A general theorem furnishing the argument of singular points situated on the circle of convergence of a Taylor's series.

JACQUES HADAMARD: Remarks on the preceding note.

RAOUL GOUDRY: Measurements of the intensity of gravity in France during the year 1936. Results for the values of g at fifty stations in France carried out with the Holweck-Lejay instrument.

VICTOR VOLKOVISKI: Vortices in bands in liquids.

ANDRÉ GUILBERT: The elementary expression of the energy affecting a magnetic particle of very small dimensions in a magnetizing field.

RAYMOND HOGART and MAURICE FALLOT: The identification of various phases by magnetic study and by the X-rays in alloys of iron and palladium. The magnetic study showed two phases the approximate composition of which are FePd and FePd_2 , and these were confirmed by the X-rays. The phases only appear after prolonged annealing.

BOBIS VODAB: The absorption spectrum of nitric oxide (NO) in the liquid state.

MILKA MILKA RADOCHITICH: The influence of the solvent on the absorption spectra of neodymium acetylacetonate. Summary of results obtained with

39 organic solvents. Neither the dielectric constant nor the electric moment afford an explanation of the results. These intervene, but there are other factors which complicate the comparisons.

Mme. NIUTA WINTER-KLEIN: The relation which exists between the temperature of transformation and the variation of the (refractive) index for several kinds of glass.

W. BRONIEWSKI and I. ST. GLOTZ: The physical and mechanical properties of pure iron as a function of the cold hardening.

LOUIS HACKSPILL and ANDRÉ BOROCOO: Compounds of the isotope 2 of hydrogen with the alkali metals (alkaline deuterides). The alkaline deuterides can be obtained by synthesis under the same conditions as the hydrides, their formulae are analogous with the latter, and their appearance is the same.

MARTIN BATTAGAY and PIERRE BOEHLER: The anthrylthiocyanates, anthrothiazols and mercaptoanthrothiazols.

MARCEL FRÉREJAQUE: Acetylglucosides of amines and rotary power.

RAYMOND PAUL and HENRI NORMANT: The action of furfuryl bromide on sodium phenate, *o*-furfurylphenol and furfuryloxybenzene.

R. TRUBAUT: Study of the compounds of glycocol and of alanine with mercuric oxide.

LOUIS LONGCHAMON: The pyrogenation of coal. Studies of the coefficient of expansion of coal at temperatures below the coking temperature.

ANDRÉ DEMAY: The age of the metamorphism in the Central Massif.

MAURICE BRUNSTROFFER: The fossiliferous levels of the Albian in the Vocontian abyss (Drôme, Hautes-Alpes and Basse-Alpes).

CHARLES BOIS: The determination of the focal depth of very distant earthquakes.

A. DEMOLON and E. BASTIEN: Observations in lysimetric boxes on the mobilization of the nitrogen and mineral reserves of the soil.

STÉPHANE HÉMIN: Asymmetry and the orientation of clay particles.

WILLIAM HENRI SCHOPFER and ALBERT JUNG: The action of the products of disintegration of aneurine on Phycomyces. The second growth-factor of the Mucorineae.

Mme. ANDRÉE DRILHON: Study of the mineral exchanges in the homeiosmotic fishes.

Mlle. M. HAMON: The mechanisms producing dehiscence of the spermatophores of *Eupagurus bridauxi*.

BASILE LUYET: The mechanism of cellular death produced by high pressures: the cytological modifications accompanying death in yeast.

ROBERT PAULAIS: Copper, zinc and cobalt in the organs of Lamellibranch molluscs.

ANDRÉ LWOFF and Mme. MARGUERITE LWOFF: The function of haemin, growth factor for *Hemiphysalis influenzae*.

LÉON BINET, GEORGES WILLER and CHARLES JAULMES: The antitoxic power of glutathion. Researches on cobra poison.

Moscow

Academy of Sciences (C.R., 14, No. 6; 1937).

S. BERNSTEIN: The Cotes and the Toebycheff formulae of quadrature.

ERVIN FELDHEIM: Mode of convergence in the interpolation of Lagrange.

N. A. SLOSOSKIN: Oscillations in rotation of a sphere filled by a viscous liquid.

V. V. ČELINOV: Structure of organo-magnesium complexes.

N. A. ORLOV and A. T. SHALYGIN: Preparation of carbohydrates by auto-oxidation of some hydrocarbons.

A. G. BERGMAN: Discovery of boron in Central Asia.

S. A. BOROVIK: (1) Finds of tin in micas. (2) Spectroscopic determination of rare earth elements in some minerals found in the U.S.S.R.

V. SMIRNOV and N. AIDINJAN: Determination of ferrous oxide in rocks and minerals.

A. P. VINOGRADOV: Manganese in insects (Formicidae). The problem of the chemical composition of organisms as a specific character.

A. P. VINOGRADOV, V. V. DANILOVA and L. S. SELIVANOV: Fluorine content of the rivers of the Union (in connexion with the occurrence of mottled enamel tooth disease).

I. A. SMORODINOV and A. M. FELD: Critical survey of methods of the separation of thyroglobulin.

I. A. SMORODINOV and S. P. BYSTROV: Influence of freezing on the swelling of meat.

E. V. PAVLOVSKI: New data on the stratigraphy of Cambrian deposits in the Lake Baikal region.

ŠAFRANOVSKI: Distribution of angular values in crystals.

M. S. LOICJANSKAJA: The first stages of the decomposition of cellulose by *Spirochaeta cytophaga*.

D. NOVOGRUDSKI, E. BRIZOVA, M. NACHIMOVSKAJA and M. PERVIAKOVA: Influence of bacterization of flax seed on the susceptibility of seedlings to infection with parasitic fungi.

E. D. BUSLOVA: A contribution to a method of cultivating embryos of higher plants, deprived of the nutritive reserves of the seed.

K. T. SUCHOBUKOV and K. E. OVČAROV: The nature of immunity to rust.

A. A. ISAKOVA and A. SMIRNOVA: Influence of various microbe complexes of bacteriorrhizas on the development of higher plants.

A. G. TOMILIN: Observations on Far Eastern whales.

A. A. VOITSEVIČ: The anterior lobes of the hypophysis and growth and differentiation phenomena in amphibians (1) and (2).

G. STREICH and E. SVETLOZAROV: The morphogenetic role of the thyroid in the process of feather formation.

Moscow

Academy of Sciences (C.R., 14, No. 7; 1937).

N. ACHYBER and B. LEWITAN: Application of the inequality of H. Bohr and I. Favard.

V. FABRIKANT, F. BUTAJEVA and I. CIRG: The absolute concentration of excited atoms in a low-pressure mercury discharge.

M. VINGERBOV: A radiometer of low inertia based on the principle of gas thermometer.

L. KIBEL: Mathematical theory of front shifting in the atmosphere.

S. J. TURLYGIN: Biological effect of centimetre waves.

N. N. MALOV: The law of nervous excitation by alternating currents.

I. LEONTJEV and K. MARKOVA: The curve of the 'racemisation' of proteins from the muscles of certain invertebrates.

J. V. RAKITIN: Absorber for acetic aldehyde determination.

G. D. PRATASINJA: Production of polyploid plants after regeneration (2). Autotetraploid of *Nicotiana glauca*.

D. KOSTOFF: Studies on polyploid plants (16). *Nicotiana rustica* and *Nicotiana tabacum* amphidiploid.

E. S. SAPRYGINA: Vernalization of wheat hybrids of the first generation.

A. A. ISAKOVA: The true influence of bacteriorhizal micro-organisms on the germination of seeds (2).

A. V. IVANOV: A new ectoparasitic mollusc of the genus *Megadenus* Rosen.

T. A. BEDNJAKOVA: Induction of the infundibulum by the anterior end of the chorda.

Washington, D.C.

National Academy of Sciences (Proc., 23, 189-250, April).

C. E. NURNBERGER: Ionization theory and radiobiological phenomena. Assuming that hydrogen is the chief absorber in biological materials of neutrons, the ejected protons are the cause of the major part of the ionization. The concentration of ions produced by protons, and also by α -particles, is more than a hundred times that produced by electrons, and irradiation of aqueous solutions of tyrosine with X-rays (Stenstrom and Lohmann) and with α -particles gives results supporting the view that the chemical changes produced depend on ionic concentration. The relation of this work to recent investigations of the 'selective effect' of neutron irradiation of tissues is discussed.

A. A. BLISS: Effects of the length of X-ray waves on seeds. For moderate dosage, two minutes' exposure gives optimum growth at one stage, while at a later stage, optimum growth is produced by a different exposure. Over the range 0.6-0.12 Å., the effects seem to be independent of wave-length.

M. MUSKAT and E. HUTCHINSON: Symmetry of the transmission coefficients for the passage of particles through potential barriers. A general wave-mechanical proof.

P. W. BRIDGMAN: Polymorphic transitions of inorganic compounds to 50,000 kgm./cm.². Thirty-five, out of eighty-five, such substances show polymorphism, and the transition parameters (pressure, temperature, change of volume and latent heat) have been determined. The temperature range of the experiments was -79° C. to 200° C. The ice-type of transition (stable phase at higher temperature has the smaller volume) tends to become more common at high pressures. Latent heat shows no statistical trend with increasing pressure, but the energy change tends to increase proportionally with pressure, leading to the view that the atoms increase in size on passing to the high-pressure form. This suggests that an important fraction of the electrons of the high-pressure form are in an essentially different state from that in the free atoms.

G. H. PARKER: Colour changes due to erythrophores in the squirrel fish, *Holocentrus*. This fish changes from red to white in about 6 sec., and from white back to red in about 10 sec., on transfer from a black-walled illuminated vessel to a white-walled one or the reverse, due to expansion or contraction of red pigment in the erythrophores. Cutting through

nerves supplying the skin suggests the existence of dispersing and concentrating nerves; the latter, at least, are activated by a neurohumor soluble in lipoids.

F. B. SUMNER and P. DOUDOROFF: Some quantitative relations between visual stimuli and the production or destruction of melanin in fishes. Colour adjustment of fishes and amphibians to background depends on (1) dispersion or concentration of pigment in chromatophores (rapid), (2) changes in amount of pigment (slow). This paper deals with the latter. Fish were placed in two series of four tanks painted white, grey, dark grey and black respectively, one set being illuminated by two 200-watt lamps, the other by two 10-watt lamps. After 87 days, the melanin contents of fish from each tank was estimated photometrically.

R. GOLDSCHMIDT: A remarkable parallelism. In investigating the mutant 'vestigial' in *Drosophila* and its series of multiple alleles, it has been found possible to arrange them in a series with increasing degeneration of wing tissue. It is thought that the genes control the production of a growth-promoting substance, and that the different alleles produce an insufficiency which, below a certain threshold, causes degeneration. Representing the data graphically, the curves produced are identical with those of Krueger on the relationship of bacteria and phage, indicating that the kinetics of the two processes are the same.

E. W. SINNOTT: The relation of gene to character in quantitative inheritance. If the distribution as to a given quantitative trait in an *F*₂ population is symmetrical, it is concluded that each gene makes a constant absolute contribution and that the contributions are cumulative; if, on the other hand, the distribution is skewed, this is considered as evidence that the genes are interacting and producing a geometric or multiplicative effect. Experimental work on fruit size in *Cucurbita Pepo* favours the latter view.

S. HINCH: The instantaneous visual threshold after light adaptation. In 1918, J. Blanchard published data on these thresholds. The eye was adapted to a given intensity by looking at a large illuminated area. At a given moment the adapting light was cut off and the minimum illumination required to make visible a central area at the same moment was determined. These data can be explained on the duplicity theory (cones functioning at high intensity and rods at low intensity), and numerical details of the data conform to the mathematical predictions of a photoreceptor process consisting of (a) a primary photochemical reaction whereby a photosensitive material is converted into active products, (b) a primary dark reaction maintaining the supply of photosensitive material, (c) a secondary dark reaction in which products of (a) undergo a change providing an impulse to the attached nerve.

G. A. MILLER: The groups of order p^m which have $m-1$ independent generators.

R. BRAUER and C. NEUBITT: Regular representations of algebras.

N. JACOBSON: Simple Lie algebras of type A.

D. V. WIDDER: The iterated Stieltjes transform.

K. MÄNGER: Metric methods in calculus of variations.

S. PARTENACK: The mean value of r^2 for Keplerian systems: a correction.

Forthcoming Events

INFORMAL CONFERENCE ON "CONDUCTION OF ELECTRICITY IN SOLIDS", July 13-16.—Arranged by the Physical Society and the University of Bristol, to be held in the H. H. Wills Physical Laboratory, University of Bristol.

Tuesday, July 13

SOCIETY FOR THE STUDY OF INHERITANCE, at 4—(at 11 Chandos Street, Cavendish Square, W.1).—Mrs. Lillias M. Blackett Jeffries: "Marriage in Relation to Alcohol and Drug Addiction".

Wednesday, July 14

BRITISH ACADEMY, at 5.—Dr. Paul Schrecker: "Leibniz: with Special Reference to his Views on International Relations".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ENGINEER at the Fuel Research Station, East Greenwich.—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (quote J. 37/10) (July 12).

LECTURER IN MINING in the Chesterfield Technical College.—The Clerk to the Governors (July 14).

LECTURER IN ELECTRICAL ENGINEERING in Armstrong College, Newcastle-upon-Tyne.—The Registrar (July 16).

LECTURER IN MECHANICAL ENGINEERING in the Northampton Polytechnic, St. John Street, N.C.1.—The Principal (July 16).

RESEARCH CHEMIST with the Bone Research Association.—Prof. W. A. Bone, Imperial College, South Kensington, S.W.7 (July 16).

LECTURER IN VETERINARY PHARMACOLOGY, LECTURER IN VETERINARY PARASITOLOGY, and LECTURER IN ANATOMY OF DOMESTICATED ANIMALS in the Department of Agriculture, I.F.S.—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 16).

LECTURER IN MATHEMATICS and LECTURER IN CHEMISTRY in the Kingston Technical College.—The Principal (July 17).

ASSISTANT (grade III) in the Signals Experimental Establishment, Woolwich, S.E.18.—The Superintendent (July 19).

LECTURER IN CHEMISTRY in the University of Birmingham.—The Secretary (July 21).

ASSISTANT CHEMIST in the Biochemistry Section of East Malling Research Station, Kent.—The Secretary (June 23).

DIRECTOR of the All-India Institute of Hygiene and Public Health, Calcutta.—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 24).

PRINCIPAL of the South-West Technical College, Walthamstow.—The Director of Education, County Office, Chelmsford (July 24).

LECTURER IN HORTICULTURE AND NATURE STUDY in the Stranmillis Training College, Belfast.—The Principal (July 29).

GEOLOGISTS in the Geological Survey of Great Britain and Museum of Practical Geology, Exhibition Road, South Kensington, S.W.7.—The Director (July 31).

STRUCTURAL ENGINEERING DRAUGHTSMEN in H.M. Office of Works.—The Chief Architect (Ref. G. W. Street), Room 131A, iv. Flr., H.M. Office of Works, Storey's Gate, S.W.1.

LECTURER IN CHEMISTRY in the Brighton Technical College.—The Education Officer, Education Office, 54 Old Steine, Brighton 1.

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT in the Croydon Polytechnic.—The Education Officer, Education Office, Katherine Street, Croydon.

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Educational Equipment for the New Age

THE address on the university in civic training, which General Smuts delivered at his installation as Chancellor of the University of Cape Town on March 2, did not receive the attention it deserved outside South Africa. It dealt with a theme which has recurred in many speeches since it was stressed by Sir James Barrett and others at the celebrations of the centenary of the University of London last year, and at the Conference on Academic Freedom at Oxford in 1935. The function of the university, General Smuts insisted, is not merely to give its students a professional qualification; it is to impart the ideals of citizenship and to fit its graduates spiritually into the world in which they had not merely to earn their living but also to play their part worthily. The university must teach the humanities—the things which furnish the student with the larger human equipment for life.

University and humanity together should form the keynote and essence of university culture, and it is in their absence that we suffer from excessive specialization and the narrow outlook responsible for so much mischief and suffering in the world to-day. Universality in its nature implies freedom from the prejudices which arise from ignorance or narrowness of outlook; it means also an impartiality, a willingness to learn and a curiosity to understand whatever life may hold for us. No less than the ordinary citizen does the university student need to avoid a single-track mentality, and his university training should give him above all a vision of harmony in the universe, of the principles of order and beauty, which should remain with him as the most satisfying and outstanding experience of his life. Science, philosophy, poetry, religion can all help to clarify and deepen that experience.

The greatest lesson that science can teach us, General Smuts urged, is respect for facts; and in the present-day tendency to follow slogans or catchwords, to worship ideologies or exalt party politics unduly, a disinterested loyalty to facts is the sovereign remedy. Equally important with this impartial spirit of science is the urbane generous spirit of humanity; and General Smuts believes that the hostility of rival fascist and communist systems to the principles of racial, religious and political toleration is a passing phase, a symptom of the confusion and unrest of the times. He urged that South Africa, more than any other country in the world, is a great human laboratory, where experiments in racial co-operation are essential to success.

If it is difficult for European onlookers to feel as confident as General Smuts of either fascism or communism learning the grace of toleration or respect for facts, his plea for universality and humanism undoubtedly will meet with a widespread response. Its force was undoubtedly recognized, for example, in the discussions at the symposium on the chemist in industry in Manchester last April, where the need for a wide outlook and high ideals, as well as technical or professional efficiency, was stressed by Prof. J. C. Philip. Here again the evils of over-specialization were discussed, though it was pointed out by Mr. F. Scholefield that this danger does not lie in the kind of subject chosen for special study, and that men can be trained for a specific technical occupation, without incurring this evil, if the training is given on right lines.

That these dangers should be recognized is all to the good, but the discussion referred to, at which much was said about the qualifications of the chemist for administrative posts, scarcely stressed

sufficiently the social responsibilities of industrial management at the present time. The growing tendency for industrial efficiency to be considered not merely in terms of dividend-earning capacity or mechanical efficiency but also in relation to industrial welfare and service to the community, enhances the importance of industrial leadership having not merely high ideals and wide sympathies but also some real understanding of social problems. The industrial leader must have the wisdom of a good citizen.

The special responsibilities of the universities in this matter have been frankly recognized of late. They were stressed in the report of the University Grants Committee as well as at the Quinquennial Congress of the Universities of the Empire at Cambridge last July, and the part which the universities have played in the social surveys of the Special Areas as well as the expansion, for example, of the Economics Research Section of the University of Manchester, indicates a desire to make a practical contribution to social science and the solution of social problems on a growing scale.

Important as are these practical studies and investigations, the fundamental problem for the universities in this matter is that to which General Smuts directs attention and on which Sir Ernest Simon challenged them in an address at Cardiff last year. If the universities adequately fill their function of providing leaders and citizens who will give a wise lead to their fellows in the effort needed to eliminate weak spots in our public life and to build a better social order, the redistribution of effort in scientific research or its initiation in new fields will follow. Moreover, effective leadership in a democracy demands a measure of co-operation and understanding from its ordinary citizens which in turn requires far higher intellectual qualities than in the authoritarian State, and here again the university has responsibilities scarcely less important than in the provision of leaders.

The two problems are in fact inextricably linked. Unless the university can provide democracy with leaders capable of taking wide and disinterested views and forming sound judgments in public affairs, and of clear and critical thinking, and able to use the appropriate scientific method of thought in the complex affairs of human society, the challenge of the authoritarian State to-day can scarcely be met. Equally the university cannot be expected to provide such leaders unless the students entering its doors have received a sufficiently wide general training in human and

cultural subjects for the university to impart that stimulation and enrichment of the whole mind, independent of any specialized study the student pursues, which enable him to lead a fuller and more interesting human life and to play more adequately his part as a member of the community. Again, unless the training of the ordinary citizen in general science, in social subjects and in public affairs is wide enough to fit him to take disinterested views, to form sound judgments and to recognize and prefer wisdom and integrity in public representatives to the arts of the humbug and the demagogue, even if the supply of competent leaders is adequate, their selection by a democracy is not assured.

The heart of the problem lies accordingly in the pre-university training, especially in the post-primary or secondary school. Only as this is adequate and broad enough can the universities fulfil their own special functions of providing men and women, not merely skilled in some special subject or branch of knowledge but distinguished by a sense of values, a wide outlook, moral courage and a capacity for creative thought which, when ripened by experience, can be at the service of the community in any of the problems with which they may be confronted in their professional, industrial or civic life.

The question of training the university graduate for participation in public affairs cannot therefore be seriously considered apart from the question of educating the community as a whole. Sir Ernest Simon's insistence that the inefficiency of transfer of training implies that citizenship cannot be taught incidentally or indirectly, but that it can only be learnt by the direct study of the thought and life and actions of men in society, while undoubtedly right, should not lead us into any attempt to graft a special course of training in citizenship into the existing curricula of universities. The basic knowledge in these matters must be acquired at school. The university may incidentally extend that knowledge in certain subjects, but its main function here must be to supply the corrective to specialization, to quicken interest in human, social and cultural values, to inspire a vision of life as a whole, and to send out its graduates with a real interest in the affairs of the world, with a standard of values, a capacity for thinking clearly and some knowledge of the more difficult aspects of the problems of citizenship.

None the less, the university has certain special responsibilities in this field. In the first place, the need for developing some effective corrective to

the present excessive and premature specialization is urgent and long overdue. Society cannot afford to wait until the universities are receiving students much more adequately prepared. Internal measures in the universities themselves are undoubtedly called for, even if only as temporary expedients.

In the second place, the influence which the universities exercise on secondary school teaching and curricula, if only through the scholarship system, is enormous. That influence could easily be exerted to repress the premature and disastrous specialization which often takes place in the later years at school. To require that a candidate for a university scholarship in some special subject such as history, classics or a science should attain a high standard in general subjects or even, as Sir Arthur Salter suggests, that any candidate for a degree should be required at some stage in his career to pass an examination in some aspect of the social sciences, might well be decisive. Merely to raise the age of the school-leaving examinations or matriculation so that they become, as they already are in Scotland, actual school-leaving examinations or entrance examinations to a university, might also assist to crush out the deplorable specialization of immature minds at school responsible for some of the most untoward results of the present system.

If, for these reasons, the initiative must largely lie with the universities, there are still other responsibilities in this field which they must accept. We are not concerned only with the students of the future or even with those at present

in residence. It is equally important to touch those who have completed their courses and now fill all types of posts in industry or the professions, in some of which they have already assumed responsibilities of leadership. Only as they are awakened to the opportunities which confront them and come to recognize the duties and responsibilities of citizenship can we hope to make democracy safe against its present dangers.

This, of course, is not a task for the universities alone. There is an ample field for the activities of the Association for Education in Citizenship; and the recent conference arranged by this Association at Ashridge on the "Challenge to Democracy" affords an admirable example of what is wanted. A panel of outstanding speakers was drawn from all shades of political opinion, and, excluding party politics, they discussed the clash of ideas between dictators and democrats from the point of view of believers in the ultimate value of the full and free development of each individual citizen. The first half of the programme was concerned with the essentials of democracy; the second with the formation of public opinion, including the schools, the universities, the Press and adult education. Such a conference can scarcely fail to have a powerful effect in stimulating clear thinking on everyday affairs, and the vision and moral determination essential as preludes to the action and perpetual vigilance in defence of democracy, which alone can preserve for us in these threatening days mankind's rich intellectual heritage and freedom of thought and speech.

An Inquiry into "Marvels"

A Book of Marvels

By Lieut.-Comdr. Rupert T. Gould. (The Fountain Library.) Pp. ix+180. (London: Methuen and Co., Ltd., 1937.) 2s. 6d. net.

THIS book is mainly a survey of records of certain phenomena occurring between 20 B.C. and A.D. 1890 which, after sifting and weighing the available evidence, the author deems worthy of the designation "marvels". Some, however, may think the book scarcely bears out its title; indeed, the author himself, in the majority of his collected cases, carefully refrains from divulging his own views—if any were held—concerning the

real significance of his "marvels". These may be summarized as follows:

(1) A line of foot-prints in the snow seen in Devon in 1855 which passed through—so it was said—locked gardens and over very high walls, haystacks, and roofs of houses, as though such things constituted no impedimenta. The impressions, which were in single file, were variously ascribed to a kangaroo, an otter, a badger, a donkey, a swan, and the Devil. Sir Richard Owen's opinion that the marks were made by a badger is discounted by Commander Gould on the score that, though Owen was an eminent palaeontologist, he was given to "making dogmatic assertions,

in defiance of fact, which proved him to be possessed of a singular and not entirely scientific type of mind". For example, he insisted that the hippocampus major is the exclusive prerogative of the human brain whereas, as proved by Sir W. Flower and Huxley, it is a structure man shares with the apes; moreover, did not Owen also—and this is where the gallant Commander's sea-boot pinches—in "his utterly childish 'explanation' of the sea-serpent seen by H.M.S. *Daedalus* in 1848" postulate that the naval officers who saw it "were, one and all, half-witted"!

(2) Movements, by unknown agents, of coffins in sealed-up vaults. Floods admittedly entered some of these vaults, robbers broke into others, while yet others were in an area of occasional seismic disturbances. In 1899 Alfred Russel Wallace quoted Dale Owen's account of the coffin movements at Arensburg as "the best evidence as to occurrences which were, and are, wholly inexplicable". The value of this particular evidence may be gauged from the fact that the account was given to Dale Owen in 1859 (fifteen years after the alleged movements) by people who had only troubled to visit the vaults some considerable time after they had heard that certain individuals reported "groans" coming from the cemetery. Commander Gould admits that the evidence in this case was at third hand, and even so by a person with very little capacity for assessing its value; yet in the same breath he maintains that in the case of certain other coffin movements the disturbing agent "was neither human nor natural".

(3) The next "marvel" is an alleged power to sense (*nauscopie*) the approach of ships far below the horizon—sometimes three or four days' run distant. As the principal 'wizard' in these feats attributed his successes—there were also misfires—to careful observations of high-level atmospheric changes induced by the presence of the vessels beneath, further comments are needless.

(4) We are then reminded of the giants with which hearsay has peopled the earth since the days of the tales of Titan and Typhon, but whose outward and visible signs have invariably turned out to be either the skeletal remains of mammoth or other large lower animals or, where actually seen in the flesh, victims of ill-balanced endocrine glands.

(5) Acoustic mysteries, such as the ringing of bells in houses by undiscovered agents, and the hammer-like sounds alleged to have been emitted by Memnon at Thebes and heard by various celebrities between 20 B.C. and A.D. 190, since which date there has been silence. In the author's opinion, unequal expansion of the materials of the Colossus was the probable cause of the sounds.

(6) The most interesting part of the book is undoubtedly the account of some experiments carried out by Captain W. E. Parry in 1822 to determine the velocity of sound. At Winter's Island, with thermometer showing -25°F. , and the barometer 28.84 inches, fifteen rounds were fired from a six-pounder gun at an angle of elevation of 10° , the times of flash and report being recorded by observers 5,645 ft. distant. The mean of these gave a velocity of 1,023 ft. per sec. What perplexed Parry, however, was that the order 'Fire!' sometimes reached the observer about half a second *after* the gun's report. Commander Gould endorses an explanation of this anomaly which was sent him by a correspondent, namely, that as the velocity of sound increases with increase of temperature, the word 'Fire!', travelling over a slightly colder route nearer the ice, reached the observers after the report of the gun which, in consequence of the 10° elevation, passed through a higher and slightly warmer air route. This explanation, in view of what must have been a very slight difference of temperature (t) of the two converging sound paths, seems to the reviewer far-fetched, especially in the light of the formula $v=1093\sqrt{1+0.00366\ t}$. It has been shown by many experiments that the velocity of the compression wave of sound increases with its intensity, a violent noise actually travelling faster than a gentle one. Jacques, for example, found that the sound emitted by the explosion of half a pound of gunpowder travelled at 1,032 ft. per sec., while that from $1\frac{1}{2}$ pounds had a velocity of 1,187 ft. per sec. Surely this principle better explains the anomaly referred to by Gould. Other acoustic mysteries alluded to are distant cannon-like rumblings occasionally heard in mountainous regions. Colonel Godwin Austen, whose name is immortalized in the 28,265 feet high Himalayan peak, heard them when surveying in 1865. Similar sounds are also heard off the Belgian coast where, says Gould, they are locally known as 'fog-hiccups'.

The book concludes with *pro* and *con* arguments concerning the presence of canals in Mars.

These chapters, which must have involved a considerable amount of diligent delving into ancient records, savour in the majority of cases of much ado about nothing. We are surrounded by marvels; they make contact with us every day of our lives. How do radiation waves, from the fifteen-mile-long Hertizian, to the twenty million millionth of an inch cosmic waves, make their way through a *vacuum*? What is the secret of 'action at a distance', and how does an apple fall to the ground? What are 'energy' and 'matter', how are they mutually convertible, and how does the brain, as a synthesized aggregation

of their fundamentals—photons, electrons and protons—feel, think, and—marvel? Here, indeed, are matters worthy of wonder, real marvels which put the mysterious pullings of bell-wires and movements of coffins in their proper perspective. Hearsay statements concerning events the causes of which were not ascertained, especially when made by credulous people with a mystical bent,

though not necessarily devoid of truth, are always suspect. Science has carried all before it in virtue of two golden rules, the one, to “take no man’s word for it”, the other to be economical in assumptions in accordance with the Law of Parsimony that causes are not to be multiplied beyond mental necessity—*Entia non sunt multiplicanda praeter necessitatem*.
CHARLES M. BRADNELL.

A Compilation on Migrations

The Wandering Spirit:

a Study of Human Migration. By Dr. Ragnar Numelin. Pp. xvi+375. (London: Macmillan and Co., Ltd., 1937.) 20s. net.

IN his attempt to analyse the conditions and stimuli underlying human migrations, Dr. Numelin has cast his net over the entire world, and has considered human movements from Palaeolithic times down to the present day. But, although his many citations show that the physical and social conditions promoting migration are very complex, his methods and criteria are too vague to yield satisfactory results.

Despite his strictures on their loose use by others, the author uses terms like migration, wandering and nomadism without clear distinction, and he often fails to discriminate between seasonal movements of all or part of a community within its territory and group migration from one territory to another. Much of the movement among food-gathering peoples, of which he cites many examples, is in its seasonal and cyclic character to be distinguished clearly from large-scale displacements under pressure of food shortage or human enemies, and the author does not seem to have considered the evidence for territorial fixation among these peoples. This confusion of seasonal movements and journeying with migration in the sense of permanent displacement also leads him to regard fishing peoples as more migratory than primitive collecting and hunting groups. There is much evidence from western North America and north-eastern Asia, not mentioned by Dr. Numelin, which suggests that the contrary is more generally true.

Although a great deal of material is brought together in this volume, the use of sources is often very uncritical. The author frequently omits to mention or consider much recent work on peoples discussed, while general statements and assumptions of earlier writers are accepted as definitive. Assuming that remote linguistic relationships imply tribal migration between particular areas,

he reaches improbable conclusions which are supported by no real evidence. The Iroquois, for example, are described as having migrated as coherent tribal groups from country west of the Mississippi, and the Navajo are brought to New Mexico from Alaska!

Dr. Numelin accepts creation myths as evidence of the origin and course of migrations of particular peoples, citing with approval for the Pueblo area the conclusions of Fewkes which, as later workers have shown, reduced the theory of historical migrations to absurdity. On the other hand, he does not refer to the more recent studies of Pueblo society by Kroeber, Parsons, and others, in which observed processes of fission and migration have been analysed. He gives numerous references to pilgrimages, trade journeys, and shifting of house and village site after death or pestilence, but does not discuss either the cumulative effects of such practices or their relation to group migration.

Although the discussion of “subsistence—geographical” conditions of migration, that is, the relation between the economy and the physical conditions at a particular place and time, is in general more satisfactory, and there are useful summaries of material on transhumance and other forms of seasonal migration in Europe, the evaluation of social and physiographical factors is rarely adequate. The author occasionally lapses into crude determinism. He refers frequently to mental qualities and uses the misleading term ‘instinct’, but does not present either a clear statement or cogent evidence concerning the part played by psychological factors.

This laborious piece of work has unfortunately been undertaken without either a clear formulation of the problems to be investigated or an adequate knowledge of recent methods and results in social anthropology. Dr. Numelin has not been very happily guided by those who revised his English text, for the writing is often unidiomatic, and his meaning is sometimes quite obscure.

DARYLL FORDE.

Epilogue to the Mendeléeff Centenary in Russia

Travaux du Congrès Jubilaire Mendeléeff
Vol. 1. Pp. v+666+16 plates. Vol. 2. Pp.
iv+471+10 plates. (Moscow et Leningrad :
Académie des Sciences de l'URSS, 1936 and
1937.) 32+17 roubles.

THE Mendeléeff centenary congress held in Leningrad during September 1934 was described directly afterwards in *NATURE* (134, 799; 1934). The official report has just appeared.

The first volume contains the speeches of the Russian organizers and foreign guests, and all the lectures delivered in Leningrad. It is obviously intended for readers both in Russia and abroad; all the official Russian speeches are here followed by French versions, Russian lectures by translations into French or German, while lectures given in either of these languages—English was not used at the congress—are rendered into Russian also. There is no need to give a list of the speakers and their subjects, as these are already mentioned in the article in *NATURE* referred to above. Those lectures dealing with modern scientific questions have lost something of their topical interest through the long delay, though the various historical contributions are scarcely affected by the two years' procrastination.

Most of the foreign delegates to the congress were unable to follow the Russian speeches. While probably they were all impressed by the picturesque welcome offered by the delegation of Moscow chemical workmen, only now can they realize that the address spoken by their representative was one of the most significant delivered at the opening meeting, giving an account of the development of the Russian chemical industry; and that Prof. Nametkin's lecture traces in a most interesting manner Mendeléeff's endeavour to promote the petroleum industry in Russia. Those of Mendeléeff's admirers who had so far venerated him only as an investigator will be glad to learn how energetically he used his influence to direct this industry in the way he thought best for the benefit of his country.

The lectures delivered during the less formal continuation of the celebrations in Moscow; a few more already held in February 1934 at a meeting of the Russian Academy; and several papers which were only presented in manuscript and not read, form the subject of the second volume. The contributions by the Russian men of science frequently throw illuminating side-lights on Mendeléeff's rich and unconventional

personality; Prof. S. I. Vavilov, in a paper on the importance of physics in Mendeléeff's scientific activities, incidentally mentions that his various interests, and their simultaneity, are reflected in his private library: it contains many books, bound by himself, which unite in the same volume novels with chemical and mathematical papers.

Some of the authors have taken the opportunity of extending their addresses. Prof. Wilh. Palmaer (Stockholm) presents in no less than fifty pages a survey of his own and his co-workers researches on the corrosion of metals; two excellent plates in colour illustrate his descriptions. In a few other cases one may be inclined to regret that the authors have strictly confined themselves to their spoken addresses; if, for example, Prof. W. Noddack (Freiburg) in his remarks on the Periodic System criticizes the evidence brought forward by some investigators for the existence of the elements 61, 85 and 87, readers may ask whether the proof which he himself offered so early as 1925 for the discovery of element 43 (masurium) is any more valid; as no confirmation has been forthcoming, it might be advisable to extend his well-founded scepticism also to this place of the Periodic System.

The delay in publication is probably due to an endeavour to produce a technically faultless book, and it must be acknowledged that the two stately volumes show none of those shortcomings in paper or print so frequently met with in Russian publications. This excellent typographic achievement and the great care devoted to the German and French texts and translations deserve high praise; although they may not always be linguistically quite correct, it is very remarkable that the Russian printers and proof-readers are able to produce such long and difficult treatises practically free from misprints in foreign languages.

At the end of the second part the names of the ten honorary presidents—the list being headed by J. V. Stalin—34 presidents, 34 members of the Organizing Committee, 28 foreign and 253 Soviet delegates, and additional official details are given. Many good reproductions of pictures adorn the volumes, amongst them portraits of Mendeléeff's father and mother, which are probably little known outside Russia.

The efforts made in 1934 by the Russian authorities and scientific workers to celebrate one of their greatest compatriots are now put on record in an appropriate manner by these two fine volumes.

F. A. P.

The Plant Diseases of Great Britain :

a Bibliography. Compiled and annotated by Dr. G. C. Ainsworth. Pp. xii+273. (London : Chapman and Hall, Ltd., 1937.) 15s. net.

THIS book, to which Dr. E. J. Butler has contributed a foreword, is a successful attempt to provide the plant pathologist—at rather a high price—with the key references to the literature on the principal plant diseases of Great Britain. The 183 host plants are conveniently arranged in groups as in the Ministry of Agriculture's reports on the annual occurrence of plant diseases, from which most of the nine hundred diseases included were taken. Under each host there is a list of diseases that may affect the plant and, where possible, the common names applied to these diseases are those recommended by the Plant Pathology Committee of the British Mycological Society. The attempt to name viruses and virus diseases will be particularly welcomed by plant pathologists. A selected list of literature references, mainly English but with a sprinkling of foreign papers, is given for the majority of the diseases, and each reference is briefly annotated to indicate the contents of the paper. Where a paper is abstracted in the *Review of Applied Mycology* a reference to this is given. Two indexes are provided, one of authors and one of hosts and parasites.

The selection of the English literature has been extremely well made, but many quite uncommon or doubtfully parasitic diseases are included without comment. Indeed, the value of the book to economic workers, both in Great Britain and Overseas, would have been greatly increased if the author had attempted to assess the relative importance of the diseases, for the number of articles published about a particular disease is apt to give a very misleading impression of its economic significance. The references have evidently been carefully checked, but elsewhere misprints are frequent.

W. C. M.

Commercial A.C. Measurements

By G. W. Stubbings. Second edition, revised. Pp. xvi+348. (London : Chapman and Hall, Ltd., 1937.) 15s. net.

THIS book has been written primarily for testing engineers. For students reading for engineering examinations it will not be so useful, as there are no examples given to illustrate the application of the theory given to practical work. The author has reduced the mathematical theory to a minimum, and so does not discuss the cases where three vectors cannot be represented by three lines lying in one plane, or stated the full conditions that must be satisfied in order that the power factor of a circuit may be unity.

The author's descriptions are easy to follow and he is thoroughly familiar with the methods used in the testing departments of power stations. Apparently it is customary to express the errors of watt-hour meters as a percentage of the true registration, the number being + (positive) if the meter is fast and - (negative) if it is slow. The average consumer would probably understand the meter card more easily if fast were written for + and slow for -. It is quite unnecessary to burden the memory in this case.

Handbook of Engineering Fundamentals

Prepared by a Staff of Specialists under the Editorship of Ovid W. Eshbach. (Wiley Engineering Handbook Series, Vol. 1.) Pp. xii+1036+50. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1936.) 25s. net.

THIS book is divided into thirteen sections beginning with mathematical and physical tables and proceeding through such other subjects as mathematics, mechanics, flow of fluids, thermodynamics, electricity and magnetism, radiation, light, acoustics and meteorology, chemistry, metallic and non-metallic materials, to a final section on contracts, and certainly deals with the fundamental subjects required by the engineer.

The forty authors responsible for this work have been selected in equal numbers from the academic and industrial fields, so that, whilst the theoretical aspects of the various subjects are not overlooked, the practical applications of the theories receive due attention.

Intended as an introduction to the two volumes comprising Kent's "Engineering Handbook", and the two volumes constituting the "Handbook for Electrical Engineers", all of which are of uniform size, it possesses much useful information, but the English reader must always remember that it treats of American practice. Although containing nearly eleven hundred pages, the book is of convenient size, clearly printed, well illustrated, and firmly bound in flexible covers ; it should prove a useful addition to the library of the engineer.

The Metabolism of Living Tissues

By Dr. Eric Holmes. Pp. xi+235. (Cambridge : At the University Press, 1937.) 7s. 6d. net.

SIR F. GOWLAND HOPKINS has written a foreword in which he calls this a highly original book. Its chief claim to originality probably lies in its popular style, which strays from the narrow vocabulary generally used in scientific works in a way that is likely to shock the purists. The book is meant to be read straight through by students of biochemistry at the beginning of their course, and is likely to appeal to such readers. Advantage has been taken of the fact that the contemplation of structural formulae brings aesthetic satisfaction to many who do not really understand them. Such contemplation is encouraged by an invitation to compare the formula of the lactoflavin in vitamin B₂ with the prosthetic group of Warburg's yellow pigment. The two substances are identical, but it takes the beginner some time to discover this fact because the two versions of the formula are written differently.

After some general remarks about enzymes, oxidations and redox potentials, the metabolism of the liver, kidney, muscles and nervous system are discussed in separate chapters, with particular emphasis on carbohydrate metabolism. This is probably the best part of the book. Hormones and vitamins are mentioned in later chapters, and their formulae given. The book is intended as an introduction. There is a danger that it will come to be regarded by students as a complete account of all that they need to know.

Chemistry of Indian Opium

By Dr. H. B. Dunncliff, Chemical Adviser, Central Board of Revenue,
Government of India

OPPIUM is the spontaneously coagulated latex which exudes when the partly ripened capsules of *Papaver somniferum* L. are lanced on the living plant. On exposure to air, the white, pale-yellow or pink latex turns darkish brown and, increasing progressively in viscosity, finally becomes quite hard. The product, called 'raw opium', is brown and soft inside, and has a characteristic smell and bitter taste. As marketed, raw opium contains about 15 per cent of water, some sugar, salts, albuminous substances and colouring matter. Its most valuable constituents are varying amounts of the meconates of some twenty-five alkaloids, the chief of which is morphine. At the time of collection, the content of morphine in Indian opium is not less than 8 per cent, though 16-20 per cent has been recorded when only latex from first lancements were taken. Narcotine (5-7 per cent); codeine (1-2 per cent), papaverine (0.4-1 per cent), thebaine (0.2-0.5 per cent) and narceine (0.5-1 per cent) are also present.

Opium waste products and contraband opium are used for the manufacture of morphine and other opium alkaloids. Excise opium is used in medicine, but in India much is chewed in harmless quantities.

The Hague Convention and the Dangerous Drugs Convention of 1925 have given international definitions to the two other varieties of the commercial drug, "prepared opium" and "medicinal opium". For the latter, selected chalans of raw opium containing 9.5-10.5 per cent of morphine are employed.

In 1926, the Government of India discontinued the auctioning of "provision" opium for export and undertook the sales direct, the policy for many years having been to deal only with Governments. Also the supplies to Far Eastern countries for purposes other than medical and scientific were reduced by 10 per cent annually so as to extinguish exports by December 1935. This decision has involved great financial sacrifice to India, the sales in 1926-27 having yielded 3.36 crores of rupees (a crore is ten million rupees, approximately £750,000), while, in 1936-37, no revenue was collected under this head.

Experts have been frequently employed to report on the preparation of standard opium for sale and, for nearly thirty years, the technical side of the factory has been under the control of a chemist. W. A. Davis, indigo research chemist

to the Government of India, deputed to report on the manufacture of medical opium and opium alkaloids at Ghazipur, recommended the installation of modern factory and laboratory research equipment, and showed how the Ghazipur Factory could produce a standard opium in sufficient quantity completely to replace that from Turkey and Persia in the English and American markets. Indian medical opium, the manufacture of which at Ghazipur was first undertaken during the Great War to replace the supplies no longer available from Turkey owing to international hostilities, is a better standardized product than that from Turkey. Indian opium also contains more codeine (2-4 per cent) than the Turkish variety (less than 1 per cent).

H. E. Annett and his co-workers* have made valuable contributions to the chemistry of opium and its alkaloids. With Bose, he showed that the observed increase in the percentage ash of the latex of the opium poppy at each successive lancing up to the fourth is accompanied by a decrease in the total alkaloid content of the latex. The principal loss was in morphine, while the codeine-morphine ratio rapidly increased at successive lancements. They failed to establish any relationship between the nature of the soil and the morphine content of the opium grown on it, though there was clearly some local factor influencing the power of a plant to produce the alkaloids. Different races of poppy possibly produced opium of varying morphine content and special strains could be produced by selective manuring. Organic manures caused an increased yield of opium of higher morphine content. Similar results with superphosphate linked the beneficial effect with the phosphoric acid in the manure.

Indian opium was, and still is, inferior to Turkish opium in morphine content. This can be ascribed to such factors as faulty methods of harvesting, defective lancing and collecting, the deterioration of opium on storage and environmental conditions in India, which are unfavourable when compared with those of Turkey, where the latex is collected in a moist atmosphere with a falling temperature, while the reverse conditions, favourable to bacterial deterioration, prevail in India.

In cloudy or moist weather a brown, watery substance called 'pasewa' exudes from opium. It used to be employed as 'lewa', a mixture of pasewa and inferior opium, in pasting poppy petals as a protective layer round the balls of provision

opium. Opium mixed with excess of pasewa is termed 'pasewa amez', but little is known of the genesis, chemistry or properties of pasewa and its peculiar sensitiveness to climatic conditions.

Considerable controversy arose over the assays of opium and its alkaloids submitted to the English market for sale. These differences between results of the English chemists and the Indian factory analysis were traced to different methods being employed for the evaluation of the opium and the purity of morphine hydrochloride, and the interpretation of the results.

In 1915, the chemical work of the Ghazipur Laboratory was done by the assistant opium examiner, W. W. Todrick. His staff was augmented in 1915 by a chemical assistant, J. N. Rakshit (Rai Sahib, 1926), who eventually succeeded Todrick. Later he was designated factory chemist, but in 1929 he was appointed to the newly created post of opium chemist to the Government of India.

In 1917, Rakshit¹ showed that opium yields about 2.5 per cent ammonia, and, a year later, isolated a complex substance he called "opium wax"². Its composition varies widely from different sources, giving saponification values, 113-126, acid values, 41-45, and iodine values 130-170. The presence of hydrocarbons is also indicated, and from two other components; J. N. Ray (Lahore, unpublished work) has separated acids melting at 76° and 178° respectively, the latter being most probably a resin acid. Hence Ray suggests that opium wax is probably a resin, since destructive distillation yields an oily product resembling the higher terpenes.

Rakshit³ isolated porphyroxine from opium and reported it to be a crystalline compound with a sharp melting point different from the mixtures examined by Merck (1837), Dey (1883) and Hesse (1894). Rakshit's proposed structure for this compound has been the subject of criticism in view of the development of the chemistry of morphine.

The determination of the morphine content is a most important but controversial question, leading to modifications of standard procedure from time to time.

The Indian Opium Factory sales of medical opium of standard strength for supply to medical men and hospitals have increased from 511 lb. in 1922 to 1,800 lb. of medical opium powder and medical opium cake of B.P. 1932 strength in 1936. During the year ending September 30, 1936, 1578 lb. of crude morphine, 130 lb. of morphine hydrochloride, 14 lb. of morphine sulphate and 284 lb. of codeine were sold from the Factory. Cotarnine prepared by the oxidation of narcotine has been made to supply special orders.

Literature on the problem of the loss of morphine from opium on storage has been summarized

in an article by Dunncliff, Ray and Singh⁴. Their investigations show that the morphine content of Indian opium does not fall if it is stored under anaerobic conditions in a moist condition but that, if dried at 60° and stored in contact with air, it suffers a rapid loss of the alkaloid. When dried at 98°-100° and stored out of contact with air, the fall in morphine content is small. Simple trituration of opium with lime shows that there are ammonium salts present, but it is claimed that their formation is not due to the degradation of morphine as hitherto believed.

The consumption of excise opium in India has decreased steadily for the last six or seven years, the issues from the Ghazipur Factory having fallen from 12,767 maunds in 1919 to 5,665 maunds in 1936. This decline is to be attributed partly to the economic depression of recent years and partly to the steady increase in the duty on opium. To a large extent, opium-eating in India is quasi-medical, being used by the poor as a very common and highly valued household remedy. Its physiological importance depends not only on its morphine content but also on the presence of alkaloids like codeine, papaverine, etc., which assist in the relief of many ailments.

The conclusion that opium may have an anti-malarial action was based on the low incidence of malaria in certain districts where opium was regularly consumed. Gordon affirmed the prophylactic value of narcotine against malaria, but Chopra and Knowles⁵ have shown that it has neither curative nor prophylactic value in malaria, even in large doses.

Ahluwalia, Kochhar and Ray⁶ oxidized narcotine to cotarnine in good yield and prepared a number of derivatives of cotarnine. One of these formed from resorcinol was found, like quinine, to be an antipyretic and toxic to *Paramecia*. Its acetyl derivative may possibly find some application in gynaecology, while cotarnine phthalate is a stypic.

The opium habit, the physiological results of smoking opium, the effect of opium and morphine on the human system and morphine addiction in India have all received the attention of scientific workers and official commissions⁷, from the reports of which valuable information on these important sociological problems may be found.

¹ Report on the Opium Factory, Ghazipur, by W. A. Davis (Government Press, U.P., India, 1918.)

² *Bull. Agric. Research Inst. Pusa*, 116 (1921); *Mem. Dep. Agric. India*, 8, 1, 2 (1921); 8, 2, 3, 4 (1925); *Agric. J. Ind.*, 6 (1922).

³ *Pharm. J.*, 96, 255 (1917).

⁴ *Analyst*, 43, 321 (1918).

⁵ *J. Chem. Soc.*, 455 (1919); *Ber.*, 2473 (1926).

⁶ *Proc. Nat. Inst. Sci. India*, 1, 107 (1935).

⁷ *Indian J. Med. Res.*, 18, 5 (1930).

⁸ *J. Indian Chem. Soc.*, 9, 215 (1932).

⁹ "A.B.C. of Narcotic Drugs", by O. Anselmino. (League of Nations. Permanent Central Opium Board. Geneva, 1931.) Report of the Royal Commission on Opium, 1905. Report of the International Opium Commission, Shanghai 1909 (*North China and Daily News Herald Ltd.*, Shanghai 1909). "Indian Opium", *Bull. Imp. Inst.*, 1915, "The Truth about Opium", by W. Brereton (1882).

Recent Caterpillar Plagues in Great Britain

THE epidemic occurrence of the caterpillars of the Antler moth (*Charaxes graminis* L.) in the north of England and Scotland, and of the Willow 'Small Ermine' moth (*Hypnomena rorella* Hb.) in Suffolk, have been the subject of considerable comment, not to say confusion, in the daily Press, and since the two outbreaks are of a very different type a brief account of their essential features may be of interest.

The species first mentioned is widely distributed throughout Great Britain, haunting chiefly moor or downland, and the poorer types of pasture, where the larvæ feed on *Festuca ovina*, *Nardus stricta*, and grasses of a similar type. In lowland regions, the Antler moth appears never to increase to such numbers as to do appreciable harm; but in hill districts from South Wales and Derbyshire northwards, moorland pastures, usually at a considerable elevation, may suffer very severely, the grasses being largely destroyed and only a brown 'mat' of dead grass left. The caterpillars then occur in such numbers as to be driven by starvation to migrate in vast hordes, blocking streams and water courses, or collecting in heaps at the base of walls or other obstacles. This migratory stage, if that term be applicable, is reached when the caterpillars have nearly completed their feeding, and although a certain proportion crawl downhill towards the lowland meadows, the latter never seem to be damaged. Antler moth outbreaks occur relatively infrequently, as the following records show, although there may have been others on a smaller scale of which records have been overlooked, notably between 1827 and 1881:

- 1827 Skiddaw¹.
- 1881 Lancashire (Clitheroe)², Derbyshire³.
- 1884 Glamorgan⁴.
- 1885 Selkirk⁵.
- 1894-95 Selkirk and south-west Scotland⁶.
- 1910 Glamorgan⁷.
- 1917 Derbyshire⁸.
- 1935 Wales (Brecon).
- 1936 Brecon Beacons and Cader Idris, north-west England.
- 1937 Cader Idris (slight compared with 1936), north-west England, Scotland.

It is evident, therefore, that outbreaks seldom occur for more than two years in succession in the same area, and often they are confined to single years with long intervals in between. The factors

that lead to these enormous increases in numbers are at present unknown. The outbreak in Derbyshire in 1917 was investigated by Imms and Cole⁹, and they suggested that these factors were possibly climatic, and the fact that the hills were snow-covered in 1916-17 might have given the species greater protection during that winter. Since, however, the insect spends this season in the egg stage (a fact not then known) this explanation is not very likely to be correct. An alternative suggestion discussed by Imms and Cole was that the failure to burn hill pastures during the Great War had favoured the outbreak, but again this explanation can scarcely apply generally, and it is more probable that the causes of an outbreak are complex and due to the interaction of both climatic factors and the varying incidence of the natural enemies of the moth.

The matter clearly needs investigation; but owing to the considerable period of years that may elapse between outbreaks and the necessity for intensive field and laboratory work every year, regardless of outbreaks, the problem would seem to be more appropriate to a university department with a succession of students than to a research worker in economic entomology, who would not be able to give annually so large an amount of time required to a problem that, taken over an average of years, is not of great economic importance. So far as direct control measures are concerned, nothing of a practical nature is yet known, since the value per acre of moorland grazing is so small that it will not carry any appreciable expenditure on caterpillar control.

The Antler moth outbreaks are thus typical of a resident species that normally occurs in small numbers, but is occasionally released from the factors that exercise a natural control.

The outbreak of the other species attracting attention, the Willow Small Ermine moth (*Hypnomena rorella*) is of a different character. This moth, until 1936, was regarded as a very rare species in Great Britain, having been noted only in Sussex and Dorset, and even in these counties there seems to be no record of any permanent colony. In 1936, however, the marshland willow trees in the neighbourhood of Beccles in Suffolk were found to be heavily infested by the larvæ, and specimens were also received from Barnby, farther down the Waveney valley, while a single specimen was taken at Rockland Broad in the valley of the Yare in Norfolk, some twelve miles from Beccles⁷.

According to Goldsmith, who first recorded the Suffolk outbreak*, larvæ had been noted at Beccles some five years before his attention was directed to them. It is thus possible that there may have been a small nuclear colony of the species in Suffolk for many years. This, however, is not very likely, since the Beccles neighbourhood has been fairly well worked in respect of the Lepidoptera, and the 'nests' of the larvæ are so conspicuous that they could scarcely be overlooked. On the whole, it is more probable that the species is a recent arrival in Suffolk, having either flown or been carried by boat from the Continent.

If this suggestion is correct, the conditions favouring an epidemic increase might easily have been fulfilled, since the moth would arrive without its natural parasites, and feeding upon willows in a marshland district, where other members of the genus are not abundant, it would gain some years' start before being found by any indigenous parasites. In 1936, the rate of parasitism was certainly very low. Mr. Stringer, of the British Museum (Natural History), reared from Beccles larvæ the species *Herpestomus brunneicornis* Grav., an ichneumonid that frequently attacks the allied *Hyponomeuta padella*; but the writer obtained no parasites whatever either from Beccles or from Barnby material.

Provisionally, then, *H. rorella* may be regarded as an invader (in contradistinction to the indigenous *C. graminis*), and although it is very unsafe to prophesy, it is at least possible that it will be increasingly parasitized, and even perhaps brought completely under control as soon as it is discovered

by the parasites of our native species of *Hyponomeuta*—a process that might be hastened artificially if it were considered worth while.

As to the economic importance of the insect, it is not possible as yet to give any definite opinion. If cricket bat willow or basket willow were attacked, the species might prove a serious menace, notably to the former, since the spraying of large trees is seldom commercially worth while. Fortunately, there is some hope that neither will be affected. In Suffolk, the trees that are suffering appear to be *Salix alba* (although the writer claims no expert knowledge in this respect). However this may be, larvæ of the *rorella* brought from Beccles, and also others reared in captivity from the egg, have been given the foliage of the true cricket bat willow, but neither in 1936 nor 1937 were they able to survive on it. Similarly, they refused to feed on *Salix caprea* or other 'sallows', or on one of the basket willows that was given them. The experiments were not sufficiently extensive to justify any final conclusion in respect of the cricket bat willow, but they are at least suggestive and show that *H. rorella* is very specific in its tastes.

A note on the outbreak in 1936 was published in the *Entomologist*, to which readers may be referred for a description of the larvæ and the damage they do. J. C. F. F.

* Curtis, "Farm Insects", 507 (1833).

* Ormerod, "Report on Injurious Insects", 21 (1881).

* *Ibid.*, 16 (1884).

* *Ibid.*, 12 (1885).

* *Ibid.*, 12, (1894); 18 (1895).

* Imms and Oole. *J. Board Agric.*, 24, 516 (1917-18).

* Fryer, *Entomologist*, 69, 259 (1936).

* Goldsmith, *Entomologist*, 68, 217 (1936).

Nottingham Meeting of the British Association

AS has already been announced, the annual meeting of the British Association will this year be held in Nottingham on September 1-8, under the presidency of Sir Edward Poulton. Twice previously the Association has held its annual meeting in Nottingham. In 1866, before the foundation of University College, Nottingham, Mr. Justice Grove, Q.C., the inventor of the Grove cell, was president. It was at this meeting that Wheatstone was president of Section A (Mathematics and Physics), before which Joule read a short paper on the heating effect of an electric current in a wire, and one wonders if this paper was an abridged version of that which Wheatstone is reputed to have rejected in his capacity as a referee for Royal Society publications. At the same meeting, Sir William Huggins gave an evening

discourse on the applications of spectroscopy to the problems of stellar constitution. Among the more distinguished members present in 1866 were Frank Buckland, T. H. Huxley, A. R. Wallace, W. Crookes and H. E. Roscoe, while Dean Farrar contributed to discussions on the teaching of science in public schools, and C. F. Varley reported on the Atlantic cable successfully completed a month before the meeting. Among the visits paid to local industrial undertakings was one to Messrs. Taylor's bell foundry in Loughborough, and it is pleasant to think that members will again have an opportunity of visiting the works this September.

In 1881 the University College, Nottingham, buildings in Shakespeare Street, near the centre of the city, were opened, and these were the headquarters of the Association at its annual meeting

in 1893. Dr. J. S. Burdon Sanderson was president, and Sir Richard Glazebrook was president of Section A, which was remarkably active, and at which a committee presented a report on the foundation of a National Physical Laboratory.

This year the Association will hold all its sectional meetings in the University College buildings in University Park, provided by the munificence of the late Lord Trent and opened by H.M. King George V in July 1928. Here the members will be able to enjoy extremely pleasant surroundings, and, if they wish, refresh themselves in an open-air swimming pool.

Nottingham is the centre of a large number of industries; its connexion with textiles is well known, and there are large chemical, mining, tobacco, bicycle and general engineering undertakings in the city and immediate vicinity. Since the last meeting here, interest in lace manufacture has declined, or, rather, been replaced by activity in hosiery manufacture. Visits to representative works have been arranged, including an excursion to a coal mine, and the Geography and Geology Sections of the Association are combining in a discussion on the potential resources of the area. Members visiting Nottingham for the first time will find much to interest them in the many excursions which have been arranged to the surrounding countryside.

A meeting in which local members should be considerably interested is an evening discussion

arranged between six sections on the planning of the land of Britain. A joint meeting of the Education and Geology Sections to discuss the teaching of geology in schools is also likely to be keenly followed, and Mr. H. G. Wells's presidential address to the Education Section will naturally be of considerable interest. In addition to the evening discourses, one on "Illusions of Colour" to be given by Prof. H. Hartridge and another on "Grass and the National Food Supply" by Dr. R. E. Slade, a series of popular lectures for non-members has been arranged in the neighbouring towns. Dr. Alexander Wood will address a company of Nottingham children on "Noise", Sir Gilbert Walker will talk to a Derby audience on "The Science of Sports", Mr. R. Kay Gresswell will talk on "Rivers" at Lincoln, Dr. J. E. Constable on "Everyday Application of Physics" at Long Eaton, Prof. J. Walton on "Coal and its Origin" at Mansfield and Mr. T. M. Herbert on "Transport of Food" at Newark.

The Lord Mayor and members of the City Council will hold a civic reception at Nottingham Castle on Thursday evening, September 2, and the College Council will give a garden party on September 7. On these occasions members should find ample opportunity of meeting many of the local scientific workers and citizens who are interested in the aims and objects of the Association and who are working to make the Nottingham meeting a successful one in every way.

Obituary Notices

Prof. Thomas Mather, F.R.S.

THOMAS MATHER was a man who worked his way up to an important and honourable position from a starting condition devoid of all advantages due to financial or personal support. His early training was that of a carpenter. By strenuous evening study he won a Whitworth Scholarship at a time when these scholarships were few in number and of greater money value than is nowadays the case. With the aid of this scholarship, he supported himself at college throughout a fairly complete course of full-time study. His early education was not such as to make it possible for him to meet all the academic conditions at that time needed in order to qualify for a science degree. He could not get a degree but he could, and did, work hard at physical, mathematical, and engineering subjects, so as to leave college with a thorough grip of them. He next became an assistant to Prof. W. E. Ayrton at the start of the technical teaching work financed by the City and Guilds of London Institute. He followed Prof. Ayrton from the college at Finsbury to the one at South Kensington

which is now part of the Imperial College. On the death of Prof. Ayrton he succeeded him as professor of electrical engineering. When he died on June 23, he had lived more than eighty-one years, and during half that period he was a fellow of the Royal Society.

Mather joined Prof. Ayrton's staff at Finsbury in 1881 before the College was actually built, and while the City-Guilds classes were carried on in a boys' school, part of the playground of which was afterwards used as the site for the College. The classes at the school and later on at the College were held mainly in the evening, and were thronged with adult students all engaged in the new industry of electrical engineering. At that time, trained men were not to be found, and electrical engineering departments did not exist. There was a new and sudden demand for large laboratory classes to train men in the use of apparatus utilizing electrical currents of a magnitude previously unknown. The development of suitable training courses with corresponding testing appliances called for much ability and initiative. Prof. Ayrton

at first directed this work, but later on was content to leave it almost entirely in the capable hands of his assistant. The work grew in volume and altered in character with the change from the Finsbury to the South Kensington College, with the establishment of three-year College day-courses, and with the rapid development of electrical engineering. As years passed, the laboratories had to be enlarged and their equipment increased, and many new members of the staff had to be engaged. Mather throughout remained in control. The main work of Mather's life consisted in the development of these laboratories and in the constant assistance given by him to those who worked in them whether as ordinary course students or as exceptional ones, like Duddell, carrying out important original work.

For many years, Mather could not lecture since his speaking suffered from an impediment so serious that he often had to resort to paper to explain what he wished to say. He was quite unable to take part in the discussions at the Institution of Electrical Engineers, or at the Physical Society. Had he been able to do so, he would have been more adequately appreciated outside the College than was the case. His struggles to overcome his disability were at times pathetic, but during and after 1914, to the astonishment and delight of everyone who knew him, he was able to give lectures. These were highly esteemed by his students.

From the pure science point of view, Mather's most valuable work was an investigation concerning details in the improvement of the standard cell and involving an accurate determination of its electromotive force. This work formed the subject of papers to the Royal Society, and was probably the main factor determining his election to the fellowship of the Society.

Technical men will remember Mather best for a number of papers written, mostly in conjunction with Prof. Ayton, dealing with improvements in the construction of electrical instruments of all kinds. An instance is a set of papers on galvanometers and accessories such as the well-known Ayton-Mather shunt. Another consists of his work on electrostatic voltmeters, which involved most skilful and careful design. These instruments were widely used in practice, since at the time they were first produced they were much wanted and were the best available instruments of their kind. The precision wattmeter of Mather and Duddell is another instance of the excellence and care in detail of Mather's work. First-rate instruments and appliances suitable for college or industrial testing are now commonplace articles of commerce, but such a result could only be reached after much previous work had been done in laboratories established for technical teaching. Mather was one of the earliest and ablest pioneers in this work.

In nature, Prof. Mather was most modest and retiring. He was always kindly and willing to help in either simple or advanced work, and never wished to have such help acknowledged in public. He was

personally much liked and was held in honour by all who knew him. It would be hard to value too highly the influence of a man who spent so many years guiding the laboratory training of ordinary students and in helping in the research work of others, many of whom have become highly distinguished men.

Prof. Albert Griffiths

PROF. ALBERT GRIFFITHS was born at Chester on October 8, 1867, and after the removal of his family to Manchester was educated at the Manchester Central School, the Royal College of Science, London, and in 1887 won the Dalton entrance scholarship to the Owens College, Manchester, then one of the constituent colleges of the Victoria University. He was one of the first students to read for the honours degree in physics of the University, and at the end of his first year was awarded the Heginbottom Scholarship. He obtained the degree of B.Sc. with first-class honours in 1890, and went to Germany to continue his studies at Freiburg.

In 1893 Griffiths was elected to a Bishop Berkeley fellowship at the Owens College, and commenced a series of electrical researches, an account of which he published in the *Philosophical Magazine*, vol. 39, in 1895. He was appointed demonstrator in physics on the termination of his fellowship in 1895 and lecturer in physics at University College, Sheffield, in 1898.

Griffiths obtained his D.Sc. degree in 1899 and in the following year, after acting as head of one of the students' hostels at Sheffield, was appointed head of the physics department of Birkbeck College, London, and ultimately professor of physics. He held this position until his retirement in 1933, and founded a school of research which concerned itself mainly with problems of diffusion of salts in solutions and improvements in the methods of determining coefficients of diffusion. Heart trouble set in during the summer of 1935 and became rapidly worse early in 1937; he died on May 24. He leaves a widow and one son.

We regret to announce the following deaths:

Prof. H. E. Armstrong, F.R.S., emeritus professor of chemistry in the Imperial College of Science and Technology, City and Guilds (Engineering) College, on July 13, aged eighty-nine years.

Dr. A. A. Bialynski-Birula, formerly director of the Zoological Museum of the Russian Academy of Sciences, known for his zoological work in the Arctic and for systematic work on scorpions and Solifugidae, aged seventy-three years.

The Right Hon. Lord Ernle, M.V.O., president of the Board of Agriculture and Fisheries in 1916-19, who received the Gold Medal for 1935 of the Royal Agricultural Society "for distinguished service to the farming industry", on July 1, aged eighty-five years.

Prof. A. W. Gibb, emeritus professor of geology in the University of Aberdeen, on July 12, aged seventy-three years.

News and Views

H.M. the Queen and the University of Edinburgh.

At a special graduation ceremonial on July 8, the *Senatus Academicus* of the University of Edinburgh conferred on Her Majesty the Queen the honorary degree of doctor of laws. The degree was conferred by the vice-chancellor, Sir Thomas Holland, who expressed to Her Majesty the thanks of the University. In her reply, Her Majesty said, "I thank you, Mr. Vice-Chancellor, for the very kind words with which you have admitted me to-day to your Roll of Honour, and I assure you that I deeply appreciate the distinction which the University of Edinburgh has conferred upon me. As a Scotswoman I know the high value which my fellow-countrymen set upon education, and the important part which a university such as this plays in the civic and national life. It is very gratifying, therefore, to me to feel that as a member of this great University I am connected with so important a centre of Scottish life and thought. It is my earnest hope that this ancient foundation will long continue to prosper, and I can assure you that its interest will always lie very close to my heart." Among those present were the Right Hon. Ramsay MacDonald, and Prof. J. Graham Kerr, two of the members of Parliament for the Scottish Universities.

Sir David Prain, C.M.G., C.I.E., F.R.S.

SCIENTIFIC workers in general and botanists in particular will join in congratulations and good wishes to Sir David Prain on the occasion of his eightieth birthday, which he celebrated on July 11. Sir David Prain's career as a botanist began with his appointment as curator to the Calcutta Herbarium some fifty years ago. After twenty-one years' distinguished service to the cause of botany, both pure and applied, in India, Sir David was appointed to the directorship of the Royal Botanic Gardens, Kew, a post which he occupied no less successfully for seventeen years. On the present occasion, however, we think not merely of his many services to the welfare of science but also of his personality that has gained for him both the esteem and the affection of his colleagues. It was this personality and his wise council that rendered Sir David so eminently successful during his presidency of the Linnean Society and of the Imperial Botanical Congress, and caused him to be in so great demand as a chairman. That his kindly charm and valued advice may be long spared to us will be the wish of all his colleagues.

Prof. R. M. Gordon

PROF. R. M. GORDON, professor of tropical diseases of Africa in the University of Liverpool, has been awarded the Chalmers Medal of the Royal Society of Tropical Medicine and Hygiene, which is given annually for research of outstanding merit in tropical

medicine or hygiene. It is one of the conditions of the award that the recipient should be less than forty-five years of age. Prof. Gordon's first experience of medical research in the tropics was in Brazil, where he worked for several years on the Amazon, in the laboratory at Manaus directed by the late Dr. Wolferstan Thomas. After this, he was transferred to the staff of the Sir Alfred Jones research laboratory in Sierra Leone, West Africa, where he has since remained. In 1929 he became director of that laboratory, and in 1930 the University of Liverpool elected him to the chair of tropical diseases of Africa. Prof. Gordon has not been in the fortunate position of being able to select a subject and settle down for a long period of years of quiet research, in a specially equipped laboratory, aided by well-trained laboratory assistants, and free from administrative and financial worries. On the contrary, he has at all times had to carry out many routine duties and has had distracting difficulties and responsibilities with which to contend. When it is remembered also that the whole of his research has been conducted in the trying climate of the worst parts of the tropics, it is a great testimony to his initiative and perseverance that he has succeeded in maintaining a standard of work which compares so well with that of colleagues working in much more favourable circumstances.

DR. GORDON'S first publication was from South America, in the year 1921, and dealt with an experimental investigation into the feeding habits of *Stegomyia calopus*. In 1922 he published a record of the ancylostomes collected at sixty-seven autopsies; it was this early interest in the subject which led soon after to the publication from Sierra Leone in 1925 of a very important paper "On the effect of *Ancylostome*, *Ascaris* and *Trichuris* infection on the health of the West African natives". In bilharziasis, which constitutes a serious menace in large areas of Sierra Leone, as in many other parts of the tropics and sub-tropics, he has made notable advances by the discovery of a focus of *Bilharzia mansoni* infection, and by a very complete experimental study of the mode of transmission, and of the much debated question of the anatomy of the cercariae. His contribution to the study of malaria in many of its aspects, especially as it affects pregnant women in endemic areas, and to the subject of metazoan immunity, assume the greater value the more research on these subjects advances. His latest paper records the discovery of typhus fever in West Africa, a discovery which is clearly destined to have far-reaching results. His investigations into the distribution and bionomics of anopheline mosquitoes in the Freetown area, carried on steadily now for many years, have yielded and will yield valuable data applicable to similar regions throughout the tropics.

General Hertzog and the South African Protectorates

GENERAL HERTZOG, Prime Minister of the Union of South Africa, on his return to South Africa from attending the recent Imperial Conference in London, once more raised publicly the question of the transfer of the administration of the native Protectorates in South Africa from the Imperial Government to the Government of the Union. According to a message, which appeared in *The Times* of July 7, he alleged that the British Government has failed to carry out pledges of early transfer, which were not only conveyed to him personally by the responsible minister on several occasions, but also were embodied in the agreement which formed the substance of the *aide-mémoire* framed and made public in 1935. He went on to assert that instructions issued by the British Government to its administrative officials in the Protectorates have failed to carry out an undertaking to direct those officials to bring their influence to bear on the natives in such a manner as to induce in them an attitude favourable to the transfer to the Union.

MR. MALCOLM MACDONALD, Secretary of State for Dominion Affairs, lost no time in his reply to General Hertzog's criticisms. In a statement to the House of Commons on July 9, he made it clear that not only was there no agreement that transfer would take place within a specified time, but also that when General Hertzog had urged upon him in a personal interview that transfer should begin in the near future, he had pointed out in his reply that the situation described in the *aide-mémoire* had not greatly altered. Further, he went on to indicate that General Hertzog has been kept fully advised of developments in the matter of the Protectorates, not least of the terms of the instructions issued to officials, in which he has fully concurred. Not only did Mr. MacDonald's action meet with the full approval of the House, but also his further reiteration of the pledge that no action in the matter of transfer would be taken without previous consultation of the inhabitants of the Protectorates received its full endorsement.

Grassland Management in Great Britain

IN his presidential address delivered on July 14 to the Fourth International Grassland Congress held at Aberystwyth, Prof. R. G. Stapledon gave an interesting summary of his views concerning the approach to grassland problems in general and also in relation to the special circumstances of grassland management in Great Britain. The most hopeful line of attack on the general problem, Prof. Stapledon believes, is by employment of the regional survey method, as developed by the Aberystwyth workers in their treatment of the grasslands of Wales. The procedure is to map, classify and plan on the basis of natural regions; adapting to each the correct type of implements, fertilizers and especially the correct strains of seeds. The breeding of herbage plants should be carried out in the area for which they are intended, and interchange of genes between

different countries is more likely to be fruitful than interchange of seeds. Of the many factors concerned in the making of useful grassland, the animal is by far the most important; next comes the leguminous plant. Improvement in many instances consists in setting up such soil conditions that a suitable legume will grow, and then adopting a system of management to favour the legume as well as the grazing animal. Then follows the possibility of growing superior herbage plants that had never succeeded before in that area.

TURNING now to some of the special problems of grassland farming in Great Britain, Prof. Stapledon made a strong case for the use of the plough on grassland wherever possible. The method should be to graze hard before breaking up with the view of laying up a store of organic manure or 'stock nitrogen' in the soil. After ploughing a dressing of lime is given, and the accumulated fertility is then in shape to be cashed in the form of some arable crop or immediately put back into still better pasture. Another point of the greatest importance is the production of out-of-season keep. Much has been done lately to conserve summer grass in dried form for winter feeding, but some progress has been made in growing good quality fresh grass for use between December and March. It is a case of species and management. Choosing winter green strains of plants, the grass is heavily manured through the growing stock, further assisted by a little mineral nitrogen, and rested from the end of summer onwards. Working in this way, the Aberystwyth workers have secured on occasions as much as $1\frac{1}{2}$ tons of dry matter per acre with 14-20 per cent of crude protein between Christmas and the end of March. Here again young leys offer more possibilities than permanent pasture.

Archaeological Excavations at Tell Duweir, 1936-37

AN exhibition of antiquities from Tell Duweir, the ancient Lachish, in Palestine, opened at the Wellcome Research Institution, Euston Road, London, N.W.1, on July 12. These antiquities, with an extensive series of photographs of the site and of the work of excavation in progress, represent the results obtained by the Wellcome-Marston Archaeological Research Expedition to the Near East in the season 1936-37. The excavations were again under the direction of Mr. J. L. Starkey. The operations of the season were directed mainly to the investigation of three areas—the north-east corner of the mound on ground rising from the valley to the level of the moat of the Hyksos period; the great rock-cut excavation of shaft discovered in 1935, now ascertained to measure eighty-five feet long by seventy feet broad, with a depth of ninety feet; and the area lying behind the south-west gate, with the rising ground to the east reaching up to the walls of the Jewish palace. In the last-named area, water-borne deposits on the ancient roadway as it descends sharply on approaching the threshold of the inner gate, which had been due to the blocking of the

drainage by the fall of the gateway before assault and conflagration, afforded the first tangible archaeological evidence differentiating the two Babylonian attacks of 597 B.C. and 588 B.C., hitherto not clearly to be distinguished. Tunnels cut in the contents of the great shaft—water-borne deposits, overlying the stones of the collapsed walls of the Jewish city—have as yet afforded no evidence of exits or means of access, nor can the purpose of the shaft yet be determined. Work on this rock-cut shaft, it can be seen, was still incomplete, when it was abandoned, possibly as a result of frontier troubles before the fall of the Jewish kingdom.

A NOTEWORTHY feature among the exhibits is the collection of scarabs, which with the character of the amulets found at Tell Duweir in Sixth and Seventh Century tomb-groups illustrate the persistent influence of Egyptian beliefs and ways of thought among the peoples of southern Palestine. In one of the numerous rock tombs of the north-east corner of the Tell nearly two hundred scarabs of the Eighteenth and Nineteenth Dynasties were found. A continuous series of scarabs with the Royal name now covers the whole period of Egyptian occupation, with the exception of a gap of some fifteen years under Akhenaten and Tutankhamen. One of the most interesting objects in the exhibition, however, is a copper dagger, found in the excavations of 1934, but recently cleaned by the Palestine Museum of Antiquities and on loan by the Palestine Government. It belongs to the Hyksos period and is certainly not later than 1600 B.C. Its interest lies in the fact that it is now seen to bear on one side characters in a pictographic script, affording proof of the development of a script independently of both Egypt and Mesopotamia. With the evidence of these pictographs of the now famous inscribed ewers and of the no less remarkable Lachish letters of the pre-exilic period, of which a detailed study by Dr. Harry Torczyner is now in the press, it is now possible to piece together something of the history of the development of writing in Palestine. The exhibition will remain open until August 7, a cinematograph film of the work of the expedition being shown twice daily; and on July 16 at 5.30, and July 28 at 6 p.m. lectures on the new discoveries will be delivered by Mr. Starkey at the Wellcome Research Institution.

Gold Mining with the Aid of Aeroplanes

Messrs FRASER AND CHALMERS, of Erith, Kent, have recently equipped a gold mine at Progreso in Peru, which is at a height of 12,800 feet above sea-level in an almost inaccessible district about ninety miles south-west of the city of Cuzco. A description of this mine and of some of the difficulties that had to be overcome in transporting the whole of the mine equipment, weighing 150 tons, and the buildings, weighing about 1,000 tons, to the site of the mine is given in the *G.E.C. Journal* (General Electric Co.) for May by W. Bullock. A railway line runs to within about seventy miles of the mine; the connexion between them is a mountain track, which can only

be traversed by mules and llamas, and the journey takes fourteen days to complete. As the track over the mountains is often merely a narrow ledge on the side of a steep hill, it is impossible to carry by animals pieces of machinery or equipment more than 10 feet long. Sectionalizing the plant to this extent rendered this mode of transport impracticable. The engineers therefore chartered and equipped two aeroplanes, each capable of carrying a load of two tons. In this way it was found possible to transport reasonable loads by air. The actual time taken by air was about one hour and that taken by a llama was 14 days. The cost of the latter method, if it had been practicable, would have been one third the cost of transport by air. The ore, after being mined, is reduced in a 'breaker' and brought into the mill on a belt conveyor. It is crushed to pieces of about 2 in. cube size and distributed into a 450-ton crushed ore bin situated behind the stamp mill, which is provided with 24 stamps each having a falling weight of 2,100 lb.

Pollution of Sea and Shore by Oil

For several years, persistent complaints have been made about the damage caused to organisms upon the sea-shore and particularly to birds which frequent the surface by oil discharged from ships. The number of birds whose feathers become so coated with the discharge that they are unable to fly or to dive for food, and in consequence die a slow death from starvation, has been reported to be very great in some years and in some places. From preliminary investigations into the whole subject of oil pollution at sea, Prof. N. K. Adam has written a report, submitted to the Council of the Royal Society, and printed for private circulation, the general effect of which is to allay some of the fears aroused by the earlier records and surmises. In the seas about the British Isles, the principal sources of oil are wrecks, fuel oil accidentally discharged, usually from ballast tanks, and sludge from the cleaning of oil tanks on tankers or oil-burning ships. But the nuisance due to the oil appears to have diminished in recent years, owing partly to the regulations which now prohibit the discharge of oil or oily water near the coast, and partly to the increased use of separators on board ships. A reassuring statement is that fuel oil entirely loses its tendency to spread after a few weeks at ordinary temperatures on a water surface in contact with gravel. On the surface of the sea also it seems to disappear, for it is rare to see an oily film, and it has been found that no appreciable amount is present as an invisible film.

As regards damage caused by oil to marine plant and animal life, the evidence is inadequate and often contradictory. Prof. Adam's impression is that the moderate amount of pollution round our coasts appears to be doing little damage to life, other than birds, either between tide-marks or below low tide level; and that in other places, if there is very heavy and continuous oil pollution, life between tide-marks is seriously affected, but there is not much

evidence of damage below low tide. The impression of the present writer, however, for what it is worth, is that in a limited area where pollution may be high, animals not exposed between tide-marks suffer and may be exterminated, and the supposition was that even if adult sessile forms may be able to withstand pollution, the delicate free-swimming ciliated larvae, by which most sessile forms propagate, succumbed, and multiplication accordingly ceased. But that and several other matters referred to in the report await the test of experiment.

Economic Value of an Experiment in Transplanting

For some seventy years before 1917, the State of Pennsylvania possessed no beavers, and in that year two, imported from Wisconsin, were set free. Between 1917 and 1924, 94 beavers were imported and liberated at a cost of about 50 dollars each. So rapidly did the creatures multiply that it soon became necessary to transfer some to other parts of the State. A survey by the Board of Game Commissioners gives an idea of what the increase meant: in 1931 there were 899 beaver dams with an estimated population of 4,377; in 1934, the population had risen to 15,000. During the trapping season of 1934 the number of beavers taken was 6,455, and the pelts brought the trappers a sum total of 22,610 dollars. Wherever beavers are doing damage, as in farming communities or in irrigation areas, the policy of the U.S. Bureau of Biological Survey has been to encourage and aid in the transference of the animals to carefully selected sites where their dam building may aid in the cause of conservation. To further this policy, the Bureau has published a *Farmers Bulletin* (No. 1768) on "Trapping and Transplanting Live Beavers", in which live-beaver traps are described and trapping methods and transport are discussed for the help of farmers, stockmen, foresters and others interested in beaver control.

An Air-Conditioning Unit

AN air-conditioning unit is usually a small cabinet, the only external evidence of its purpose being two small grilles. In *Engineering* of July 9, a description is given of one meant to stand on the room floor and placed near a window as the air inlet can then be readily arranged. It is about 40 in. high, 30 in. wide and 18 in. deep. It is electrically operated, and the supply cable can be plugged into any existing power point such as one used for a radio cabinet. With the air-cooled type this is all that is required, but with the water-cooled type connexions are needed with the water supply. In both summer and winter, the incoming air is first filtered; the inlet is a permanent fixture and does not interfere with opening the window for cleaning. Otherwise the window is kept closed to keep out the noise of street traffic. The fan is driven by a motor independent of the fans used for cooling and so can provide ventilation without either heating or cooling, if the outside air is in the desired condition. The cooling of the air and the removal of excess moisture by condensation is effected by a special refrigerator. The condensate is

then re-evaporated and carried outside, so no drain-pipe is required in the air-cooled unit. For increasing the moisture in the air, the water in the humidifier tank is vaporized by an electric immersion heater. The relative humidity is settled by a hygrostat which automatically controls the heater. A small neon light indicates when the heating elements are working, and reminds the occupant to consider whether it is advisable to turn off the heat at night when leaving the conditioning plant running.

Atmospheric Pollution

THE twenty-second report on atmospheric pollution contains an account of observations for the year ending March 31, 1936 (London: H.M. Stationery Office, 1937. 6s. net). Reviewing the last twenty years, it is concluded that the effort and propaganda of the period have brought about an appreciable reduction in air contamination. This now seems to have ceased, or even changed to a slight rise, probably on account of the increased industrial activity. Again the figures for some London stations are very high, especially for sulphur. Westminster shows some of the highest figures, and compares very unfavourably with some of the industrial areas. In some cases, remarkable improvements have been rendered over a period of years, and the causes deserve scrutiny. The report is cautious in its interpretation, as the difficulty of sampling is obvious. At Burnley a fifty per cent fall has been recorded in ten years—attributed to the removal of a factory. Attention is directed to the high drop at Wakefield in total deposit, from 613 tons per square mile in 1924 to 227 tons in 1935. This may be associated with the persistent efforts made by the authorities there, and shows what is possible when those who wield political power treat seriously the problem of cleaner air. Unfortunately, it is only too rare that in local authorities the will and wish to improve the atmosphere are combined. The most important development recorded is the initiation of an intensive survey in and around Leicester—selected because it is relatively isolated from other industrial areas likely to prove disturbing factors.

Empire Conference on Tuberculosis

THE Minister of Health, Sir Kingsley Wood, delivered the inaugural address on May 3 at the Empire Conference on the "Care and After-care of the Tuberculous" at Overseas House, St. James's, London. He first reviewed tuberculosis as a cause of mortality in England and Wales. The standardized death-rate from this disease has fallen from 3,638 per million of population in 1851-55 to 687 in 1935; nevertheless, tuberculosis in this country still comes next to cancer in the list of killing diseases. Sir Kingsley next dealt with the public provision for the treatment of tuberculosis—29,000 beds in approved institutions—and the amount of expenditure thereon. He commended particularly the value of village settlements for treatment and after-care, and emphasized the importance of the after-care of patients who did not enter a village settlement.

Tuberculosis (Attested Herds) Scheme

THE Minister of Agriculture and Fisheries has amended the Tuberculosis (Attested Herds) Scheme (England and Wales) dated January, 1935, by the issue of a revised scheme, which came into force on June 1. The purpose of the new scheme, which adheres to the principles of the earlier one, is to encourage the addition of herds to the register of herds officially certified to be tuberculosis-free, by the offer of additional financial inducements to owners of cattle herds to qualify for a certificate of attestation. Further information in regard to the scheme may be obtained from the Secretary of the Ministry, Whitehall Place, London, S.W.1.

International Population Congress at Paris

UNDER the patronage of the International Union for the Scientific Investigation of Population Problems, a congress will be held in Paris for the discussion of these problems on July 29-August 1. The congress is organized by the French National Committee of the Union, under the presidency of M. Adolphe Landry, a former Cabinet Minister. Among the members of the organizing committee may be mentioned, MM. P. Rivet, J. Alquier, H. Bunle, A. Demangeon, M. Huber, R. Legendre, A. Siegfried and other distinguished workers in the field of demography. It is expected that there will be many representative delegations from a large number of countries. From Great Britain there will be members of the British Population Society, presided over by Prof. C. B. Fawcett, and of the Population Investigation Committee, presided over by Prof. A. M. Carr-Saunders, and others. America will send Prof. P. K. Whelpton, Dr. Warren S. Thompson and others. Delegations are also expected from Belgium, Czechoslovakia, Denmark, Germany, Holland, Hungary, Italy, Rumania, Sweden, and perhaps India and Japan.

THE subject-matter of the congress is divided into two main groups: quantitative problems, namely, historical demography, contemporary demography, including existing statistics, movements and international migrations, mortality, fertility and so on, and the resulting economic and social problems; and qualitative problems, namely, biometry, ethnology, transmission of characters, eugenics. Two questions are specially put forward for discussion, namely, (1) "De la meilleure méthode pour dégager et mesurer la tendance du mouvement naturel de la population"; and, (2) "La biométrie différentielle et la biotypologie, comme méthodes pour la classification des individus et des groupes". It is clear that the congress has plenty of work before it. It has been announced that the opening session will be honoured by the presence of the President of the French Republic, M. Albert Lebrun, and will take place at the Maison de la Chimie, 28 rue Saint-Dominique. All inquiries should be addressed to the Congrès International de la Population, 16 rue de l'Estrapade, Paris, V.

Leverhulme Research Fellowships

AMONG the list of Leverhulme Research Fellowships and Grants for 1937 are the following, who will carry out their researches at the places indicated:

RESEARCH FELLOWSHIPS: Prof. D. H. Bangham, professor of inorganic chemistry, Egyptian University, Cairo, the wetting of solid surfaces and the phenomena of spreading liquids thereon (Great Britain); Dr. D. Enid Charles, research fellow, Department of Social Biology, London, the mechanism of population decline with special reference to Scottish population problems (University of Aberdeen); Dr. C. W. Davies, senior lecturer in chemistry, Battersea Polytechnic, adsorption at liquid surfaces (University College, London); O. V. S. Heath, research worker, Institute of Plant Physiology, London, carbon assimilation by the green plant (Imperial College, London); Dr. J. de Graaff Hunter, late director, Survey of India, planning and execution of geodetic triangulation of great extent (renewal of present fellowship) (England); G. W. B. Huntingford, farmer, Kenya Colony, member, Nandi Land Trust Board, Government examiner in Nandi language, sociology of the Dorobo, a forest people of Kenya (Kenya); Dr. J. W. H. Lugg, biochemist, Imperial College, London, preparation and amino acid analysis of pasture plant proteins (Imperial College, London); J. P. M. Prentice, solicitor, meteors and meteor streams (England and North Africa); Dr. H. Scott, assistant keeper, Department of Entomology, British Museum, biogeographical research on the fauna of the highlands of South Western Arabia (Arabia); G. Seligman, chairman, British Group, International Commission of Snow, the transition of firn snow into glacier ice (Switzerland); Dr. H. W. Thompson, departmental demonstrator, Old Chemistry Department, University Museum, Oxford, correlation of data derivable from the spectra of polyatomic molecules with chemical problems (Pasadena).

RESEARCH GRANTS: Dr. D. Elliot Dickson, colliery surgeon, Lochgelly, Fife, occupational morbidity in coal miners (Scotland); Dr. E. M. Lind Hendricks, research worker, Imperial College, London, geological research in Cornwall (Cornwall); G. Manley, senior lecturer in geography, University of Durham, the helm wind of the Northern Pennines (England); Dr. R. E. Mortimer Wheeler, keeper, London Museum, origins in northern France of later prehistoric civilizations of Britain (France); Dr. M. Wilson, reader in botany, University of Edinburgh, a comparative study of the diseases of the Douglas fir in Europe and North America (Canada).

Beit Memorial Fellowships

THE following elections have been made by the trustees of the Beit Memorial Fellowships for Medical Research:

FOURTH YEAR FELLOWSHIPS (value £500 a year): Dr. R. P. Cook, to continue his research on cholesterol metabolism in reference to the cause of atheroma in blood vessels (at the Institute of Biochemistry, Cambridge); S. L. Cowan, to continue his research on the neuro-muscular transmission of nervous

excitation (at the Department of Pharmacology, University College, London); Dr. D. E. Green, to continue his studies on intracellular enzymes and on the influence of vitamin B on oxidation processes (at the Institute of Biochemistry, Cambridge); Dr. M. Jowett, to continue his study of the action of narcotic drugs on the metabolism of the central nervous system (at the Biochemical Laboratory, Cardiff City Mental Hospital).

JUNIOR FELLOWSHIPS (normal value £400 a year): I. A. Anderson, for research on iron analyses of diets of women of the poorer classes at Aberdeen, and studies on the treatment of anaemia (at the Metabolic Research Laboratory, Aberdeen Royal Infirmary); Dr. D. Beall, for work on sterol metabolism, with special reference to sex hormones (at the Department of Pathology, British Postgraduate Medical School, London); J. G. Chalmers, for work on the role of polycyclic hydrocarbons in experimental tumour production (at the Glasgow Royal Cancer Hospital); Dr. F. C. Courtice, to study the influence of insulin and endocrine secretions on the metabolism of prolonged muscular exercise (at the Physiology Laboratory, Oxford); H. Davson, to study the cause of primary chronic glaucoma of the eye (at the Department of Physiology and Biochemistry, University College, London); Dr. T. R. R. Mann, for research on intracellular compounds of blood pigment and the metabolism of oxalic acid in mammalian tissue (at the Molteno Institute, Cambridge); Dr. Antoinette Pirie, to study the metabolism of filterable organisms by analysis of their enzyme systems (at the Institute of Biochemistry, Cambridge); Dr. D. Richter, for work on the action of adrenaline and related substances on the metabolism of individual organs (at the Institute of Biochemistry, Cambridge).

Travelling Fellowships in Tuberculosis

THE Medical Research Council has awarded Dorothy Temple Cross research fellowships to the following, who intend to study problems of tuberculosis at centres abroad, during the academic year 1937-38: Dr. B. C. Thompson, formerly assistant tuberculosis officer, Durham County Council (renewal of present fellowship for three months); R. H. R. Belsey, resident surgical officer, Hospital for Consumption and Diseases of the Chest, Brompton, London; Dr. B. M. Maxwell, senior assistant medical officer, Cheshire Joint Sanatorium, Market Drayton; O. S. Tubbs, chief assistant to a Surgical Unit, St. Bartholomew's Hospital, London; Dr. Enid M. Williams, assistant lecturer in tuberculosis, Welsh National School of Medicine, Cardiff.

British Empire Cancer Campaign

THE quarterly meeting of the Grand Council of the British Empire Cancer Campaign was held on July 12. On the recommendation of the Scientific Advisory Committee, the following grants were approved: £500 to Dr. P. M. F. Bishop, at Guy's Hospital, for the expenses for one year of certain investigations in regard to endocrine therapy in relation to cancer; £250 to Prof. G. I. Finch, at the Imperial College of

Science and Technology, for the expenses of an investigation, on behalf of the Scientific Advisory Committee, into the nature and structure of carcinogenic compounds; and £180 to Dr. P. R. Peacock, at the Glasgow Royal Cancer Hospital, for the purchase of special apparatus for the continuation of his cancer research. On the recommendation of the Joint Committee of the Campaign and of Mount Vernon Hospital, Dr. G. Cranston Fairchild was re-appointed the William Morris research fellow in radiology at that Hospital for a further period of one year. The William Morris research fellowship was established five years ago by a generous donation of a capital sum of £25,000 by Lord Nuffield.

Occultations of Mars and Venus

IF the evening sky is clear on July 17, an interesting observation can be made without a telescope (though, preferably, slight optical aid is desirable) of the occultation of the planet Mars by the moon. The disappearance of Mars, as seen from a station near Greenwich, takes place at the moon's dark limb (the age of the moon being 9.7 days) at position angle 53° from the north point of the disk, measured eastwards, at $21^h 13^m$ U.T. ($22^h 13^m$ Summer Time). The reappearance of Mars at the moon's bright limb is at position angle 326° at $22^h 10^m$ U.T. or $23^h 10^m$ Summer Time. The apparent diameter of Mars is about $14''$ and its stellar magnitude -0.8 . A map in the B.A.A. Handbook for 1937 gives the limits on the earth's surface of the visibility of this occultation. The occultation of Venus by the moon on August 3 takes place in full daylight and cannot, in any event, be seen from southern England. The southern limit of visibility of partial occultation, as given in *J. Brit. Ast. Assoc.*, March, p. 187, runs approximately between Hull, Bradford and a little north of Blackpool; the southern limit of total occultation runs from just south of Bridlington, to Borough Bridge and just north of Carnforth. At Edinburgh, the disappearance of Venus is due at $8^h 26^m$ U.T. at position angle 159° from the north point of the moon's disk, and the reappearance at position angle 212° at $9^h 1^m$ (add 1^h to convert to Summer Time). The phenomenon will require telescopic aid generally, though Venus can on occasions be 'picked up' in daylight by keen-sighted observers. The moon's age is 26.2 days, so that the crescent is a very narrow one. Venus is in its gibbous phase, the ratio of the illuminated area of the disk to that of the entire apparent disk ($17''$ in diameter) being 0.67. Its stellar magnitude is -3.6 . The position of Venus on August 3 at 9^h is R.A. $5^h 53^m.0$; Dec. $+21^\circ 20'$.

A New Comet (1937 f)

A NEW comet was discovered on July 4 not far from the star, β Persei (Algol), by Mr. Finsler at Zurich. At discovery, the comet was diffuse without a central condensation of nucleus, but two days later, according to an observation made at Barcelona, a nucleus was observed as well as a short tail somewhat more than 1° in length. The *International*

Astronomical Union Circular No. 664 from Copenhagen gives elements of the comet derived from observations made at several observatories from July 4 to July 7. Independent elements of the comet's orbit are derived by Möller (Copenhagen), Kwiek (Poznań) and Cunningham (Harvard). These elements give the time of perihelion passage, respectively, as August 12.435, 11.139 and 14.52 U.T. The ephemeris derived from Möller's elements gives the position of the comet at 0^h U.T. on July 14, 18 and 22 as follows:

	R.A.	N. Decl.
July 14	3 ^h 17.5 ^m	45° 43'
18	3 ^h 25.6 ^m	40° 50'
22	3 ^h 39.1 ^m	55° 31'

Dr. Steavenson has already observed this comet, which promises to be an interesting object. Its present magnitude is 7, but the decrease in its present heliocentric and geocentric distances, 1.05 and 1.25 units respectively, will probably cause a considerable increase in brightness.

Announcements

THE first award of the Johannes Schmidt Medal has been made to Mr. Henry G. Maurice, fisheries secretary of the Ministry of Agriculture and Fisheries, and president of the International Council for the Exploration of the Sea, in recognition of his great services to international oceanographical and fisheries research. Most appropriately the presentation, by H.R.H. Prince Waldemar of Denmark, was made in the new offices of the Council in Charlottenlund Slot, on the occasion of the thirteenth annual meeting of the Council, which was held on July 5-10.

IN connexion with the centenary celebrations of the University of Athens (see *NATURE*, May 1, p. 749), the honorary degree of doctor of science was conferred upon Sir Napier Shaw, formerly director of the Meteorological Office and honorary president of the Commission for the Exploration of the Upper Air.

THE following officers have been elected to the Council for the year 1937-38 of the Institution of Electrical Engineers: *President*, Sir George Lee; *Vice-Presidents*, Sir Noel Ashbridge, Mr. J. R. Beard; *Hon. Treasurer*, Mr. W. McClelland.

THE following, among others, were granted Civil List pensions during the year ended March 31, 1937: Mrs. Jessie Bennett, in recognition of the services rendered by her husband, the late Mr. Arthur Bennett, to botanical science (£80); Dr. Maurice Copisarow, in recognition of his services to science, and in particular to chemical research (£130); Mrs. Elizabeth MacKenzie, in recognition of the services rendered by her husband, the late Mr. Donald MacKenzie, to the study of anthropology, mythology and folk-lore (£70).

THE following appointments have recently been made in the Colonial Service: R. A. Wright, veterinary officer, Malaya; R. J. A. W. Lever (entomologist, British Solomon Islands Protectorate),

entomologist, Fiji; C. Swabey (assistant conservator of forests, Trinidad), forestry officer, Jamaica; K. J. Johnston (superintendent of surveys), assistant surveyor general, Ceylon; A. V. Lawes (surveyor, Tanganyika), surveyor, Gold Coast; H. M. W. Nicholson (assistant pharmacist), pharmacist, medical department, Tanganyika; H. F. Rainsford (staff surveyor, Tanganyika), computer, survey department, Uganda; W. F. Wegener (assistant chief mechanical engineer), chief mechanical engineer, Federated Malay States Railways; W. W. Williams (assistant superintendent), superintendent of surveys, Ceylon; L. G. O. Woodhouse (assistant surveyor general), deputy surveyor general, Ceylon.

PROF. PAUL MONTÉL, professor of the theory of functions and theory of variability at the Sorbonne, has been elected a member of the Section of Geometry of the Paris Academy of Sciences, in succession to the late Prof. E. Goursat.

M. LÉON GUILLET, director of the École Centrale des Arts et Manufactures, and professor at the Conservatoire des Arts et Métiers, Paris, has been nominated an honorary vice-president of the Iron and Steel Institute.

PROFS. JULIUS BORDWIJ, director of the Pasteur Institute of Brussels, and Pierre Nolf, president of the Red Cross, have been awarded the Grand Cross of the Order of Leopold.

DR. RUFUS COLM, director of the Hospital of the Rockefeller Institute for Medical Research since 1909, has retired. His successor is Dr. Thomas Milton Rivers, who has been a member of the board of scientific directors of the International Health Division of the Rockefeller Foundation since 1927.

THE Paul Appel Prize and Gold Medal of the Renaissance française, for the best contribution in recent years to the campaign against social scourges, has been awarded to the French League against Cancer for the "Index Analytique Cancérologique", commenced eleven years ago under the scientific direction of MM. Forgue, de Nobile, Hartmann, Rogard and Roussy. The recipients of the prize are MM. Lacazeagne and Lavedan, general secretaries of the League.

A "Catalogue of Books and Journals on Zoology, Biology and Geology" (No. 507) for sale by W. Heffer and Sons, Ltd., Cambridge, contains 1,886 items. General works and scientific journals are well represented, as also are the groups dealing with entomology, ornithology and geology.

IN connexion with the notes on national and international standardization in *NATURE* of July 3, p. 19, we are asked to state the Survey to which they refer can be obtained from the Central Office of the World Power Conference, 36 Kingsway, London, W.C.2, price 3s. 6d., or 3s. 8d. post paid; copies may also be ordered through any bookseller.

non-specific activated diffusion. The data needed to test this hypothesis were available in papers by Edwards and Pickering³, and by Dewar⁴. Graham⁵ first noted the large temperature coefficient of the diffusion process through rubber, and that the diffusion velocities had no connexion with the molecular weights.

Edwards and Pickering's data for the diffusion of hydrogen, helium and carbon dioxide through vulcanized rubber, and Taylor, Hermann and Kemp's data⁶ for the diffusion of water through vulcanized rubber, give good straight lines when log (diffusion rate) is plotted against the reciprocal of the absolute temperature (T), with the exception of the data for carbon dioxide at temperatures of 80° and 100° C. Similarly Dewar's data (Fig. 1) for diffusion of hydrogen, helium, carbon monoxide, carbon dioxide and oxygen through pure para-rubber, give linear log (diffusion rate) vs $1/T$ curves. Energies of activation calculated from these curves for vulcanized and for para-rubber are given in the accompanying table. They are very much larger for the pure para-rubber than for the vulcanized rubber.

VULCANIZED RUBBER

PARA RUBBER

Gas	Energy (cal./mol.)	Author	Gas	Energy (cal./mol.)	Author
He	6,800	Edwards and Pickering	He	15,400	Dewar
H ₂	6,470	"	H ₂	19,000	"
	5,900	Daynes ⁷			
CO ₂	7,580	Edwards and Pickering	CO ₂	19,100	"
H ₂ O	2,780	Taylor, Hermann and Kemp	O ₂	16,300	"
			OO	19,000	"

The solubility of these gases in rubber varies only slightly with temperature⁸, so that no explanation save one involving activated diffusion can account for the velocity increasing exponentially with temperature.

RICHARD M. BARBER.

Laboratory of Colloid Science,
Cambridge.
May 29.

¹ *Altj, Phil. Mag.*, **15**, 1035 (1933).

² *Barrer, J. Chem. Soc.*, 278 (1934).

³ *Edwards and Pickering, Sci. Papers. Bureau of Stds.*, **15**, 327 (1920).

⁴ *Dewar, Proc. Roy. Inst.*, **21**, 813 (1914-16).

⁵ *Graham, Phil. Mag.*, **33**, 401 (1866).

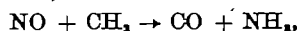
⁶ *Taylor, Hermann and Kemp, Ind.-Eng. Chem.*, **26**, 1255 (1936).

⁷ *Daynes, Proc. Roy. Soc. A*, **97**, 236 (1920).

⁸ *Wróblewski, Wied. Ann.*, **8**, (1879).

Nitric Oxide and Alkyl Ethers

THE reaction of dimethyl ether and nitric oxide has been investigated in some detail by Dr. P. F. Gay and myself¹, and whatever the mechanism of the secondary reaction which follows the suppression of the main decomposition process may be, it seems to be quite clear that it cannot be the one represented by the equation,



since the ratio, $(\text{CO} + \text{CO}_2)/\text{CH}_4$, in the product is the same as when nitric oxide is absent from the system. What does happen is that the ratio CO_2/CO

is greater when nitric oxide is present than when it is absent, and in the presence of nitric oxide the product contains very little free hydrogen. It seems likely, therefore, that the mechanism suggested by Dr. Gay and myself¹ explains the effect of the nitric oxide better than that put forward by Messrs. Thompson and Meissner in *NATURE*² of June 12.

I may point out that nitrous oxide is also certainly a product of the process, and it is interesting to note that ammonia, or an amine, is also formed. However, the significance of this observation will only be arrived at by quantitative study of an exacting character, which will be difficult.

As Dr. Gay and I have pointed out, the interaction of nitric oxide and the ethers is a particular instance of a common phenomenon involving the retardation or suppression of one process and the acceleration or initiation of another. Similar reactions have been studied in this laboratory.

MORRIS W. TRAVERS.

Department of Chemistry,
University,
Bristol.
June 16.

¹ *J. Faraday Soc.*, **33**, 768 (1937).

² *NATURE*, **138**, 546 (1936).

³ *NATURE*, **136**, 1018 (1937).

Structure and Resistance of Thin Metal Films

IT was proposed by Kramer¹ that a film below a certain 'transition temperature' is mainly amorphous, though containing some regions of normal metal, and that at the transition temperature the film is converted completely into the normal crystalline metal. The transition temperature was given by an empirical formula in terms of atomic volume, conductivity, and the number of free electrons per atom (N) in the normal metal. Structural changes have been shown to occur by different investigators², and have been discussed by them and others³. It has not always been observed that the structural changes occur at a sharply defined critical temperature, and theories alternative to that of Kramer have been proposed.

It does not appear to have been remarked that the resistance-temperature curve shown by Coslett⁴ indicates a transition temperature at about 10° C. for indium. If we take for indium $N = 3$, then Kramer's formula indicates a transition temperature of 282° K., which is in excellent agreement with Coslett's curve. Kramer takes $N = 3$ for aluminium, which would justify the use of $N = 3$ for indium, although Hume-Rothery prefers $N = 1$ in each case⁵. The transition temperature of 282° K. would not agree with the recent proposal of Fukuroi⁶ that the 'recrystallisation' temperature is 0.4 multiplied by the melting point, since the melting point of indium is 428° K., and the zero-thickness transition temperature would be higher than 282° K.

On the other hand, this agreement with Kramer's theory may be fortuitous, since, setting $N = 1$ in his formula, we obtain for rubidium and caesium transition temperatures of 80° K. and 117° K. respectively. The work of Lovell⁷ on rubidium covered the range 64°-90° K., and showed not only no transition point but a resistance-temperature curve with a positive slope, while caesium⁸ showed similarly a positive slope, which would not be expected below the transition temperature.

It seems possible that the existence of a sharp transition temperature may be associated with the desorption of gas from a film originally formed under poor vacuum conditions, or on a substrate not free from gas, owing either to the existence of a critical temperature for gas desorption or to a delay of recrystallization owing to the presence of gas. That gas may be important under high vacuum conditions (10^{-4} mm.) has been shown here in work on the high-frequency resistance of thin molybdenum films deposited on glass. High-frequency resistance is insensitive to large-scale structural changes, for example, to formation of cracks and fissures, and even to the formation of 'windows'. Nevertheless, there is an increase in film resistance with time unless the glass has been thoroughly degassed by prolonged baking.

D. A. WRIGHT.

Research Laboratories of the
General Electric Co., Ltd.,
Wembley.
May 31.

¹ Kramer, *Ann. Phys.*, 19, 37 (1934).

² Gen. Zelmanoff and Schalmkoff, *Phys. Z. d. Sowjetunion*, 4, 825 (1933). Perucca, *S. Phys.*, 91, 660 (1934). Suhrmann and Barth, *S. Phys.*, 123, 123 (1935). Comlett, *Proc. Phys. Soc.*, (3), 40, 121 (1936).

³ Tamman, *Ann. Phys.*, 22, 73 (1935). Vand, *S. Phys.*, 104, 48 (1936).

⁴ Comlett, *Proc. Phys. Soc.*, (3), 40, 121 (1936).

⁵ Hume-Rothery, "Metallie State", p. 335 (Oxford, 1931).

⁶ Fukuroi, *NATURE*, 139, 884 (1937).

⁷ Lovell, *Proc. Roy. Soc.*, A, 117, 311 (1936).

⁸ Appleyard and Lovell, *Proc. Roy. Soc.*, A, 155, 718 (1937).

⁹ Andrade, *Phil. Trans. Roy. Soc.*, A, 235, 69 (1935).

the pressure change will be a measure of the change in quantity of gas. If, therefore, within the diver processes take place involving liberation or absorption of gas, the rate of these processes may be estimated quantitatively by measuring at different times the pressures at which the diver is in (unstable) equilibrium at a fixed level.

Fig. 1 shows how this may be done on an ultra-micro scale. *A* is a diver of the simplest type and with a gas volume of approximately 10 c.mm. In the bottom of the bulb 1 c.mm. of reaction mixture (*R*) is placed, and in the neck there is a small stopper of paraffin oil (*O*). *T* is a glass tail which serves as a weight to maintain the diver in a vertical position and to regulate its equilibrium pressure at a value close to that of the atmosphere. The diver is placed in a vessel *B* filled with saturated ammonium sulphate (to reduce gas exchange to a minimum without increasing viscosity). *B* is submerged in a well-regulated thermostat ($\pm 0.02^\circ$) and connected with the manometer *M* and pressure adjuster *P*. The latter consists of a syringe the piston of which is moved by means of a rack. The manometer and the syringe are filled with water. By pressing the piston up and down it is possible to bring the diver to a temporary standstill at the mark *F*, and the corresponding pressure observed on the manometer is reproducible within 0.2 cm. water. Since this uncertainty is 0.02 per cent of the total pressure (about 1 atm.), any variation of the quantity of gas within the diver may be measured with an accuracy of $\frac{10 \times 0.02}{100}$ c.mm.

Furthermore, the equilibrium pressures of two different divers kept in two different vessels for a period of 24 hours will not change mutually by more than 0.2 cm. water.

The principle has been successfully applied to the study of choline esterase activity using the Warburg technique (change of carbon dioxide tension over bicarbonate buffered reaction mixtures). But it is also applicable to the study of respiration and generally in many cases where gasometric analysis is used.

Details and applications will be described in subsequent papers.

K. LINDERSTROM-LANG.

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May 19.

On Bremsstrahlung

THE method previously used¹ to calculate the cross-section for pair production by a beam of γ -rays has been extended to deal with transitions of a Dirac electron between two states of positive energy in a Coulomb field. It is thus theoretically possible to obtain an exact evaluation of the differential cross-section for energy loss by radiation of an electron incident on an atomic field (neglecting screening, which is justifiable for the energy values used). Actually, owing to difficulties of computation, the calculation is only practicable for fairly slow electrons losing more than half their kinetic energy in the field of a heavy nucleus. This is the case in which the values calculated by the use of Born's approximation² may be expected to be least reliable. The numerical work involved in the exact solution is too heavy to

Principle of the Cartesian Diver applied to Gasometric Technique

If for some reason or other the quantity of gas in a Cartesian diver decreases or increases, the

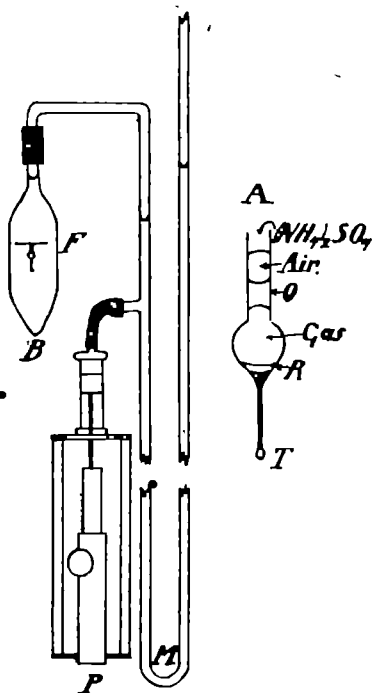


Fig. 1.

pressure necessary to bring the diver to a standstill at a fixed level will change correspondingly, that is,

allow a full survey of the low energy region, so in order to check the Born values in this region the differential cross-section (per unit energy range of the final state) has been calculated in two particular cases, for lead ($Z = 82$) for an incident electron of total energy $E_0 = 3mc^2$, losing energy $h\nu = 1.5mc^2$ and $1.95mc^2$.

The cross-sections Φ are given for these two cases and for comparison the values obtained using the Born approximation are inserted (Bethe and Heitler, *loc. cit.*, eqn. (15)).

Energy loss	$1.5mc^2$	$1.95mc^2$
$\Phi \times 10^{24}$	13	8
$\Phi \times 10^{24}$ (Born)	9.9	1.8

The values given should be correct to about 10 per cent. It appears that in this case the Born approximation gives fairly good results, except towards the short wave limit, $h\nu \rightarrow E_0 - mc^2$, where it is much too low. This is to be expected, as the wave function of the electron in the final state can no longer be regarded as an approximately plane wave.

As suggested by Heitler², it can also be shown that for the Dirac electron, as in the non-relativistic theory of Sommerfeld, the cross-section approaches a finite value at the short wave limit. We may expect that, as in the analogous case of pair production by a beam of γ -rays³, the error of the Born values will decrease rapidly with increasing E_0 and decreasing atomic number, except near the short wave limit.

Comparison with experiment is as yet impossible, but it may be noted that Klarman and Bothe⁴, using electrons of mean total energy about $3.5mc^2$ scattered in xenon and krypton, have obtained results indicating energy losses about 3-5 times those given by the Born approximation.

J. C. JAEGER.

University of Tasmania.

¹ Jaeger and Hulme, *Proc. Roy. Soc., A*, **153**, 443 (1936).

² Bethe and Heitler, *Proc. Roy. Soc., A*, **146**, 83 (1934).

³ "Theory of Radiation", p. 171.

⁴ *NATURE*, **137**, 781 (1936).

⁵ *Z. Phys.*, **131**, 499 (1935).

Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd^{+++} Ion due to Crystalline Fields

PARAMAGNETIC ions in crystals are subject to electrostatic crystalline potentials the symmetry properties of which depend mainly on the local arrangement of other atoms around the ion. For example, six oxygen atoms grouped octahedrally around the ion, as in $NdCl_3 \cdot 6H_2O$ and $Nd_2(SO_4)_3 \cdot 8H_2O$, give rise to a field of cubic symmetry of the type $D(x^4 + y^4 + z^4)$. A general method for determining the decomposition of the energy levels of the ion in such a field has been worked out by Bethe¹, and Van Vleck² has utilized this theory to account for the broad features of the temperature variation of the magnetic susceptibility of crystals. Penney and Schlapp³ have considered the rare earth salts in detail. From the temperature variation of the mean susceptibility, as measured by Gorter and de Haas, they find that the level $^4I_{5/2}$ of the free ion is split into three groups of levels at 0, 244 and 610 cm^{-1} . Spedding⁴, by direct spectroscopic measurements of the absorption spectra of this crystal, finds levels at 0, 77 and 260 cm^{-1} . From these results the conclusion is drawn that the levels predicted by Schlapp and Penney are not found, but the levels actually

observed have the same relative, but only one third overall, separation. Determining the value of the constants in Penney and Schlapp's equations, Spedding finds that his results are in better agreement with the susceptibility measurements of Zernicke and James, and of Selwood.

I wish to report on the result of certain investigations carried out in my laboratory by Mr. P. C. Mukherji on the absorption spectra of crystals of $NdCl_3 \cdot 6H_2O$, which are in good agreement with the predictions of Penney and Schlapp's theory. The detailed results are being published in the *Indian Journal of Physics*. It has been found that in the region of 5000 Å., there is an absorption band consisting of seven intense lines, and accompanied on the longer wave-length side by a similar group of six faint absorption lines.

Strong lines	Weak lines	Interval
19,144 cm^{-1}	18,897 cm^{-1}	247 cm^{-1}
19,095	18,852	243
19,062	18,820	242
19,035	18,788	247
19,001	18,752	249
18,973	—	—
18,940	18,691	249
	Mean	249 cm^{-1}

On reducing the temperature of the crystal to that of liquid oxygen, it is found that while the sharpness of the faint components increases, their intensities diminish, so that they can be observed at the low temperature with a comparatively thick crystal only ($t = 2.5$ mm.). The weak lines seem, therefore, to be due to transitions from a lower excited level of the ground term of the Nd^{+++} ion, and the observed frequency difference of 249 cm^{-1} seems to be in good agreement with the calculated value of 244 cm^{-1} found by Penney and Schlapp. This result appears to be a definite optical verification of the splitting up of a term in a crystalline field as calculated from purely magnetic data.

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92 Upper Circular Road,
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April 28.

¹ *Ann. Phys.*, **5**, 133 (1929).

² "Theory of Electric and Magnetic Susceptibilities" (Oxford, 1932).

³ *Phys. Rev.*, **41**, 194 (1932).

⁴ *J. Chem. Phys.*, **5**, 160 (1937).

THE interpretation of the absorption spectra of rare earth crystals, as given by Spedding and his collaborators¹, and by Prof. Bose in the above letter, to us seems too simple to be true. Spedding claims that his measurements on the absorption spectrum of crystals of the type $X_2(SO_4)_3 \cdot 8H_2O$, where X is a rare earth element, can be quantitatively explained on the basis of a crystalline potential $D(x^4 + y^4 + z^4)$. In the case of Pr^{+++} , for example, this potential by no means removes all the degeneracy of the lowest state, $^4H_5$, of the free ion, but gives a pattern consisting of a single, a doubly-degenerate, and two triply-degenerate levels. Spedding actually finds four low-lying levels, and identifies them with this pattern. As he points out, any terms in the potential function not of cubic symmetry will remove the degeneracy of the triple levels in first approximation, and the fact that no trace of such doubling or tripling can be detected, he takes to mean that terms other than those of cubic symmetry are practically absent.

The validity of the assumption of a crystalline field of almost perfect cubic symmetry can be tested with considerable accuracy by an appeal to magnetic data, since any deviation from cubic symmetry causes anisotropy in the paramagnetic susceptibility. At room temperatures, for the rare earths (anisotropy/mean susceptibility) must be of the same order as (splitting caused by non-cubic terms in a triply degenerate cubic level/overall splitting due to cubic field). Prof. K. S. Krishnan has kindly informed us that $\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ at room temperatures has an anisotropy roughly 10 per cent of the mean susceptibility*. Hence, separations of at least 50 cm^{-1} must be assumed between the various components of either of the two triply degenerate cubic levels of Pr^{+++} in order to account for the magnetic measurements. All nine levels of $J=4$ should show up in absorption spectra, and the failure of Spedding to locate more than four may simply mean that at room temperatures these are the only ones with any appreciable population. Again, the explanation may very well lie in peculiar intensity rules, at present not understood.

We have made further calculations on the mean susceptibility and anisotropy of $\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$, and the corresponding salts of neodymium and ytterbium. Roughly the same cubic fields, together with small rhombic terms give satisfactory agreement for Pr^{+++} and Yb^{+++} , and for Nd^{+++} at all but very low temperatures. At these temperatures, as pointed out by Van Vleck², small departures from cubic symmetry can only have the effect of *increasing* the susceptibility of Nd^{+++} , whereas the experimental results are considerably *lower* than those predicted by a field of cubic symmetry. We find that if the rhombic field is made sufficiently large to lower the mean susceptibility of Nd^{+++} to the observed value, all resemblance of the energy diagram to the cubic field pattern is lost.

Details will be published elsewhere.

W. G. PENNY.

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and Technology,
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June 2.

G. J. KYNCH.

* Spedding, Hankin and Nutting, *J. Chem. Phys.*, 5, 191 (1937), and earlier papers.

² Krishnan and Mookherji, to appear shortly in *Phil. Trans.*

³ *J. Chem. Phys.*, 5, 108 (1937).

Band Spectrum of Chromium Hydride, CrH.

CONTINUING our investigations of the spectra of the hydrides of the transition elements, we have now observed a band in the region 3600–3700 Å. when running a high-tension arc between chromium electrodes in a flame of hydrogen burning in air.



Fig. 1.

The method of production of this band is similar to that used by us to obtain the spectra of nickel hydride¹, NiH, and manganese hydride², MnH, and we attribute the new band to CrH. A spectrogram taken in the first order of a 20 ft. concave grating is reproduced in Fig. 1. The band is degraded to

shorter wave-lengths, and the rotational structure is only partially resolved under this dispersion.

The chromium oxide, CrO, bands in the orange region of the spectrum were not observed under the conditions most favourable for the production of the new band, and it seems very unlikely, for experimental reasons, that the band can be due to anything except the hydride. The chromium atom has a ³S level as its lowest state, and a high multiplicity, probably six, is therefore to be expected for the hydride; this would account for the complexity of the rotational structure of the band.

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London, S.W.7.

A. G. GAYDON.

R. W. B. PEARSE.

¹ *Proc. Roy. Soc., A*, 145, 312 (1935).

² *NATURE*, 130, 560 (1937).

Nuclear Moments of Aluminium

THE hyperfine structure of the lines $3^2P_{1/2} - 4^2S_{1/2}$ (3944 Å.), $3^2P_{3/2} - 4^2S_{1/2}$ (3961 Å.), $3^2P_{1/2} - 3^2D_{3/2}$ (3082 Å.) and $3^2P_{3/2} - 3^2D_{5/2}$ (3093 Å.) was investigated by means of the absorption in an atomic beam of aluminium. The structure of the lines $3^2P_{3/2} - 4^2S_{1/2}$ and $3^2P_{3/2} - 3^2D_{5/2}$ could not be resolved. The line $3^2P_{1/2} - 4^2S_{1/2}$ was found to possess three components at -0.048 , 0.000 and $+0.048 \text{ cm}^{-1}$ of approximately equal intensity. The line $3^2P_{1/2} - 3^2D_{3/2}$ possessed two components, their separation being 0.062 cm^{-1} ; the intensity ratio of these two components was measured to a high degree of accuracy; the mean of eighty measurements gave the value 1.21, the component of longer wave-length being the stronger.

From the observed structure of the line $3^2P_{1/2} - 4^2S_{1/2}$, it follows that the levels $3^2P_{1/2}$ and $4^2S_{1/2}$ are both split into two levels, of separation 0.048 cm^{-1} (the greater splitting of the line $3^2P_{1/2} - 3^2D_{3/2}$ is due to a small unresolvable inverted structure of the level $3^2D_{3/2}$, which is probably caused by perturbation by the term $3s3p^2^2D_{3/2}$). The observed intensity ratio of the components of 3082 Å. gives a value 9/2 for the nuclear spin, the theoretical value for a spin 9/2 being 1.22. The magnetic moment, calculated from Goudsmit's formula, is 4.1 nuclear magnetons according to the splitting of the level $4^2S_{1/2}$ and 3.6 nuclear magnetons according to the splitting of the level $3^2P_{1/2}$. The agreement between these two values is the more satisfactory as the formula for p -terms gives, according to Goudsmit, rather too low values for light elements.

The lines $4^2S_{1/2} - 5^2P_{1/2}$ (6696 Å.) and $4^2S_{1/2} - 5^2P_{3/2}$ (6699 Å.) were observed in emission; they were both doublets, only just resolvable on account of the Doppler width, of separation about 0.05 cm^{-1} ; the intensity ratio, when corrected for overlapping, was found to be about 1.23, the long wave component being the stronger. These observations are in agreement with the above conclusions.

This result is in disagreement with the contents of a preliminary note by Ritschl¹; from an observed doublet hyperfine structure in the lines 3057 and 3050 of the arc spectrum and 2669 of the spark spectrum, he suggested a nuclear spin of 1/2; but he made no intensity measurements, and the observed doublet structures can be explained by incomplete resolution.

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May 14.

D. A. JACKSON.
H. KUHN.

¹ Ritschl, *R. NATURE*, 131, 58 (1933).

Aggregation of Virus Particles

EVIDENCE confirming the description¹ by Bawden *et al.* of the shape of the tobacco mosaic virus particle appears in Best's recent photograph² of virus protein forming long threads after it has been precipitated from solution. Further evidence that virus particles, even in dilute solutions, may form chain aggregates is obtained from experiments on the relation between dilution of virus and number of infections caused.

Certain carefully purified preparations of virus³ gave, on dilution, infection series which agreed closely with an equation of the form $y = N(1 - e^{-px})$, where y is the number of infections produced by an inoculum of relative concentration x , N is the asymptotic number, n_1 is the number of virus particles in the undiluted preparation, and p is the small probability of any one particle entering one of the N points in the plant tissue to cause an infection.

In the example given of a dilution series for a purified sample of tobacco mosaic virus (ref. 3, Table 1) there was a significant divergence from the values calculated from the equation; and the results since published by Stanley^{4,5} for crystalline tobacco mosaic and aucuba mosaic proteins are widely divergent from calculated values. The number of infections increases less rapidly with concentration of virus than would be expected. In attempting to explain such divergences, we assumed that the virus particle was capable of combining reversibly with a particle of impurity to give an inactive complex. The relation between the concentration of effective virus particles, n_1x , and the total concentration, v_1x , is given by

$$(n_1x)^2 + n_1x(k - v_1x(1 - q)) - v_1xk = 0,$$

where q is the ratio of the number of particles of impurity to the number of virus particles and k is the dissociation constant of the complex. The special form of the equation which fitted the results was that when $q = 1$. This seemed to be a highly unlikely state of affairs. Search for a more likely hypothesis revealed the fact that the same equation is obtained if it is assumed that virus particles can join end-to-end to form chains, single particles or aggregates being infective units. If r is the number of junctions between particles, then using the above nomenclature,

$$r = v_1x - n_1x;$$

and if k_1 and k_2 are independent of chain length

$$k_1(n_1x)^2 = k_2r = k_2(v_1x - n_1x) \\ (n_1x)^2 + kn_1x - kv_1x = 0.$$

The infection-dilution data for a number of experiments with viruses of the tobacco mosaic group and Stanley's results with purified virus proteins^{4,5} have been tested by applying this modifying equation. The former were obtained with virus preparations at various stages of purification, but in all cases the agreement between observation and calculation is sufficiently accurate to render it likely that end-to-end aggregation is the main cause of the divergence of the results from expectations based on the simpler picture of separate virus particles.

It may be expected that the modified picture will apply only to the tobacco mosaic group of viruses,

which are thought to consist of rod-shaped particles⁶, and this has so far been borne out by experiment.

These results are described more fully in a paper to be published in the *Australian Journal of Experimental Biology and Medical Sciences*.

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¹ Bawden, F. C., *et al.*, NATURE, 138, 1051 (1936).

² Best, R. J., NATURE, 139, 628 (1937).

³ Bald, J. G., *Ann. Appl. Biol.*, 24, 33 and 56 (1937).

⁴ Stanley, W. M., *J. Biol. Chem.*, 117, 325 (1937).

⁵ Stanley, W. M., *Amer. J. Bot.*, 24, 59 (1937).

⁶ Bawden, F. C., and Pine, K. W., NATURE, 139, 546 (1937).

Production of Mutations by Neutrons

IN experiments to determine the possibility of producing mutations by treatment with neutrons, adult males of *Drosophila melanogaster* were subjected to a neutron bombardment derived from a 485 gm. block of beryllium exposed to the γ -rays from 4 gm. of radium. It is known that beryllium thus exposed produces neutrons of two velocities, the fast ones having an energy of 0.60 million electron-volts and the slow of 0.16 million electron-volts. Fast neutrons were used in one series of experiments, the very slow ones being excluded by means of a cadmium plate. In a second series, the fast neutrons were slowed down by passage through paraffin, so that only slow neutrons were used. In a third series, serving as a control, paraffin was substituted for the beryllium block, so that the flies received no neutrons but did receive the same gamma radiation and secondary radiation from the radium source as in the first two series. In these three series, a thick lead block was used to remove most of the radium γ -radiation. Finally, in a fourth series, serving as a second kind of control, the flies were not irradiated artificially in any way.

The CLB method of breeding was used, and the occurrence of all sex-linked lethals was noted. The table below gives the summarized results of the examination of the F_2 groups of flies (15,352 fertile cultures in all).

Series	No of Groups of F_2	No of lethals	Observed frequency of lethals
1. Fast neutrons plus escaping radium radiation	4312	44	1 in 98
2. Slow neutrons plus escaping radium radiation	1504	5	1 in 301
3. Escaping radium radiation without neutrons	4764	19	1 in 250
4. No irradiation	4772	12	1 in 398

It will be seen that although the radiation escaping from the radium source may have caused a few mutations, this by no means accounts for all the mutations arising in the flies treated with fast neutrons. On the other hand, the slow neutron series did not have an appreciable number of mutations produced in it, although, from a theoretical point of view, some production of mutations by this means also is to be expected.

The mutations produced by the fast neutrons probably result from the action of the recoil protons and other atomic nuclei, in producing ionization along their tracks. This effect then falls in line with that of gamma and X-rays, of fast electrons, of ultra-violet and of alpha rays, in producing mutations, being most nearly akin to that of the last-named agent.

A more detailed account of the physical arrangements and of the results obtained is in course of preparation. We wish to express our thanks to Prof. Edgar Altenburg, under whose encouragement and guidance on the genetic side the work was carried out. We wish also to thank the American Oncologic Hospital of Philadelphia for the use of its 4 gm. radium bomb.

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A Short Periodic Growth Cycle and a Secular Variation in *Lemna minor*

THE rate of frond production in *Lemna*, when grown under constant conditions in which light, temperature and culture solution were all controlled, was found to be only approximately exponential and certain deviations from the ordinary compound interest law have been established. First, there is a secular variation which takes the form of a wave with a 25-35 day cycle and, secondly, superimposed on the long variation is a short periodic cycle of 4-8 days. The short wave has been followed through 15 successive cycles in one experiment. The length of the cycle of the short, and possibly also of the long wave, appears to be correlated with the mean rate of increase in frond number, in that when grown under conditions which give rise to a rapid rate of division the cycle is short, and vice versa.

Successive measurements of dry weight show a secular 'wave' as in the case of the rate of increase in frond number. The waves in both cases are of approximately equal lengths in any one experiment, but are opposite in phase. The presence of a short periodic cycle in dry weight determinations has not been definitely established, but the data available indicate its probability.

The experiments show that, while there is neither constancy in the dry weight per frond nor in the relative rate of increase in frond number, yet the rate of increase of total mass appears to be strictly exponential.

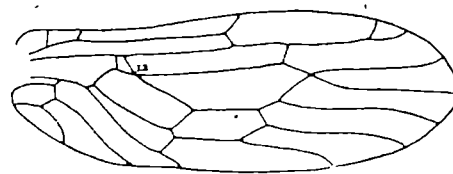
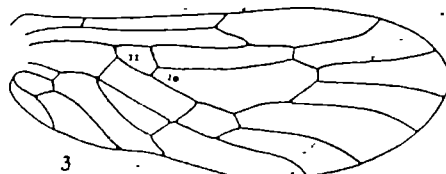
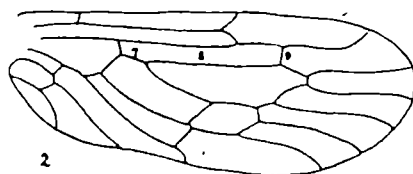
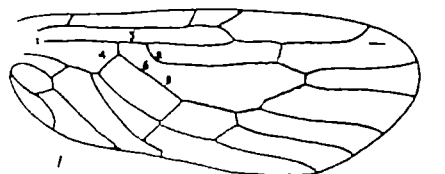
Little is known of the factors influencing the rhythmic increase in frond number and variation in dry weight, but they may be related to the fact that the growth data are those of colonies of numerous individuals, that is, that there is a social biological effect. This aspect of the matter is now undergoing investigation.

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Graded Mutations in Wings of a Stonefly

MORE than two hundred definable variants have been recognized in the wings of the variable stonefly, *Allocapnia pygmaea* Burmeister. Some of them were mentioned in a former paper¹. The three following deviations are new and merit special reference. Figs. 1 and 2 are left and right forewings of the same female, the former nearly normal, the latter highly exceptional; Fig. 3 is the left forewing of another and Fig. 4 that of a third. Left wings are seen from below. In a typical plecopterous forewing (Fig. 1), the radial sector (2) arises directly from the radius (1) by its own radicle; it is separated from the arculus or basal anastomosis (4) by a radial internode (5) and from the median stem (3) by the basimedial



passage (6). The hindwing is characterized, typically but not invariably, by a partial fusion of radial sector and median vein, which leave the arculus by a common mediosectoral pedicel. In *A. pygmaea* these veins issue separately from the arculus on an average of 8 per cent in five hundred hindwings.

In two forewings from a sample of five hundred, there is a perfect mediosectoral pedicel (7) in the right forewing of one (Fig. 2), in the left of the other, so that there is no basimedial passage, no sectoral radicle, and the interractorial cell (8) extends throughout the length of the discal area from the upper division of the arculus to the interractorial crossvein (9). In several instances an adventitious mediosectoral basal crossvein (10) passes from the angle of the sectoral radicle across the intervening space to the median vein (Fig. 3), closing off a basimedial cell (11) from the median basin. This crossvein appears in three states: strong, weak and rudimentary.

In another rare instance (Fig. 4), the sectoral radicle has attained direct nodal fusion with the median radicle (12) and has thus been drawn definitely into the mediosectoral linkage group. If the sectoral radicle faded out of existence or became merged with the arculus, the result would be that shown in Fig. 2.

In conclusion it may be remarked that while these phases are consecutive in form, they are contemporary in incidence, occurring as individual variations.

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The Neutrino Theory of Light

SOME time ago I directed attention¹ to some serious difficulties connected with the neutrino theory of light as developed by Jordan and Kronig, namely, (1) the contradiction with the superposition principle especially in the three-dimensional case, and (2) the impossibility of expressing the Bose amplitudes $b(v)$ in terms of Fermi amplitudes $\gamma(v)$. This criticism has met with objections^{2,3}. It has been pointed out that in Jordan's theory the introduction of neutrino-holes is essential and that operators satisfying the Bose commutation rules can be constructed if Dirac's theory of holes is used.

My present purpose is to elucidate some points connected with the operators considered, and to point out that (1) the problem of constructing Bose amplitudes remains unsolved, and (2) new difficulties arise in the theory when the neutrino-holes are introduced.

In a theory working with an indefinite number of particles, the following boundary condition for the wave functional is necessary. *The probability of finding more than N physical particles must tend to zero if $N \rightarrow \infty$.* The boundary conditions in the ordinary theory (physical particles are neutrinos) are thus different from those in the theory of holes (physical particles are neutrino-holes and neutrinos with positive energy). In the ordinary theory, if we put

$$L(v) = \int_{-\infty}^{+\infty} \gamma^+(\alpha) \gamma(v + \alpha) d\alpha, \quad (1)$$

we obtain¹

$$L(v)L^+(\mu) - L^+(\mu)L(v) = 0. \quad (2)$$

In the hole theory, we must introduce a new quantized wave function, $\varphi(\alpha, \epsilon)$, with $\alpha \geq 0$, $\epsilon = \pm 1$, by means of the equations

$$\varphi(\alpha, 1) = \gamma(\alpha); \quad \varphi(\alpha, -1) = \gamma^+(-\alpha); \quad (\alpha \geq 0). \quad (3)$$

The operator (1) transforms⁴ into

$$K(v) = \sum_{\epsilon=0}^{\infty} \int_0^{\infty} \varphi^+(\alpha, \epsilon) \epsilon \varphi(\alpha + v, \epsilon) d\alpha + \int_0^v \varphi(v - \alpha, -1) \varphi(\alpha, 1) d\alpha \quad (v \geq 0), \quad (4)$$

and satisfies the Jordan-Kronig commutation rules

$$K(v)K^+(\mu) - K^+(\mu)K(v) = \mu\delta(\mu - v). \quad (5)$$

Jordan and Kronig put $\sqrt{v} b(v) = K(v)$. But the Bose amplitudes $b(v)$ are defined by their commutation rules only if $b(v)$ and $b^+(v)$ form a complete set of operators, in the sense that any operator commuting with them must be a c -number. This can

only be the case if the parameter v in $b(v)$ includes all the degrees of freedom contained in the arguments of the quantized wave function φ and of the corresponding wave functionals.

This is not the case in Jordan's theory, since $\varphi(v, \epsilon)$ contains, besides v , a new degree of freedom ϵ , corresponding to a replacement of a neutrino by an antineutrino.

From this it follows that: (1) in Jordan's theory the operators $b(v)$ do not form a complete set and are not uniquely determined (we might take for example $\sqrt{v} b(v) = K(v) - K(0)$ as well); and (2) all the probabilities and mean values referring to light quanta depend essentially on the values taken by the ϵ variable.

But a neutrino cannot be distinguished by any physical means from an antineutrino, since according to the very neutrino theory their charge, their mass and their spin are the same and they possess no other physical characteristics. Thus the dependence of the above probabilities on the circumstance whether a particle is a neutrino ($\epsilon = +1$) or an antineutrino ($\epsilon = -1$) constitutes a very serious objection to the neutrino theory. If one remembers that the superposition principle is also violated in this theory and that only neutrinos having strictly parallel momentum—the probability of which is zero—are supposed to contribute to the formation of a light quantum, it is difficult to avoid the conclusion that a consistent neutrino theory of light is impossible.

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¹ Fock, V., *O.R. (Doklady). Acad. Sci. U.R.S.S.*, 4 (13), No. 5 (109), 220 (1936); *NATURE*, 138, 1011 (1936).

² Stenckelberg, E., *NATURE*, 139, 106 (1937).

³ Nath, Nagendra, *NATURE*, 139, 331 (1937).

⁴ cf. Sokolow, A., *NATURE*, 139, 1071 (1937), where a similar formula is given.

Number of Fragments of the Pultusk Meteorite

It is generally stated that the remarkable meteorite fall near Pultusk, Poland, on January 30, 1868, consisted of 100,000 stones. Thus Charles P. Olivier in his monograph "Meteors"¹ states that "the famous fall at Pultusk . . . consisted of perhaps 100,000 fragments". Also F. Heide cites in his book² the same number, and places this fall as the highest with regard to number of fragments (in the second place comes the shower at Holbrook, Arizona, on July 19, 1912, with 14,000 fragments). The same number is quoted by various works on astronomy and cosmography.

In 1936 I visited the Mineral Department of the British Museum (Natural History) in London, which contains a beautiful collection of fifty-nine Pultusk meteorites; and in the note placed on the collection I found again the total number "estimated at 100,000". The same value is given also in the guide to the collection of meteorites by Dr. G. T. Prior³.

In spite of this remarkable agreement of data, the high number of 100,000 fragments does not seem to correspond with the facts. Indeed, in the original report on the Pultusk meteorite, published in 1868 by the University of Warsaw⁴, we find that only 400 fragments had been collected, although the total number of stones which reached the ground at the time was greater. On the other hand, the Polish "Cosmography" by J. Jędrzejewicz⁵ estimates the amount of the Pultusk shower at about 1,000 stones,

and the Polish edition of the "History of the Earth" by M. Neumayr* at 3,000 stones.

What is the source of this discrepancy? The original paper of 1868 contains the figure 100,000; this, however, does not refer to the number of fragments of the shower, but only to the result of chemical analysis, which is as follows:

Silicates soluble in HCl	47.014
Silicates insoluble	52.986
	100.000

Therefore it seems to be probable that this total (100 per cent) was erroneously read by someone as hundred thousand and cited as the number of meteoric fragments.

This explanation would account for the enormous figure quoted for the number of fragments stated to have fallen on January 30, 1868, near Pułtusk. As to the real number, I believe that 3,000 stones, as given by Neumayr, may be adopted as the most probable number of fragments.

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* "Meteors" (Baltimore, 1925).

* "Kleine Meteoritenkunde" (Berlin, 1934).

* "Guide to the Collection of Meteorites" (Brit. Mus. (Nat. Hist.), 1926).

* "Notice sur la météorite tombée le 30 Janvier 1868 aux environs de la ville de Pułtusk" (Haute École de Varsovie).

* "Kosmogonia", 2nd edition, by M. Hirsi (Warsaw, 1907).

* "Dzieje Ziemi", vol. 1 (Warsaw, 1912).

Points from Foregoing Letters

FROM measurements of the energy of an electron-positron pair, produced by a beta particle of energy 1.1 MV. in a mixture of nitrogen and mercury dimethyl vapour (5 per cent), Dr. F. C. Champion and A. Barber find that there is approximate agreement with the values obtained by Skobelzyn and Stepanowa when beta particles impinged on lead. It appears that the probability of pair production by beta particles of low energy increases rapidly with the atomic number and is large when the energy of the beta particle is of the order $2mc^2$.

The rate of elimination of 0.5-14 millicuries of radon injected into rats is found by Dr. F. Běhounek and F. V. Novák to be half an hour when glucose solution is used as vehicle, and several hours when tungsten emulsion is used as vehicle.

By plotting the logarithm of the rate of diffusion (through rubber) for various gases, against the inverse absolute temperature, R. M. Barrer finds straight line relations. He also gives a table for the energies of activation, calculated from the linear diffusion curves in the case of vulcanized and para rubber, and concludes that only an explanation involving activated diffusion can account for the diffusion increasing approximately with the temperature.

A method for measuring small amounts of gas liberated during certain chemical reactions, using a modified 'Cartesian diver' technique, is described by Dr. K. Linderström-Lang.

D. A. Wright points out that the resistance-temperature curve obtained by Coslett for thin films of indium indicates a transition temperature at about 10°C ., in agreement with Kramer's formula. Thin films of rubidium and caesium, on the other hand, do not behave in accordance with deductions based on Kramer's theory.

The differential cross-section for transition of a Dirac electron between two states of positive energy in a Coulomb field has been calculated by J. O. Jaeger for lead in the case of an incident electron of total energy $3mc^2$ losing energy equivalent to 1.5 and $1.95mc^2$. The theoretical values obtained by Jaeger agree fairly well with the theoretical values calculated by means of Born's approximation except near the short wave limit.

Prof. D. M. Bose reports measurements of the absorption spectra of crystals of neodymium chloride ($\text{NdCl}_3 \cdot 6\text{H}_2\text{O}$), which, he considers, illustrate the six

oxygen atoms grouped octahedrally around a (paramagnetic) neodymium ion. Dr. W. G. Penney and G. J. Kynch point out that the agreement claimed by Spedding and others, between the spacings of the low-lying levels of various rare earth ions, as deduced from absorption spectra measurements and from theoretical considerations of the temperature variation of the magnetic susceptibilities, is probably fortuitous. The magnetic data is not sufficiently detailed to permit accurate determinations of the levels.

A spectrum band in the region 3600-3700 Å. observed when running a high-tension arc between chromium electrodes in a flame of hydrogen burning in air, is attributed by A. G. Gaydon and Dr. R. W. B. Pearse to chromium hydride.

From the intensity of the components in the hyperfine structure of the lines 3944, 3961 and 3993 Å. (observed by absorption) and 6696 and 6699 Å. (observed in emission), D. A. Jackson and Dr. H. Kuhn calculate for aluminium a nuclear spin of $9/2$, which does not agree with the previous value of $5/2$, suggested by Ritschl. The magnetic moment, calculated from Goudamit's formula, is approximately 4 nuclear magnetons.

The results of investigations on the relation between dilution of virus preparations and number of infections caused suggest, according to J. G. Bald and G. E. Briggs, that in the tobacco mosaic group there is an end-to-end aggregation of the virus particles comparable with the 'crystal' structure recently described.

Fruit flies (*Drosophila melanogaster*) treated with fast neutrons from a radium-beryllium source, show, according to Mary Nagai and G. L. Locher, a larger proportion of mutations than untreated flies, as indicated by the sex-linked lethals, which increased $2\frac{1}{2}$ times.

Certain deviations from the ordinary compound interest law of frond increase which have been established for *Lemna minor* grown under constant conditions are described by H. Dickson. These involve a secular variation which takes the form of a wave with a 25-35 day cycle, and superimposed on this a short periodic cycle of 4-6 days. Successive measurements of dry weight also show a secular wave. It is suggested that a social biological effect may be responsible for these growth cycles.

Research Items

Natives of Mount Hagen, Papua

MR. F. E. WILLIAMS, Government anthropologist, Papua, in *Man* of June, records some results of a short visit by aeroplane to the natives of Mount Hagen, the previously unknown tribes first described by Mr. E. W. P. Chinnery in 1934. Information going beyond externals was obtained from Fr. Roes of the Mission of the Society of the Divine Word, who has now resided among them for two years. He estimates that there are now 25,000 natives speaking various dialects of the Mount Hagen language, divided into some twenty tribes, who are again divided into numerous local groups. One of the most remarkable features of the life of these peoples, as well as of the Papuans recently patrolled by Hides and O'Malley, is that they have no villages, but live in scattered homesteads, to some extent grouped together as settlements, something like primitive garden cities. Descent is patrilineal, and marriage patrilocal. Girls marry young, and there is a ceremonial payment. Many households are polygamous. The natives are of strong build and fleshy with somewhat heavy, decided features and a darkish skin. The men mostly wear fine black beards, and the women roll their eyes. Altogether they are a good-looking people, of a caste that is Papuan rather than Melanesian. The main item of dress of the men is an apron of fine netting, black, greasy and soft, which is suspended from the belt, and reaches below the knees. Behind they wear numerous twigs of *Dracena* tucked into the belt. The belt is of stiff bark, up to eight inches and more in width. It is usually plain, but sometimes is decorated with incised geometrical patterns. Thongs of stiff cane may be bound round the belt near the upper and lower margins. To some extent, the belt may have served the purpose of armour. The hair is worn short by boys and youths, but nearly all adults cultivate a fairly long growth, which is tightly encased in bark cloth, bound round the forehead and occiput with a band of the same material. This gives the effect of a well-stuffed globular cushion.

Serbian Gypsy Feast-Days

DR. ALEXANDER PETROVIĆ continues his studies of Serbian gypsies with an account of the feast days they observe (*J. Gypsy Lore Soc.*, Ser. 3, 16, Pt. 3). While the Serbs belong to three religions, Orthodox, Catholic and Mohammedan, the Gypsies are Orthodox and Mohammedan only. As, however, the only mosque is at Nish, the Gypsies of other localities perform for themselves the rites of baptism, marriage and burial. In Bosnia, the Mohammedan clergy hold that the Gypsies were never true Mohammedans. On the other hand, neither are the Orthodox priests pleased with their Gypsy parishioners; but scarcely more satisfactory in his home was the Serbian peasant of the illiterate class up to the beginning of the present century, for he preserved his ancient pre-Christian customs and beliefs. While the Serbs could not carry out a feast without the services of the Gypsies in some capacity or other, the Gypsies, though thus made familiar with them, on conversion

adopted only some of the beliefs and customs of their Orthodox fellow villagers. They considered the feast of Bibi as their greatest religious holy day. Bibi is a disease—cholera. In order to protect their children from being strangled by Bibi, they founded the cult, and propitiate her by celebrating her feast day. She then protects their children from her wrath. This basic idea of a strangler going from house to house is borrowed from the Serbs, who think that the cause of every illness is some living thing that enters a man. Plague and cholera are women dressed entirely in black, who always carry an infant in their arms. It is evident that the Gypsies are beginning to forget the origin of their belief in Bibi. She is for them a Gypsy woman who has babies and likes Gypsies, protecting their children, while she strangles those of the Serbs. Many Gypsies believe that Bibi has appeared to them in their dreams, and this is to them the strongest proof that Bibi really exists. Until some years ago, Bibi's day was celebrated only by a few colonies between Belgrade and Krusevač. Now it is becoming widespread, though confined to Orthodox Gypsies speaking Roman.

Embryonic Monkeys and Man

No complete account of the intra-uterine development of any species of monkey appears to have been published, and therefore the description of the prenatal development of the grey langur, *Simnopithecus priam thersites*, by Prof. W. C. Osman Hill, is of unusual interest (*Spolia Zeylanica*, 20, Pt. 2, 211; 1937). The embryos differ from human embryos very early in showing, as a rule, a double placenta instead of a single one, in possessing 43 instead of 38 body somites, a more slender body form, a longer tail, which persists and grows after the tenth week, and slightly different feet and hands, in which the thumb is rudimentary at the 24.5 mm. stage. On the other hand, resemblances between the development of the monkey and corresponding human stages are shown in the peculiar twist on the long axis of the 9 mm. embryo, the form of the neural tube and cerebral vesicles, the mode of formation of the face and branchial arches, the slight advance in development of fore limb over hind limb, the presence of an umbilical hernia, the disproportionately large head, and large cranium relative to face, the projection of the upper jaw beyond the lower in about one third term embryos, and the presence of a lobule on the pinna. The last character seems to be confined to the family of monkeys to which the genus belongs and to man, for it is not found in the apes, nor in macaques or their relatives. It has, in fact, usually been regarded as a peculiarly human characteristic.

Effect of Pasteurization on the Nutritive Qualities of Milk

THE annual report for 1936 of the National Institute for Research in Dairying, University of Reading, recently issued, contains summaries of two researches carried out at the Institute upon the effect of pasteurization upon the nutritive qualities of milk. In one experiment, shorthorn bull calves when 4-5 days old were grouped in pairs of similar age and

weight, and one of each pair, chosen by lot, received raw, and the other pasteurized, milk until the completion of the experiment twenty-six weeks later. The milk diet was supplemented from the ninth week onwards with a little hay, and from the seventeenth week with a small allowance of crushed oats and flaked maize. Records were kept of the food consumed, the live weight gains, general appearance of the animals and other relevant matters. Eleven pairs completed the experiment, and no material difference could be detected between the two groups. The average daily live-weight gain per head for the calves receiving raw milk were 1.967 lb., for those receiving pasteurized milk 1.969 lb. Another study was on the effect of commercial pasteurization upon the nutritive value of milk. The raw and pasteurized milks were from the same bulk, the experiments being carried out on rats. No marked loss in the value of milk as food which could be attributed to commercial pasteurization could be detected. One fifth of the vitamin C content of raw milk is lost in the course of commercial pasteurization, but this is partly due to exposure to light. Milk exposed in a bottle in the sun for half an hour loses half its original anti-scorbutic properties.

Fossil Insects from Kansas Rocks

CONTRIBUTION No. 16, on Kansas Permian insects, by the late Dr. R. J. Tillyard, appeared in the December issue of the *American Journal of Science* (32, 435-463; 1936). In addition to describing new fossil mayflies, the author discusses the affinities of his group Protohymenoptera. The eminent Russian worker on fossil insects, A. Martynov, and also F. M. Carpenter, of Harvard University, claim that this group is not a separate order apparently ancestral to the Hymenoptera but a subdivision of the fossil order Megasecoptera. Carpenter claimed that Tillyard had misinterpreted the venation, and concluded that any affinities with the Hymenoptera were extremely remote. Tillyard re-examined the subject in this paper and accepted Carpenter's revision of the venation, but reaffirmed his opinion that the Protohymenoptera are ancestral to the Hymenoptera. The fact that a large and complete ovipositor is present in *Asiathohymen*, it is claimed, strengthens this argument. This character, furthermore, argues against Carpenter's contention that the Protohymenoptera are specialized members of the Megasecoptera since none of the latter possessed an ovipositor. The presence of three-segmented tarsi seems to preclude Tillyard's Protohymenoptera being on the direct line of descent of the Hymenoptera, which have five-segmented tarsi. Tillyard argued that since *Asiathohymen* is the most advanced member of the Protohymenoptera, more archaic forms may have possessed tarsi of five segments.

Scottish Copepods

DR. S. G. GIBBONS, who has already studied certain copepods of Scottish seas in some detail, now reports on collections made by the R.R.S. *Explorer* in February-November 1933 on eight cruises covering a large area and including the southern North Sea, the Hebrides and Faroes and round to the Moray Firth ("*Calanus finmarchicus* and other Copepods in Scottish Waters in 1933". Fishery Board for Scotland. Scientific Investigations 1936, No. II). Except for two large isolated patches at the surface in May and June, the bulk of the *Calanus* population (later

copepodid and adult stages only being considered) were taken in the mid-water and bottom nets and few were in the surface layer. From February until July they were mostly in mid-water; from August onwards they were in the deepest layer. This indicates a general sinking towards the end of the year. There is conspicuous vertical movement, and the figures show a maximum diurnal migration which takes place at those seasons when the hours of darkness are longest, whilst in July when the light is strong the difference is less marked. As in previous years, *Calanus* proved the dominant plankton organism throughout the year, their greatest abundance occurring in June in the Faroe Shetland Channel region, and the least in the North Sea in November. Among the other copepods mentioned is *Anomalocera patersoni*, the 'blue feed', well known as important herring food, which occurs in numbers in certain areas in May and June. It is noteworthy that, in the chart showing its abundance together with *Calanus*, it should be usually more abundant than that species when it occurs. Although nothing is said to this effect, it is probably because *Anomalocera* is eating *Calanus*, for it is a voracious copepod feeder.

Feeding Habits in Pleuronectidae

THE relationship between the structure of the brain and the feeding habits of the Pleuronectidae has been studied by H. Muir Evans (*Proc. Roy. Soc., B*, May 1937). The same author has previously shown a relationship between the structure of the medulla oblongata and the feeding habits in cyprinoids, alupeids and gadoids. In the present work, the investigation is extended to include the fore-brain, mid-brain and infundibulum. Four groups can be recognized: (1) typified by the sole, a purely bottom, night feeder; (2) typified by the plaice, which is also a bottom feeder but utilizes sight, taste and smell; (3) typified by the turbot, which is predatory and feeds by sight; and (4) typified by the halibut, also predatory and feeding by sight. The fourth group is distinguished from the third by the deep dorso-ventral extension of the olfactory lobes and by a different arrangement of the tubules of the pituitary gland.

A Disease of Hawthorn

A SHORT paper by Messrs. W. J. Dowson and W. A. R. Dillon Weston (*Gard. Chron.*, 426, June 19, 1937) directs the attention of plant pathologists to a brown rot of the hawthorn. The malady, which is fairly widely distributed in East Anglia, is caused by the fungus *Sclerotinia orotagi*. The conidial stage only has yet been found in Great Britain, but the ascigerous condition has been known for many years in Germany and the United States. Similar diseases appear on the medlar and quince, but are caused by different species of *Sclerotinia* from that which attacks the hawthorn. Symptoms are a browning of the young shoots, the dead leaves of which often bear a sweetly-scented powdery grey mould of conidia. The disease may be more widespread than is reported by the present paper, and appears to be sufficiently destructive to mar the beauty of a quick-thorn hedge.

Gold Deposits of the Canadian Shield

A REVIEW of the geological relations of some of the chief gold deposits of the Canadian Shield is presented by E. L. Bruce in a paper read at the New York Meeting of the American Institute of Mining

and Metallurgical Engineers (*Technical Publication* No. 807; 1937). Summaries are given of the Beattie and Sisoo mines of Quebec, of the mines of the Porcupine and Kirkland Lake area, and of the Howey and other mines of north-west Ontario. It is shown that there are few places in which a genetic relationship between ore-bearing solutions and neighbouring igneous rocks can be satisfactorily established. In some places where such relationships have been assumed, later investigation has shown that the igneous rocks are very much older. In deposits like those of Porcupine and Kirkland Lake, it seems likely that the solutions that formed the veins were derived from a magma far below the present surface and that the veins are localized by structural factors. The fact that contacts between igneous rocks and the rocks invaded are structurally favourable for the development of zones of fracturing, in some deposits at least, explains the occurrence of gold-bearing veins near intrusive bodies.

Formation of Submarine Canyons

IN recent years, there has been much discussion of the various hypotheses suggested to explain the formation of submarine canyons and gorges. The only hypothesis to which there are no serious objections is that proposed by Daly. During the low sea-levels of the Pleistocene glaciations, mud was stirred up by wave action on the shallowing continental shelves. In this way, a suspension was formed with a higher specific gravity than that of clear seawater. The 'heavy' liquid flowed down the continental slope, as submarine currents which developed runs in the soft bottom deposits and gradually deepened them into gorges. This theory, though superficially seeming to be improbable, has been greatly strengthened by experiments carried out at Leyden by Ph. H. Kuenen (*Leidsche Geol. Med.*, (2), 8, 327-351; 1937). The results prove that a suspension will flow down a slope without being much diluted by mixing with the adjacent clear water, and that such a flow will concentrate in slight depressions in the surface. Quantitative data and comparison with natural slopes show that the velocity of the actual submarine currents should be somewhat lower than that of large rivers, but increasing as it proceeds and picks up more sediment. At the lower end the suspension gains six times the effective density with which it began and two or three times the velocity, and at this stage the load of sediment being carried is that of the most muddy major rivers. Though the data are rough, they show that no preposterous assumptions are involved in accounting for such submarine canyons as those of the Georges Bank. It is of special interest to note that an 8 mm. film of about 20 metres length, illustrating the experiments, can be obtained at the price of 8 guilders from the Rijksmuseum van Geologie at Leyden.

A New Type of Threaded Connexion for Oil Well Casing

At a meeting of the Institution of Petroleum Technologists on May 4, Mr. W. M. Frame described a new type of threaded connexion for use on oil well casing. Casing having such connexions is known as 'extreme line casing' and is being used successfully in a number of the United States oil fields. The joint consists simply of an upset, threaded pin end and an upset, threaded box end without any coupling. A shoulder is provided on the pin end to avoid any abrupt change of contour, and the outer surface is

turned and the inner bored to give more accurate joint dimensions than are normally obtainable. The advantages claimed for this type of joint over the normal V-threaded type are that it is stronger and has a higher resistance to leakage and accidental drainage, that the external joint diameter is smaller and has a stream-lined contour both inside and out. Experience has shown that a great saving of time in running and pulling can be effected with this 'extreme line casing' as compared with collared casing.

A West Indian Hurricane

AN account was given by Mr. C. S. Durst, at the meeting of the Royal Meteorological Society on May 26, of a case that occurred in September 1936 of a West Indian hurricane which recurved into middle latitudes towards the far side of the Atlantic and crossed over almost to the Irish coast without losing its tropical character of a mass of revolving tropical air. The recurve took place at about lat. 30° N., long. 61° W., and the track of the storm was then an almost straight one to the south-west of Ireland. As the storm approached the polar front, which lay at about lat. 45° N., a new depression developed on that front and became intense, and to this development is attributed a great increase in the speed of travel of the tropical storm. When centred at about lat. 43° N. and long. 39° W., its continued tropical character was well shown by the existence of a northerly wind of nearly gale force of which the temperature was 74° a short distance behind the centre. The author was unable to find any previous case of this kind of a persistent revolving tropical vortex within the warm sector of another depression farther to the north. He attributed the abnormal features in this case to the fact that the encounter between the tropical storm and the polar front took place in mid-ocean, and to the fact that a very shallow disturbance already existed on the polar front at that point. It is more usual for tropical storms to reach the coast of America and to have greatly diminished in intensity by the time that they encounter the polar front, and for their tropical characteristics to be lost in the temperate depression which results.

Passivity of Iron

EXPERIMENTS by W. H. Cone and H. V. Tarter (*J. Amer. Chem. Soc.*, 59, 937; 1937) show that iron is passive in solutions of chromic acid at all concentrations. If the solution also contains sulphuric acid or other activating electrolytes such as phosphoric acid and sodium sulphate, the iron under reduced pressure becomes active, but in pure chromic acid solutions iron does not become activated by reduction of pressure. An atmosphere of hydrogen causes iron to be active in a chromic acid-electrolyte solution. Oxides of iron were found to be soluble in chromic acid solutions, and oxide-covered wires could be made active by a reduction of pressure. This makes it doubtful whether an oxide layer is an essential factor for passivation, as has been asserted, and an adsorbed film of oxygen or a "two dimensional compound" of iron and oxygen as the primary cause of passivity is suggested. Definite oxides may be formed afterwards, particularly in the case of anodic passivation, but such oxides are readily soluble in the acidic solutions used by the authors.

Transmission of Excitation in Living Material

ON Thursday, June 3, at the Royal Society, Dr. C. F. A. Pantin opened a discussion organized by Prof. A. V. Hill on "The Transmission of Excitation in Living Material", which was largely devoted to the consideration of the rival merits of electrical and chemical theories of conduction.

The electrical theory, which has been worked out mainly in connexion with the nerves of vertebrates, is briefly as follows. We know that conducting tissues may be excited at the cathode by an applied electric current, and we also know that the propagated wave is invariably associated with an electric disturbance which is in such a sense that the current flowing between the active and the inactive regions of the tissue has the cathode on the inactive part, and is hence in the direction which tends to excite it. Thus it is clear that if the disturbance is intense enough, the inactive region in front of the wave must be raised to activity, thereby achieving propagation. Whether in fact this is the mechanism therefore rests upon the measurement of the adequacy of the electrical disturbance to excite the region in front of the wave.

This study was presented by A. L. Hodgkin (Cambridge), working on frog's nerve in which the propagation was blocked by the application of pressure or by freezing. Though the impulse is not able to traverse the block, yet the electrical current spreads out into the inactive region and produces there a considerable exciting effect, for, when the shock setting up the impulse is followed by a second shock applied this time to the inactive region just beyond the block, and so timed that it coincides with the electrical disturbance due to the blocked impulse, it is found that the second shock can be effective at only 10 per cent of the intensity necessary when applied alone. The excitability thus measured is found to follow a time course nearly identical with that of the electrical wave from the blocked impulse. It is clear that if at some distance from the disturbance the excitability is raised to 90 per cent threshold, at the active region itself the current will be fully adequate. Thus the electrical theory is established for conduction in frog's nerve.

But the adequacy thus shown for a full-grown impulse will not apply to the very small impulse arising from the area under the cathode of an external stimulating circuit. It is clear that a stimulus, to be effective, must not only excite the tissue at a point, but also must nurse the new-born impulse until it has reached a size adequate to propagate on its own.

The results of a mathematical development of this aspect were presented by W. A. H. Rushton (Cambridge), who pointed out that, in spite of shortcomings due to over-simplification, it is possible to describe quantitatively the whole range of excitability measurements both spatial and temporal, including some observations hitherto unexplained, with only two arbitrary constants.

Now in the intact organism, nerve-muscle activity is carried out by impulses following each other in rapid succession, hence the electrical generation of repetitive impulses from continuous currents is of interest. A. Monnier (Paris) has found that excised nerves and muscles in solutions of low calcium ion

content respond to prolonged continuous currents with prolonged rhythmic discharges. The bearing of this upon the mode of origin of central nervous rhythms was strongly indicated by B. H. C. Matthews (Cambridge) from oscillograph records of single motoneurons. When these cells are provoked to reflex activity by sensory stimulation, in addition to the quick potential change associated with each impulse there are slowly developed changes localized somewhere in the spinal cord, apparently produced by the cumulative effect of the sensory impulses, and acting like the prolonged currents in Monnier's experiments. This similarity has been further confirmed by passing a prolonged current in at the nerve and out at the cord, which, even in the absence of sensory stimulation, produced repetitive impulses of reflex character.

Though these experiments suggest that electrical considerations are sufficient to explain the passage of an impulse from one cell to another, there is quite other evidence, primarily pharmacological, which shows that the liberation of a specific chemical substance in relation to the cell junction may be of great importance.

Adrenalin has long been known to produce, when injected, the same general effects as widespread sympathetic stimulation, and it is now recognized that sympathetic nerves act by liberating adrenalin (or something very like it) in intimate relation to the cells of the organ supplied. Later, a similar state of affairs was found in connexion with the parasympathetic nerve endings, but the specific chemical, acetyl-choline is rapidly inactivated by an enzyme normally present and hence cannot be obtained unless the enzyme is inhibited by eserine. Chemical transmission was thus established in conduction between cells in two important classes, and the question arose as to whether some chemical was invariably necessary for such conduction. In particular, the cases of nerve-voluntary muscle, sympathetic ganglion and central nervous system are receiving consideration, but the possibility of a similar chemical counterpart of transmission down the nerve fibre itself is not overlooked.

A. von Muralt (Bern), realizing that any liberation of acetyl-choline during nerve transmission must be almost instantaneously reversible, adopted the following method to 'fix' the chemical liberated by a single impulse. The stimulated nerve together with an unstimulated control were shot instantaneously into liquid air, withdrawn, and ground to powder in solid carbon dioxide and then extracted and tested pharmacologically for acetyl-choline. It was found that the stimulated nerve contained about twice as much as did the control, but as was brought out in discussion with Prof. J. H. Gaddum, this was possibly due to the effect of the applied current (as in Gaddum's own experiments) for the results were more pronounced with prolonged currents, and the 'resting' control was probably excited by contact with the liquid air.

G. L. Brown (Hampstead), continuing the work of Dale and his other colleagues, showed that when an impulse passes from nerve to muscle, not only is acetyl-choline liberated in circumstances strictly

imited to the passage of the impulse, but also that the injection of it suddenly into an artery in close relation to the muscle gives rise to a twitch very similar both from mechanical and from electrical records to that produced on nerve stimulation.

F. Buchta (Copenhagen) has made a more minute study of the structures involved in this transmission. Working with single muscle fibres from the lizard, he measured the resting and active potentials on the surface of the muscle and the nerve-muscle junction. There is a resting potential of some 50 mV. between junction and fibre, and this difference is reversibly reduced to zero by the drug curare, which simultaneously produces a reversible nerve-muscle paralysis.

Z. N. Bacq (Liège) treated from a much wider zoological aspect the question of chemical transmission, and showed that, though acetyl-choline may be regarded as transmitter over a great range, yet this substance is not present in the Protochordates, the Crustacea, or the Coelenterates.

J. O. Eccles (Oxford) considered the application to ganglion and central nervous system. He presented evidence for two transmitters, one rapid, and apparently related to the electrical effect, the second slower and probably related to acetyl-choline.

This same duality was advocated by C. F. A. Pantin (Cambridge) in his opening communication. His own work on sea anemones and crabs shows that facilitation at the nerve-muscle junction depends upon both the number and the frequency of impulses arriving there. A chemical transmitter is suggested because the time relations of the decay of facilitation

are much longer than those of electrical effects, and are not dependant upon ions as are the electrical phenomena. On the other hand, the accumulation of facilitating chemical is never sufficient to set up repetitive impulses on its own account, nor are the ionic changes which increase facilitation capable of allowing a first impulse to pass; it seems that in these systems it is necessary to have the electrical change associated with the present impulse as well as the chemical facilitation resulting from a previous impulse. He also pointed out that the study of comparative physiology is rich in examples of the same end being achieved by different means, and of the same means being employed to different ends, or to no end at all. The fact that a certain chemical has important function in one tissue and that it is also present in another tissue, cannot be used as indicating that it has any biological significance in the second case.

Prof. E. D. Adrian, starting the open discussion, was also of the opinion that both electrical and chemical conditions are involved in transmission. He pointed out, however, that the secretion of molecules so strongly polar as those of acetyl-choline may involve quite considerable potential changes, while on the other hand the diffusibility of acetyl-choline through lipoids makes this ion of importance in the passage of electricity through cell walls. It is therefore possible that some of the phenomena variously considered as electrical or chemical may in fact be merely two aspects of the same process.

W. A. H. RUSHTON.

The Individuality of Gliadin

By Prof. A. G. Kuhlmann, Research Institute of the Baking Industry, Moscow

THE principal proteins of wheat are, as is well known, glutenin and gliadin. These proteins, upon the interaction of wheat flour with water, form the so-called gluten, the quality and quantity of which is of such great significance in the baking of bread, in the manufacture of macaroni, noodles and similar products. In the numerous works devoted to the proteins of wheat, a great deal of attention is paid to the question of the individuality of glutenin and gliadin.

Considering gluten to be a natural high polymer, we must come to the conclusion that it represents a complex of proteins, forming micelles of various length. Such a conclusion has been fully confirmed by an investigation which I conducted in my laboratory, which showed as well that the longest and most stable micelles are those of glutenin. Gliadin consists of shorter micelles, which are less stably built and more flocculent than those of glutenin.

According to the literature, the gliadin of wheat is best extracted by a 70 per cent solution of ethyl alcohol. A study of the influence of the concentration of ethyl alcohol on the peptization of the proteins of gluten carried out in my laboratory gave the following picture (Fig. 1). In one series of experiments, samples of one and the same gluten were treated with alcohol-water solutions. The

experiments were repeated, this time a given sample of gluten being treated with alcohol solutions of increasing concentration (alcohol of higher concentration being used only after complete extraction with alcohol of the preceding lower concentration).

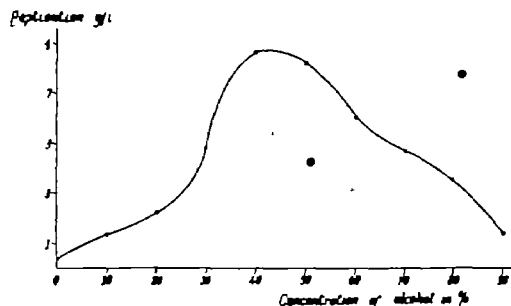


Fig. 1.

Results of these experiments are shown in Fig. 2. The data of both these series of experiments are in good agreement with each other and show that maximum peptization occurs with alcohol having a concentration of about 40 per cent. The

investigation of several kinds of gluten gave an analogous picture.

When gluten is treated with alcohol of low concentration (up to 30 per cent C_2H_5OH) it retains its cohesive properties and changes only slightly in its external appearance. Upon treatment with 40 per cent alcohol, it is greatly altered; it loses its cohesive properties and begins to disintegrate into separate particles. The supernatant liquid becomes turbid and viscous.

It is a striking fact that peptization of gluten by alcohol of various concentrations falls considerably more sharply after reaching a definite maximum, in the case illustrated by Fig. 2 than that by Fig. 1. This can be accounted for by the presence in gluten of a less highly aggregated and more easily peptizable fraction the solubility of which reaches a maximum with concentrations of alcohol of about 40 per cent. This fraction, through interaction with the more highly aggregated and less soluble fraction of gluten by means of absorption, acts as a peptizer of the latter. It also conditions the stability of the sol obtained. This fraction, when separate samples of gluten are extracted by different concentrations of alcohol (Fig. 1), asserts its action even at high

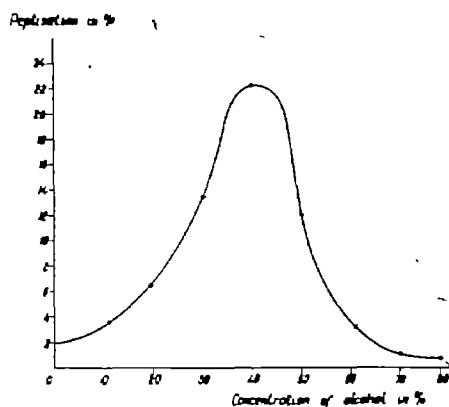


Fig. 2.

concentrations; while when one and the same sample is extracted by alcohol of different concentrations, the alcohol solutions containing more than 40 per cent C_2H_5OH , devoid of this less highly aggregated fraction of gluten due to its solution by the alcohol solutions of lesser concentrations, show a sharp decrease in peptizing properties (Fig. 2).

A study of the peptization of the proteins of gluten as a tricomponent system, sol of gluten - alcohol - water, using the method of the triangular diagram of Gibbs, was also carried out in my laboratory on twelve specimens of wheat. In general, they all gave analogous results. A typical example is shown in Fig. 3 (a). Isopeptides (lines connecting the points of equal quantities of peptized colloids) clearly show a definite maximum of peptization at a definite concentration of alcohol (40-50 per cent). If isoprotein sections (lines I, II, III) parallel to the side BC and connecting points of equal quantities of protein are drawn, then the above-mentioned maximum is seen still more clearly (Fig. 3 (b)).

If proteins are extracted with 40 and 70 per cent alcohol-water solutions from separate samples

of a given specimen of gluten, then we obtain two products, different from each other with respect to their behaviour towards water (swelling and hydration). Thus the protein fraction extracted with 40 per cent alcohol from the gluten of the wheat *Lutescens* 0329 imbibes 1.63 gm. of water (calculated on the basis of 1 gm. of dry substance), while gliadin (that is, the fraction extracted from that same sample of gluten with 70 per cent alcohol) imbibes 1.83 gm. The corresponding fractions extracted from the glue

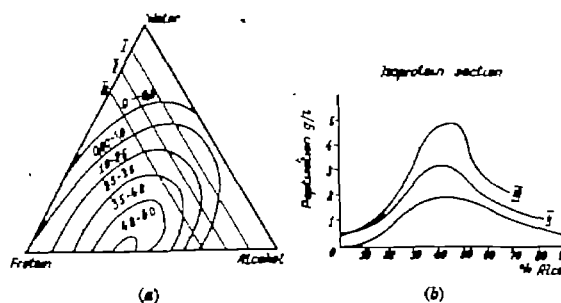


Fig. 3.

of the wheat *Ferrugineum* H 622 gave a still more distinct picture: here gliadin imbibed 1.08 gm. of water while the '40 per cent-fraction' imbibed 0.91 gm. The gliadin of that wheat increased its volume by 15 per cent on swelling, while the '40 per cent-fraction' increased by 135 per cent.

The above data, as well as other observations noted in my laboratory, give me reason to maintain that the gliadin of wheat is not a chemical individual. It represents an adsorption complex of at least two fractions, which I name α - and β -gliadin. In its properties (swelling, peptization etc.) β -gliadin approaches glutenin. β -gliadin dissolves as a result of interaction by means of adsorption with the more easily peptizable fraction α -gliadin, which forms the main mass of Osborne gliadin.

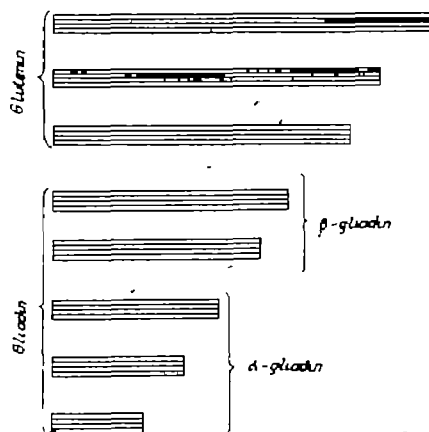


Fig. 4.

In the light of this work, the distribution of proteins of the various fractions of gluten according to the length of their micelles may be represented schematically as in Fig. 4.

Research in this field is being continued.

Intellectual Co-operation and International Science

A JOINT meeting of the Executive Committee of the International Council of Scientific Unions and of the Scientific Experts Committee of the International Organization of Intellectual Co-operation was held on July 9-10, at the International Institute of Intellectual Co-operation, in Paris.

Representing the Executive Committee of the Council were: Prof. C. Fabry, chairman of the Council; Prof. H. R. Kruyt, vice-president; Prof. S. B. Némec; Prof. F. J. M. Stratton, general secretary of the Council; E. Esclançon, representing the International Union of Astronomy; Jean Gérard, representing the International Union of Chemistry; General Perrier and Brigadier H. St. J. L. Winterbotham, representing the International Union of Geodesy and Geophysics; General Bourgeois and L. J. Voute, representing the International Union of Geography; Profs. Abraham and A. Cotton, representing the International Union of Physics; and Dr. M. J. Sirks, representing the International Union of Biological Sciences. The Committee of Scientific Experts included: Prof. Cabrera, chairman of the Committee and professor of theoretical physics at the University of Madrid; Prof. Bialobrzewski, professor of theoretical physics in the University of Warsaw; Prof. F. A. E. Crew, director of the Institute of Genetics at the University of Edinburgh; Prof. P. Langevin, professor of experimental physics in the Collège de France; Prof. Ch. Maurain, dean of the Faculty of Sciences of the University of Paris; Prof. Harry M. Miller, professor of zoology in Saint Louis University; Prof. M. Plancherel, professor of mathematics in the Polytechnic Federal School of Zurich; Prof. A. A. J. de Sigmund, professor of agricultural chemistry in the Palatin Joseph University of Technical and Economical Sciences, Budapest; and Prof. E. Späth, rector of the University of Vienna.

This meeting is the result of several years negotiations between the International Council of Scientific Unions and the International Organization of Intellectual Co-operation, the outcome of which was the approval by the assemblies of the two organizations of the draft agreement prepared by a joint committee of representatives of the Council of Scientific Unions and of the International Committee on Intellectual Co-operation.

The agreement lays down in detail the manner in which the two institutions are to collaborate. The

International Council of Scientific Unions will henceforward act as the advisory body to the Intellectual Co-operation Organization on questions of a scientific character, while the latter will be consulted by the Council on all international matters concerning the organization of scientific work. The executive organs of the Intellectual Co-operation Organization will provide the secretariat for the committees to be appointed by the Council, the president of which will *ex officio* attend plenary meetings of the Committee on Intellectual Co-operation at which the sciences are discussed; a representative of the Intellectual Co-operation Organization will take part in the meetings of the Executive Committee of the Council.

One of the aims of the meeting of July 9-10 was the signing of this agreement by the presidents of the two organizations, Prof. Gilbert Murray and Prof. C. Fabry. It also dealt with a number of other questions, among which are: the analysis of the scientific programme of the Organization of Intellectual Co-operation, that is, co-ordination in the matter of scientific research (financial aid, collaboration with the scientific unions for the preparation of small co-ordinating committees, publication of reports on the progress made in each branch of science); scientific bibliographies (transcription of the titles and the names of authors of scientific works written in a language that does not use Roman characters, and compilation of a bibliography of scientific works published in such languages); 'scientific conversations' the first of which will deal with "the general consequences of deep alterations that have taken place in physics concerning the principles of the explanation of the natural phenomena", etc. . . .

The Committee has also studied the programme and methods of the International Council of Scientific Unions and examined several new proposals received by the Organization of Intellectual Co-operation, among which are the publication of old scientific manuscripts and the question of the co-ordination of work in the study of physical constants.

It is necessary to emphasize the importance of the signing of the agreement by the presidents of the two organizations. It marks the beginning of a practical collaboration removing all possibility of overlapping, and having as a result the development of a definite programme.

New Chemistry Laboratories at Birmingham

THE new A. E. Hills Laboratories, which form a most valuable extension of the Department of Chemistry in the University of Birmingham, were formally opened by the donor (Mr. A. E. Hills) on July 7. The pro-chancellor (Mr. Walter Barrow) expressed the gratitude of the University to Mr. Hills for his generosity in giving £50,000 to build the laboratories, as well as a further gift of £25,000 for postgraduate scholarships. Benefactions by Birmingham donors have provided a further £7,700 for equipment (including £4,200 from Cadbury Bros. and £2,000 from W. Canning and Co.)

The opening address was given by Sir Frederick Gowland Hopkins, who remarked that every encouragement given to chemistry increases the possibility of discoveries of universal value. The thoughts of physicists and that of chemists, which have been separate, are coming nearer together, and the help which chemistry has given to physics in the past is to-day being handsomely repaid; though there is still an inherent distinction between the modes of thought of the chemist and physicist which is of mutual advantage in their collaboration.

Chemistry is also becoming more serviceable to medicine and all the biological sciences. The psychiatrist is now coming to the chemist for help. Many forms of mental disorder appear to arise from disturbances of metabolism which are revealed by chemical studies, and there is hope that methods of treatment may be found to correct the errors so discovered. If only some forms of insanity can be cured, it would be at least a partial solution of one of the most painful human problems. "Extending this idea, may we not believe that even the psychologist will have to pay attention to chemistry? So intimately interwoven are the activities of mind and body that no one can deny that the psychology of the individual is greatly affected by the hormonal balance which is part of his physical constitution; and hormones owe their specific influence in the body to particular aspects of their molecular structure". Chemistry in fact is ubiquitous, though it required the Great War to make Great Britain realize the truth of Disraeli's dictum that the prosperity of the chemical industry is the best index of the prosperity of the country as a whole.

The distinction between pure and applied science is becoming less real, and it is probable that never before has organic chemistry shown more possibility of continued development. How remarkable in kind the development of organic chemistry has been in its apparently static time. The product of a pictorial, or even artistic rather than mathematical type of intellect, the evolution of the idea of molecular structure was something new and distinct, and the verification by modern physical methods of the conclusions reached is indeed remarkable. Organic

chemistry in approaching physics is becoming more dynamic and more subtle.

Biochemistry is a borderland subject (not a hybrid because it is certainly not infertile), and borderland workers usually find work not found by the cultivators of either of the contiguous regions. Intellectual trust and sympathy between two departments may be very fertile. Biochemistry is the study of chemical dynamics as exhibited in life, and requires a knowledge of the physical properties and molecular structure of the substances which play an essential part in the constitution of living systems. Its special endeavour must be to follow so far as possible the function and fate of each significant constituent amid the multitudinous reactions which underlie the manifestations of life, and to explore the mechanisms which control those reactions. For this work, biochemistry is developing its own technique, and its progress though difficult is real. While immersed in problems so different in kind, it is almost impossible for the specialized biochemist to acquire the knowledge and experience, or the mode of thought and intuitions of the accomplished organic chemist, in determining molecular structure and in the difficult art of synthesis. Even the best biochemist must remain an amateur in organic chemistry. There never was a case in which progress could be better secured by a wise division of labour. Recently organic chemists have been examining the structures of natural products with marked success.

Sir Frederick concluded with a eulogy of the work of the Birmingham University School of Chemistry, referring in particular to the synthesis of vitamin C, the commercial manufacture of which means that no case of scurvy need in future remain uncured.

Standardization of Physical Units

IN a paper by Lyman J. Briggs, director of the National Bureau of Standards at Washington, which appeared in the January issue of the *Journal of the Franklin Institute*, some of the present-day problems in connexion with securing international uniformity in standards are discussed.

The British inch, derived directly from the imperial yard, is about four parts in a million shorter than the United States unit. But if we use the conversion factor so that one inch equals 25.4 millimetres exactly, then the new value of the inch would fall midway between the British and the United States inch. The Bureau of Standards has definitely proposed that this be done. The change would not affect industry in the slightest because it falls well within the tolerances in industrial measurements. This conversion factor, one inch equals 25.4 mm., has recently been adopted for industrial purposes by standardizing groups in fifteen countries including both England and the United States.

In the field of electricity, the tools of measurement now depend on national standardizing laboratories. The maintenance of units is made possible on a world-wide basis by the rise of the great national standardizing laboratories, especially in Germany, Great Britain and the United States. The revision of the units is under way at the present time. But as the present units are more than sufficiently accurate for

industrial use, the changes made will only affect laboratories making very precise measurements. The change will become effective on January 1, 1948. The present 'international' units of the ampere, ohm and volt will be respectively 0.9999, 1.0005 and 1.0004 of the new (absolute) ampere, ohm and volt respectively.

The present standards for use in photometry are either flame standards or carbon filament lamps giving light of a yellowish colour, and there is a general agreement as to a method regarding a method of passing over to lamps giving 'whiter' light. The German-speaking countries also never accepted the old 'international candle' but use their own unit, the Hefner, which is only nine tenths of it. Now the Bureau of Standards has determined the behaviour of the normal eye in terms of 'factors of luminosity' which have been internationally agreed as a basis has been fixed for measuring lights of all colour provided we have some kind of standard as starting point. We have still to agree upon the photometric scale for the brightness of the primary standard. The Bureau of Standards has recently suggested that the old 'international candle' be abandoned and that a slightly different unit be fixed by taking the round value of 60 candles per sq. cm. instead of the old value of 58.9, as the brightness of the blackbody radiator at the platinum point.

Science News a Century Ago

The Engineering Branch of the Royal Navy

ON July 19, 1836, an Order in Council was promulgated which for the first time granted permanent rank to engineers serving in the Navy and laid down the regulations for the training and employment of engineers. The Order in Council began: "Having had under our serious consideration the situation of the Engineers of Your Majesty's steam vessels, and being of opinion that it is necessary to place this description of officers on a permanent footing, in the same manner as the Gunners Boatswains and Carpenters in Your Majesty's Navy, with such rank and pay as appears to be fitting for persons charged with the performance of such important and responsible duties, we beg leave most humbly to entrust for Your Majesty's most gracious consideration and approval the following regulations. . . ." The engineers were to be appointed in the same manner as other warrant officers; they were to rank next below carpenters; they were to be distributed into three classes and they were to be allowed to retire upon superannuation upon the scale laid down for warrant officers in 1826. The pay of a first-class engineer was to be £9 12s. a month, and sixpence a day for each apprentice or boy that may be placed under his instruction; the pay of a second class engineer was to be £8 16s. a month and that of a third class was to be £4 18s. a month. On entry into the service engineers had to pass an examination before the Chief Engineer and Inspector of Machinery or such other officer as might be appointed for that service.

The Order concluded with: "And with a view of encouraging the education of youths in Your Majesty's Service for Engineers, we beg leave further most humbly to propose that Your Majesty will be graciously pleased to establish four classes of Apprentices or Engineers' Boys, for the service of Your Majesty's steam vessels, with the following rates of pay: 1st Class, £1 14s.; 2nd Class, £1 6s.; 3rd Class, £1 3s.; 4th Class, 14s. 6d. a month."

Launch of S.S. *Great Western*

ON July 19, 1837, the S.S. *Great Western*—the *Queen Mary* of her day—was launched at Bristol. Designed by Isambard Kingdom Brunel and built by Patterson for the Great Western Steamship Company, which had been formed at Brunel's suggestion for connecting Bristol with New York, she was the largest vessel constructed up to the time she was launched. She was 236 ft. long, 35½ ft. beam, 59 ft. wide over the paddle boxes and of 1,320 tons. "Her scantling," wrote one author, "is equal in size to that of our line of battleships, it is filled in solid, caulked within and without up to the first futtock heads before planking, and all above this height is of English oak. The flooring is of immense length, each floor overrunning the other; they are strongly dowelled and bolted in pairs first and also together by 1½ in. bars of 24 ft. in length, driven in parallel rows, scarfing about 4 ft. She is trussed in the firmest and closest manner by iron and wooden diagonal and also shelf pieces, these including all the upper works, are fastened with screws and nuts to an immense extent." After being launched, the ship was towed to the Thames to have her engines fitted. She made her first voyage to America in April 1838.

Meteorology in the United States

AT the fifty-fourth quarterly meeting of the Franklin Institute of Philadelphia held on July 20, 1837, the report submitted contained the following statement: "Whereas, a considerable number of members of this Institute, in conjunction with members of the Philosophical Society, have recently devoted much time to the observations of the phenomena accompanying the various conditions of the atmosphere, with a view to ascertain the general laws by which the changes of weather are governed; and the belief is confidently entertained, that a continuance of these observations, and their extension over the widely spread territory of the United States, will enable us to determine many general facts of a highly important and useful character, therefore, Resolved, that the Joint Committee of the American Philosophical Society and the Franklin Institute be, and are hereby authorized, on the part of this Institution, to memorialize Congress for the purpose of obtaining the national aid in furtherance of this interesting object."

University Events

ABERDEEN.—The following degrees of D.Sc. have recently been awarded: E. M. Dodds, for a thesis entitled "Researches on the Internal Combustion Engine and its Fuels"; Dr. A. W. Downie, for a thesis entitled "Studies on Immunity to the Pneumococcus"; Dr. D. S. Raitt, for a thesis entitled "Stock Replenishment, Fishing Intensity, Yield Prediction and Ancillary Problems in relation to the Haddock Stocks of the North-East Atlantic"; Dr. H. E. Shortt, for a thesis entitled "Life-history and Morphology of *Babesia canis* in the Dog-Tick *Rhipicephalus sanguineus*".

The honorary degree of LL.D. has been conferred on Prof. T. Shennan, emeritus professor of pathology in the University.

BELFAST.—The degree of D.Sc. has recently been conferred on the following: Prof. W. A. Osborne (*honoris causa*), M. J. Lynn (botany) and R. H. Sloane (physics).

CAMBRIDGE.—The following University appointments have recently been made: Dr. O. M. B. Bulman, lecturer in paleozoology; Dr. J. K. S. St. Joseph, demonstrator in geology; M. Black, demonstrator in geology; J. D. Boyd, lecturer in anatomy; Dr. W. A. H. Rushton, lecturer in physiology; S. J. R. Reynolds and C. D. P. Jones, demonstrators in anatomy; A. L. Hodgkin, demonstrator in physiology; and Dr. G. N. Myers, demonstrator in pharmacology.

A. M. Barry has been appointed to a Frank Edward Elmore studentship as from October 1.

The Frank Smart prizes have been awarded to B. G. Wilkinson, Downing College (botany); M. G. M. Pryor, Trinity College (zoology).

Applications are invited for the Gwyneth Pretty studentship, the holder of which shall devote himself to original research in the etiology, pathology and treatment of disease, with particular but not exclusive reference to those diseases which cripple or disable in childhood or early life. The studentship is of the annual value of £200 and is tenable for three years. Further information can be obtained from Prof. H. R. Dean, Department of Pathology.

Societies and Academies

Edinburgh

Royal Society, Edinburgh, June 7, 1937.

H. S. TAYLOR: Heavy hydrogen in scientific research (Bruce-Preller Lecture). Heavy hydrogen has led to interesting developments in theoretical and experimental aspects of reaction kinetics, especially in the fields of catalysis and photochemistry. Problems of molecular structure involving all types of spectral analyses of deuterium-containing compounds have also been solved. The biological and astronomical aspects of the problem were discussed, and the important role of deuterons, at high voltages, in the production of artificially radioactive elements and isotopes of known elements, particularly in the field of radiotherapy, was indicated.

A. O. ATKIN: Studies in practical mathematics. (2) The evaluation of the latent roots and latent vectors of a matrix. The paper develops and exemplifies a method, based on the repeated transformation of a vector, for finding all the roots and characteristic vectors of the secular equation and more general determinantal equations. By a simple auxiliary process a few poor or moderate first approximations are shown to be capable of yielding second and later approximations of high accuracy. Numerical examples are used to illustrate the routine of computation, which is well adapted to modern machines. F. A. E. CREW and CH. AUMBACH: 'Spheroidal': a mutant in *Drosophila funebris* affecting egg size and shape, and fecundity. 'Spheroidal' eggs are broader and shorter than normal, with greater variability in both dimensions and also in the shape index. These differences, as well as the abnormal curves of regression of length on width and of volume on length, suggest fundamental deviations from the normal processes concerned in egg development. 'Spheroidal' females are remarkably infecund, and differ from normal in respect of the curve of laying performance from day to day.

FRANCIS GREENSHIELDS: Studies in the cytology of parthenogenetic reproduction of Hymenoptera Symphyta. (1) Chromosome number and individuality in three arrhenotokous species. The complement of 0 chromosomes in the male germ-track of three arrhenotokous species of Hymenoptera Symphyta consists of 4 'morphological' pairs, and that for one of these species the 16 chromosomes in the female germ-track consists of 4 groups of 4, corresponding to the pairs in the male. Sex chromosomes are not distinguishable; which fact does not favour application of Whiting's theory of sex-determination to Hymenoptera Symphyta. It is suggested that true relationship between the sexes is of tetraploidy to diploidy, and that initial emergence of the parthenogenesis has been by polyploid evolution.

Paris

Academy of Sciences, May 24 (C.R., 201, 1517-1596).

LUIGI CAYEUX: New data on the existence of bacteria in the old sedimentary rocks. The results of work done on ferruginous oolites, with the aid of infra-red microphotographs. The existence of bacteria in the seas is proved back to the Huronian; they probably made their appearance still earlier. It is possible that bacterial action exercised a preponderating effect in sedimentary formations.

ALEXANDRE GUILLIERMOND and ROGER GAUTHIER: The property possessed by plant cells of excreting neutral red after having accumulated it in their vacuoles.

LOUIS BLARINGHEM: The double fertilization of flowering plants and the separation of the hybrids: from the correspondence of Hugo de Vries and Léon Guignard.

SERGE BERNSTEIN: Modification of the quadrature formula of Tchebysheff.

LUCIEN DANIEL: New researches on the variations of the apogamous dandelion.

MAURICE NICLOUX: The proportion of alcohol in water from the interstitial plasmas and of protoplasmic water, in an aquatic animal, is that of the external medium in which it is immersed. Experimental demonstration for the frog.

W. SLEBODZINSKI: The realization of a variety with affine connexion by a surface plunged in an affine space.

PAUL GILLIS: The equations of A. Haar of the calculus of variations.

CHARLES JACOB: The Gibbs phenomenon in the development of series of Hermite polynomials.

ROBERT FORET: Linear operations not completely continuous.

HENRI CORBLIN: A compressor with two membranes for use with gases forming dangerous compounds with lubricants.

LEOPOLD ESCANDE and GEORGES SARATHÉ: A weir inclined with respect to the axis of a canal.

Mme. MARGUERITE MOREAU-HANOT: The theoretical study of toroidal high-tension collectors.

GEORGES BODIER: The influence of the earth circuit of lightning protectors in an electrical network.

ROBERT FORRE: The electronic lattice of the transition elements.

HENRI LACOSTE-TAYAN: The cycles of recoil of magnetic steels.

MARCEL LAPORTE: A law of emission of a radiation with continuous spectrum (white light) by xenon tubes.

MOHAMMAD MONADJEMI: The materialization of the energy of the β -rays of thorium B+C.

FRANÇOIS BOURION and EMILE ROUYER: The determination of the hydration of the ions of calcium nitrate.

JEAN COURNOT and MARC BAUDRAND: The corrosion of riveted joints. Supplementing work described in a previous communication. The conditions of working are similar, but the two plates are of different materials.

MARCEL SERVIGNÉ and ETIENNE VASSY: An application of luminescence to quantitative analysis: the micro-estimation of the element samarium. In the particular case of samarium in very dilute solid solution, the intensity of the band studied is proportional to the concentration of the active element. With concentrations between 1.07×10^{-4} and 0.082×10^{-4} grams per gram of diluent (calcium tungstate) the accuracy of the measurements is about 5 per cent.

RENÉ DUBREY and GEORGES ARDITI: The alteration of metals by carbon tetrachloride in the presence of water. Results obtained with copper and zinc are given.

Mlle. YVONNE GARREAU: The oxidation of hydroquinone by air in the presence of *n*-butylammonium sulphite.

MARCO BASSINER: The structure of cadmium nitride (hydrazoate). Description of the method employed for obtaining cadmium hydrazoate in pure crystals, with details of the crystallographic and X-ray study.

J. MALAVOY and F. JACQUET: The geological formations of Portuguese Guinea.

MILAN MARGUERITE FROILLO: Study of the submarine breccias containing dolomitic elements in the dolomitic Trias of the eastern Carpathians.

NICOLAS STOKO: The periodic variations of longitude.

EDOUARD BOURNAU: The presence of tracheids in the alternate wood of the radiæ of conifers.

MARCEL MASCHÉ and RENÉ PARIS: The constitution of scoparoside (scoparine) of *Sarothamnus scoparius*. Scoparoside is a heteroside of the formula $C_{22}H_{34}O_{11}$, hydrolysable with difficulty, giving a molecule of rhamnose and a molecule of a flavone derivative, probably a quercitol methyl ether.

RENÉ SOULIER: The embryogeny of the Plumaginæ. The development of the embryo in *Armeria plantaginæa*.

ANDRÉ TOURNADÉ and MARC CHEVILLIOT: Does the action of the vaso-dilator nerves amount to a liberation of acetyl-choline?

PHILIPPE JOYET-LAVERGNE: Distinguishing the zones of oxidation in the living cell by the method of cobalt salts. In the living cell, whether plant or animal, the chondriome and the nucleole are two constituents which possess a catalytic oxidizing power sufficiently great to transform cobaltous salts into cobalt salts, a change shown clearly by the colour change.

YVES LE GRAND: The apparent rhythm of flickering.

MAURICE FONTAINE and RENÉ GUY BUSNEL: The localisation and the nature of the flavine contained in the skin of the eel.

AUGUSTE LAFAY and BERNARD LAFAY: The introduction of artificial radioactivity into therapeutics.

Geneva

Society of Physics and Natural History, May 20.

P. ROSSER: (1) Definition of stellar colour indexes. Photometers used for the determination of colour indexes are generally standardized in such a manner that the index is zero for the A_0 stars. There may be an advantage, especially in the case of photo-electric cells, in considering the index as the difference of two magnitudes, omitting this adjustment. (2) The Wien-Planck correction in the calculation of the magnitude of a star. This calculation makes use of certain sums the handling of which is somewhat inconvenient. It is possible to replace these by certain exponentials, with an error which never exceeds 0.03 magnitude.

J. PH. BUFFLE: The origin of the calcium bicarbonate in the waters of the River Versoix (Canton of Geneva). The river contains no free carbonic acid, and is not capable of dissolving the limestone which forms its bed. As, on the other hand, the proportion of calcium bicarbonate increases from the source of the river to its mouth, the origin of the salt must be external to the river. It is brought in by waters of infiltration, which fulfil the necessary conditions for dissolving the chalk of the strata which they traverse.

G. THIÉRY and P. JAVET: The pulsation of variable stars of the Cepheid type. A study of the case where the periodic variation of the ray includes two terms, one of which has a period double that of the other.

P. BALAVOINE: The variation of the iodine value of drying oils according to their origin. The iodine values of drying oils, particularly linseed oil, vary according to the country of origin and the season during which they have been prepared. The value is higher when the oil is prepared at a higher temperature.

Vienna

Academy of Sciences, April 22.

H. MOLISCH: Influence of one plant on another which is remote from it. The principal results are given of a research arising out of the well-known property of ripe apples of accelerating the ripening of unripe ones stored with them. The full results are to be published in book form.

S. MEYER: The age of the sun, the decay constant of actino-uranium and the ratios of the amounts of lead, thorium and uranium on the earth.

N. V. SZENTPÁLY: Heating effect of radioactive minerals. A combined micro-calorimeter and thermostat is described.

F. VIERHEGGE: Loss of charge of α -particles in helium. For particles of velocity 1.08×10^8 cm./sec., the mean free paths for capture and loss are 11.3 times the corresponding values for air.

M. MLADENOVIC: Nature of manilla resin.

E. BEUTEL and A. KUTZELNIGG: Production of a brilliantly fluorescent zinc oxide by partial decomposition of basic zinc carbonate.

E. KRUPPA: Projective geometry of a Hermitian plane.

R. LINZINGER: Geometry of the Monge-Ampère differential equation of the second order.

J. KRAMER: (1) Cubic circular motion of space. (2) Geometry of the Bennett mechanism.

J. PIA: Recent researches on the Cetacea of the Vienna Miocene.

K. O. FELSCH: Stratigraphically important corals from the upper Nassefeld strata and the Troglkofel chalk of the Carnic Alps.

G. E. KIMLHAUSER: Carboniferous flora from the loess of the mill near the Rattendorf meadow in the Carnic Alps.

April 29.

FRANZIŠKA SMIDL: Observations of the diurnal variation of the electrical conductivity of the air in Fulpmes in the Stubai valley.

K. EHRENBERG: Two new remains of primates from the Miocene of Lower Austria. A right ulna and a humerus bone are described which possess characteristics of both the anthropoids and the lower primates. They are believed to belong to a new species which has been named *Austriacopithecus wienfuerteri*.

May 7.

K. HILLEBRAND: Evolution of cosmic dust clouds. A permanent change in the distribution of matter which is initially uniformly dispersed can be brought about by inelastic collisions.

E. W. KELLERMANN: Coloration and luminescence of fluorite.

K. GRAFF: Visual colour excess of bright stars near μ Cephei.

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The Future of the South African Protectorates

THE statement made by General Hertzog, Prime Minister of the Union of South Africa, on his return from attending the recent Imperial Conference in London, which dealt with the question of the transfer of administrative control of the South African native Protectorates to the Union (*The Times*, July 7), has raised a grave issue in the gravest possible manner. He accuses the British Government of a dilatoriness virtually amounting to bad faith, and in the event of further delay, foreshadows an appeal to the Crown, of which the consequences both to Great Britain and South Africa would be so incalculable, that he is not prepared to accept as final the British minister's reply to pressure for early transfer.

General Hertzog clearly intended a reply to certain opinions expressed in the House of Lords in the debate on Lord Noel Buxton's motion on June 9 (see *NATURE*, June 26, p. 1083). When he went on to speak of the Government's attitude as dictated by the ballot box, he descended to a mere piece of political invective, worthy neither of its author nor of South Africa's case.

It cannot be denied that South Africa has a case; and the interests of the Protectorates afford strong, indeed almost overwhelming, argument in support of that case on geographical, economic and administrative grounds. The territories are, and must always be dependent economically upon the Union. They have no natural effective outlet except through the Union; they are dependent upon it for the employment by which their labour makes up the deficiencies of their capacity to produce. On the side of the Union any serious disparity in administrative methods might at any moment aggravate difficulties in dealing with its own native question. Nor should it be overlooked

that the Union has been generous in assistance to the Protectorates in a time of stress, although that assistance may have been granted under a misapprehension, for which General Hertzog himself is largely responsible.

Mr. Malcolm MacDonald, the Secretary of State for Dominion Affairs, showed in the House of Commons on July 9 that there had been a complete misunderstanding of the position. There had been no undertaking that transfer would be effected within any specified period. Once more he enunciated in terms the pledge, which was again repeated in the House on July 13, that no action would be taken without previous consultation of the inhabitants of the Protectorates, white and native, though he could not be brought to the point of a categorical statement that without consent there would be no action.

In delaying transfer, the British Government has displayed supreme wisdom. In the eyes of informed opinion—and in this matter the House of Lords is perhaps a better gauge of public feeling than the House of Commons, hence General Hertzog's aggrieved reference to its periodical pronouncements—the time is not yet ripe. For this the attitude of the Union Government on the native question is as much, if not even more responsible than the admitted reluctance of the Protectorate native populations to acquiesce in the change of administrative rule.

Since the passing of the South Africa Act of 1909, a great change in outlook has taken place in matters affecting the welfare and the administration of the affairs of backward peoples. At that time the anthropologist was urging the imperative necessity for scientific study of native institutions and beliefs as a basis for sympathetic administration

of native affairs. In South Africa the Government had embarked on a policy which seemed to hold out to the native an avenue of approach to a useful participation in citizenship and a share in the future development of the country through the organization of native councils. Great Britain, therefore, at that time felt justified in looking forward to a day when all the natives of South Africa might pass to South African control. Events in the political, economic and industrial history of the Commonwealth have falsified anticipation. The problem of the native population, which as a sociological question should be approached in the spirit of scientific and objective inquiry, has become an issue in party politics, while the trend of legislation, notwithstanding pledges to initiate a more liberal course of action when once the 'menace' of the native franchise was removed, has been to strengthen the colour bar and to emphasize the social and economic disability of the 'inferior' race, through the policy of segregation. It is not the least disquieting feature of the present situation that a certain section of advanced native opinion is strongly in favour of segregation and the complete separation of the two races in the interests of the native himself.

As a self-governing Dominion, it is South Africa's business to deal with her native problem as seems to her best. A white population outnumbered by the native in the proportion of four to one has need of provident statesmanship if it is to preserve its supremacy without crippling its powers of expansion. There is, however, in South Africa a growing section of opinion, in which the anthropological school of thought counts for much, that sees in the present policy of segregation as enforced by legislation, no way out for the native towards further development. In present conditions, it is true, some measure of training in various directions, educational and vocational, lies open to the native, though these conditions are perhaps less favourable than they were a generation ago. But there is little scope for the exercise of the native's powers and energy when once he is trained. For this *impasse*; the anthropologist would seek to substitute conditions such as a scientific and dispassionate survey of the situation would suggest. These, he is confident from his knowledge and experience, would, without turning the native into a black European, open the way to growth along lines congenial to native character and institutions, and yet would admit him to a

share in the development of the country, to the advantage of white and native communities alike.

These matters, however, are for the Union of South Africa to decide; but the appearance within the Union of a body of opinion critical of the dominant policy is not without its lesson for the people of Britain. Under the Imperial Parliament, the policy of native administration has virtually ceased to be a political issue. In general, parties are now united in accepting the doctrine of 'trusteeship' as the principle of government of the backward peoples of the Empire; and that in appropriate circumstances, "the interests of the native shall be paramount", has been enunciated repeatedly as the decisive formula of British native administration. In the South African Protectorates under the administration of British officials, circumstances have brought about a system of control, which if not technically 'indirect rule', approaches that method of government in some near degree. Under that system, a process of acculturation has been taking place, which is producing a system of religious belief and social organization, that if neither entirely European nor wholly African, has something of each, and yet—and this is the important factor—is both congenial to the African temperament and affords, in the eyes of competent judges, a potentiality of further cultural development along progressive lines. What those lines should be, it is the opportunity and the obligation of scientific study to assist in determining in the light of the effects of the cultural impacts which are now taking place—in short, the function of the 'applied anthropology' for which the Royal Anthropological Institute has recently appointed a standing committee (see p. 145).

Apart from the question of the obligation imposed on the Imperial Government by its pledge to consult the inhabitants of the Protectorates before any action is taken in the matter of the transfer of their administration to the Union, the crux of the problem lies in the temper with which the people of the Union of South Africa attempt to solve the problem of their own native population. Unless this is such as to afford a reasonable guarantee that it will foster rather than frustrate the steps, slow and hesitant they may be, now being taken by the natives of the Protectorates towards a cultural development, which may truly be regarded as a progress in civilization, the British Government should see no alternative but to hold its hand.

Evolution of the Holarctic Fauna and Flora

Die Holarktis:

ein Beitrag zur diluvialen und alluvialen Geschichte der zirkumpolaren Faunen- und Florengebiete. Von W. F. Reinig. Pp. vii+124. (Jena: Gustav Fischer, 1937.) 7.50 gold marks.

ONE cannot fail to agree with the author's remark in the preface to this interesting book, that the rapid recent development of zoological science has served, to some extent, to obscure the intrinsic value of biogeographical studies, which often tend to be regarded as a mere branch of ecology. Actually, biogeography, or the study of the composition, origin and evolution of the living faunas and floras, represents a higher degree of synthetic biological knowledge than either ecology or faunistics (or floristics), on both of which it largely relies for its fundamental data. The book under review must be regarded, on the whole, as a very successful attempt to treat the problem of the Holarctic fauna and flora on broad biogeographical and evolutionary lines.

The indisputable fact that the greater portion of the territory of Holarctis was either covered by Quaternary ice, or experienced the climatic effects of glaciations, was apparently the reason which made the author restrict his analysis only to the later stages of Pliocene and to Pleistocene. This course certainly simplified the task very greatly; but it can scarcely be justified in the face of many distributional facts, which obviously have their origin in much earlier geological periods. The volume of reliable palaeontological data on the distribution of life in the present Holarctic region during the Tertiary is very considerable, while geological data permit one to form some judgment with regard to the Tertiary climates, as well. The restriction of the field of study is, therefore, largely artificial, and makes the results less complete and convincing than they might have been.

The main thesis of the book, developed at considerable length and with abundant supporting evidence, is that the present distribution of Holarctic animals and plants can be explained on the basis of their evolution during, and under the influence of, repeated glaciations and of warmer interglacial periods. The maximum glaciation in the Eurasian continent forced the temperate pre-glacial forest flora and fauna to retreat to four main 'refuge areas', namely: (1) Mediterranean; (2) Armeno-Persian; (3) Central-Asian (consisting of three separate parts—Afghanistan, Tian-Shan

and northern Mongolia); and (4) Eastern-Asian (including south-eastern China and Japan).

In North America, the flora and fauna of the same pre-glacial type retreated also into four refuge areas: (1) Atlantic, comprising Florida and adjoining lowlands; (2) Mexican (subtropical); (3) Pacific, extending along the southern Rockies; and (4) Alaskan. The subsequent retreat of glaciers resulted in re-invasion of more northern regions from the refuge areas, where in the meantime distinct races and even species were produced by isolation. This re-invasion was not simultaneous everywhere, since the maximum glaciation, according to the author, both commenced and ended in Europe and in North America earlier than in Asia. This accounts for the considerable European element in the present Siberian fauna, and for the great affinities of the latter with the American one. Certain elements were slower in the re-invasion, and some of them remained restricted to refuge areas and represent well-known examples of discontinuous distribution. Repetition of retreats and advances of animals and plants during successive glaciations served to complicate the resulting distribution still more, and some of the details cannot be elucidated as yet.

Of course, this is only a very brief and greatly simplified summary of the author's ideas, which are developed with a wealth of data. These ideas certainly appear sound and well documented, if not wholly new. It is, however, obviously inconsistent to disregard the influences to which the Holarctic fauna and flora must have been subjected from the more southern zones of the continents under study. The author attributes to glacial climates the power to drive animals and plants into what are now subtropical zones; but he appears to ignore a northward pressure of subtropical elements (or those derived from them) during the warmer inter-glacial periods. If the displacements of climatic zones are admitted, it is only logical to study all their implications, including the influence of southern faunas and floras on those of Holarctis. The author prefers to be one-sided in this respect, and goes so far as to state that the present Mediterranean and even the Eremian zone cannot be separated from the Holarctic because they partly served as refuge areas for Holarctic plants and animals during glaciations. Such a sweeping disregard of deep ecological, floristic and faunistic differences which exist between deserts and temperate forests will not be accepted by other biogeographers.

A similar disregard of ecology is apparent in many parts of the book, representing probably a reaction against undue preponderance of the ecological point of view in modern biogeography. As an example, it is sufficient to point out that the author uses the words 'steppe' and 'desert' almost as synonyms, and often speaks of "Steppen und Wüsten" as of a single biogeographical unit, while there is nothing but a superficial similarity between these two types of habitat, which are profoundly different in their distribution, climate, ecology and in their plant and animal population.

It would be easy to criticize various lesser

points in the author's theories, but this would be scarcely fair, since the book is clearly a first and incomplete attempt to present a connected evolutionary history of the Holarctic fauna and flora. The author has certainly succeeded in conveying the idea of slow climatic changes causing movements of plants and animals, and resulting in complicated distributional patterns of the present day. For this alone the book must be regarded as an outstanding contribution to biogeography in the modern sense of the word, and is certain to lead to fruitful discussions and to stimulate new researches. B. P. UVAROV.

Early Science in Cambridge

Early Science in Cambridge

By Dr. R. T. Gunther. Pp. xii+513+68 plates. (Oxford: The Author, The Old Ashmolean, 1937.) 42s. net.

A GOOD many years have passed since Dr. R. T. Gunther began to discover at Oxford the great store of old astronomical, mathematical, and other scientific instruments which enabled him to illustrate the development of scientific studies in that University from their earliest beginnings; discoveries that have resulted in the preservation of much valuable material, which might easily have been lost, in the admirable Museum of the History of Science which he has arranged in the Old Ashmolean building.

Having thoroughly explored the resources of Oxford, it was natural that Dr. Gunther should turn his attention to Cambridge. There he found that while the existence of interesting objects was known to a few, no one had made a systematic examination of the ground. When, therefore, he expressed a desire to undertake this work, his suggestion was welcomed, and all necessary facilities were afforded him by those in a position to give him help. It was further arranged that an exhibition of the results of his labours should be set out in the Old Schools and be on view at the end of the Easter term, 1936. Dr. Gunther threw himself into this task with characteristic energy, and the results far exceeded all expectations.

From dusty cupboards in laboratories, from the corners of college libraries, and from seldom-opened museum drawers, he brought together a wealth of old apparatus which surprised even those who had some knowledge of the hidden

treasures of Cambridge, and aroused great interest in numerous visitors during the all too short time the exhibition was open.

The historical and biographical notes which Dr. Gunther accumulated in the course of his researches, and the catalogue of the exhibition which he compiled form the basis of this book, which to do it justice must be regarded more as a source book than as an orderly treatise.

In his introductory chapter, Dr. Gunther wisely deprecates unprofitable controversy as to the relative age of our two ancient universities, and leaves their origins wrapped in the mists of antiquity, but by interesting quotations from William Harrison (1577), and other early writers, he shows the convenience and importance of the site of Cambridge at the head of a navigable water-way by which commodities could be brought to the town when roads were but miry tracks. The paragraphs headed "Roads and Communications", "Travel by Air", and "Railways", contain information which will be new to most Cambridge residents to-day, and the clauses relating to Cambridge in the Assessing Act for the Eastern Counties Railway, printed *in extenso*, give an amusing account of the obstacles placed by the University in the 'forties in the way of any of its younger members who wished to travel by train. A brief account of Fen drainage schemes and notable floods has especial interest in view of recent experiences.

The second chapter, entitled "Mensuration", is essentially an excerpt from the exhibition catalogue, prefaced by some historical matter relating to Sturbridge Fair and to the University in its capacity as an inspector of weights and measures.

Dr. Gunther deals next with mathematicians and mathematical instruments, and following the method he employs throughout the rest of his book, gives in chronological order brief biographical sketches of the eminent men who have cultivated this study in Cambridge, incidentally rescuing from oblivion many lesser lights. Thus, while Newton holds the field, Briggs, Oughtred, Seth Ward, Barrow and others are not forgotten, and the chapter is illustrated with excellent plates of the splendid set of mathematical instruments made for Roger North and now in the possession of Jesus College, and of the perfect specimen of Oughtred's circular slide rule which came to light in the Cavendish Laboratory.

Mechanics and physics are dealt with in the same way, the great wealth of material being handled under such sub-headings as weighing the earth, sound, heat, light and colour, magnetism and electricity.

A long and richly illustrated chapter is devoted to astronomy, and as is but natural, much space is allotted to astrolabes and sun-dials. It may, however, be doubted whether the importance of Dr. Dee justifies the amount of attention given to him.

Two short chapters dealing with geography and meteorology bring us to chemistry. Here the somewhat elusive figure of Vigani, the first professor of chemistry, comes to life with his cabinet of *materia medica* still preserved at Queens' College, and the better known names of Smithson Tennant and Wollaston receive adequate attention.

Chemistry leads on to medicine, and while "pestilence walks at noon day", a strange assortment of practitioners and quacks passes across the stage. This chapter is packed with curious lore, and leaves the reader with a wholesome respect for the stamina of those of our ancestors who managed to survive the attentions of their medical attendants.

Anatomy, physiology and pathology are dealt with next, and on almost every page will be found the record of some curious fact or the revelation of some quaint personality. Particularly interesting are the accounts of the researches of Glisson and Stephen Hales.

In the account of zoology, John Ray and his friend Willughby hold pride of place. Two of Ray's letters are reproduced in facsimile, and a number of others now published for the first time are to be found in an appendix. Ray, too, is prominent in the section devoted to botany, and Stephen Hales tells the story of some of his most important botanical discoveries in his own words.

The study of geology in Cambridge, being based on the foundation of Dr. Woodward, it is interesting

to have before us his will *in extenso*. It can only be regretted that the annual inspection of his collections, to be followed by a dinner, to which he attached so much importance, has been allowed to fall into abeyance.

The appendixes with which this work concludes are not the least valuable part of it, and Sir Thomas Selater's practice of fruit and fish culture towards the end of the eighteenth century will have interest for many.

Up till the middle of last century, it was still possible for one man to attain distinction in more than one branch of science. The arrangement of the matter of this book under subjects leads, therefore, to the appearance of the same individual in different categories and tends inevitably to a certain amount of repetition. This, with the intercalation of excerpts from the exhibition catalogue, produces a somewhat patchwork effect. The first inconvenience could scarcely be avoided, but if the catalogue had been printed as an appendix, the narrative would have become more continuous and satisfying.

In a work of this kind, some slips and misprints are bound to escape the vigilance of the author. Many have been noted, but not in undue number or likely for the most part to mislead a reader seriously. A few may be mentioned. Darwin worked at Downe, not Dover. Prof. G. H. F. Nuttall's name is unfortunately omitted from the list of the Quick professors, and the press set up in 1752, at which astronomical works were printed, had its home in Pembroke, and not, as might be inferred from p. 79, at Queens'.

Though the book suffers from a certain lack of orderly arrangement and from rather meagre documentation, a vast amount of interesting and entertaining information culled from a great variety of sources, many of them obscure, has been brought together within its covers. All Cambridge men should be grateful to Dr. Gunther for making it possible for them to become acquainted so pleasantly with the personalities, aims and achievements of their scientific forbears, and for compiling a work which should be in every college and departmental library. Senior members of the University who keep it handy on their shelves will find it a sort of scientific "Gunning", admirable for browsing in at odd moments; for most junior members it will probably prove too expensive.

In conclusion, we would re-echo the hope expressed in the author's preface, that among the institutions of the University a modest room or two may be found, where the more interesting and important of the exhibits got together last year, suitably displayed and labelled, may find a permanent home.

A. H.

The Structure of the Flower

Floral Morphology:

a New Outlook, with Special Reference to the Interpretation of the Gynæceum. By E. R. Saunders. Vol. 1. Pp. viii+132. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 3s. 6d. net.

THE history of plant morphology shows a number of more or less distinct phases. The earliest phase was one of description, including the recognition of morphological categories and the introduction of terms. Later the idealistic concepts of Goethe laid the foundation of much that is still orthodox. With the advent of Darwinism, there commenced a long period of explanation in terms of use and, on the whole somewhat later, attempts to trace the evolution of organs. At the present time, all these earlier phases seem to be revived in a new interest in plant structure, with the introduction of certain new methods and theories.

The vast majority of existing seed plants are characterized by possessing flowers clearly marked off from the vegetative parts of the plant body. The evolutionary history of the flower is still obscure and, even as a preliminary to research on this problem, there is an urgent need for clarification in our knowledge of the morphology of its component parts. Botanists are not all agreed as to whether it be a simple stem bearing modified leaves, a modified branch system, or essentially a structure *sui generis*. All parts have been subject to detailed and comparative examination: perianth, andræcium, and gynæceum (gynæceum). The composition of the latter has, however, been the subject of most recent research. The numerous papers of Miss E. R. Saunders have made botanists familiar with the theory of carpel polymorphism. None will deny the importance of her work in directing attention to the many peculiarities of arrangement, anatomy, and behaviour to be found in the ovaries and their associated parts in both monocotyledons and dicotyledons. In a first volume on floral morphology, Miss Saunders summarizes her views on the architecture of the flower, with special reference to the gynæceum, in an introduction, and outlines on this basis the flower structure of thirty-nine families. A student unacquainted with the new concepts would probably find the book somewhat difficult reading, partly because of the very few illustrative drawings. The size, founts, general format, and low price of the book are all excellent, and it is to be hoped it

will be widely read and used, especially as a guide to laboratory work by teachers and students. If it gives stimulus to the detailed dissecting of flowers and a study of their anatomy in academic institutions, it will have fulfilled a most important and urgent need.

The special theory of carpel polymorphism, which is the central theme of the book, is "in accordance with the view that in true apocarpous the individual ovary is formed of a single carpel, which arises as a separate structure, but that in syncarpous and pseudo-apocarpous forms it is composed of two kinds of carpels, sterile and fertile". Two main types of carpels are distinguished: valve and consolidated. The former shows pinnate venation, marginal ovules (when fertile), and when present alone generally forms an apocarpous gynæceum. The consolidated carpel has a pair of strongly developed bundles close to the mid-line (with or without a median bundle). The ovules are usually borne on either side of the mid-line, and the consolidated carpel is, in syncarpous ovaries, generally fertile. It may be contracted (solid carpel) or expanded (pseudo-valve carpel).

Though based very largely on the number and relationship of the vascular strands in the flower, it is claimed that the principles outlined "dispose of many morphological fictions, including hypothetical splittings and unions, hypothetical suppressed whorls, 'commisural' stigmas, 'false' partitions, 'free central' placentation and epigyny, as traditionally interpreted, while 'parietal' and 'axile' placentation and 'septicidal' dehiscence now have an altered significance. They provide an explanation of obdiplostemony, various forms of fruit dehiscence, and many other hitherto unexplained features".

There is no doubt that, considering the evidence as a whole, Miss Saunders has presented a strong case. It is probable that not all her interpretations will be accepted by future investigators; but they will have to be examined from the point of view of the evidence she has provided, even if other viewpoints be also considered valid. The evidence is particularly strong in the *Rhodadales* (including the *Cruciferae*) and in the *Liliaceae*. Some of the families in which it is probably more difficult to provide an acceptable interpretation of the structure of the gynæceum on the basis of carpel polymorphism, such as the *Leguminosae*, are not included in this volume.

W. B. T.

Nauka Polska:

jej Potrzeby, Organizacja i Rozwój. (Science and Letters in Poland: their Needs, Organisation and Progress.) Tom (Vol.) 22. Pp. ix+433. (Warszawa: Kasy Imienia Mianowskiego, 1937.)

VOL. 22 of "Nauka Polska", an annual publication edited by Prof. S. Michalski and issued by the Mianowski Institute for promoting Science and Letters in Poland, is devoted largely to a series of papers on the influence of science upon human culture and progress. Among several noteworthy contributions is one by Prof. S. Ossowski, who deals with the influence of the personal opinions of the man of science on researches in the domain of the social sciences. He goes on to examine the effect that personal political and social convictions can have upon the course of a research worker's investigations in such subjects as sociology, political economy and anthropology, that is, in sciences directly contributing to progress in social life.

The influence of physics upon the development of modern civilization is the theme of a contribution from Prof. S. Szopeniowski, who endeavours to show how the theories of pure physics and the exact sciences have moulded opinion with regard to modern conceptions of the universe. Another interesting memoir in this issue of "Nauka Polska" is that by Mme. Danilewicz, who wishes to direct attention to the scientific work conducted between 1805 and 1831 at the former lycée of Krzemieniec in south-east Poland (Volhynia). The concerted attempt of an enthusiastic group of specialists in physics, chemistry, mineralogy and botany to create a local interest in the flora and natural resources of this district made a most promising beginning, but was afterwards suppressed for political reasons.

In the notes referring to scientific events in Poland and abroad there is a brief account of the British Association meeting at Blackpool, and reference is also made to the activities of the Research Co-ordination Committee.

P E P (Political and Economic Planning)

Report on International Trade: a Survey of Problems affecting the Expansion of International Trade, with Proposals for the Development of British Commercial Policy and Export Mechanism. Pp. vii+302. (London: Political and Economic Planning, 1937.) Paper boards, 8s. 6d. net; cloth, 12s. 6d. net.

THE group of industrialists, distributors, local government officers, university teachers and others who have produced this comprehensive monograph claim allegiance to no political party and are concerned solely with the problems of social and economic reconstruction. It is a lengthy report and contains a mass of statistical and other matter, bearing on the mechanism, finance and politics of international trade. The writers conclude that the idea of sweeping away international trade barriers is impracticable and is being replaced by organized exchange between nations, which, however, should be more constructively planned. The report discusses at length such constructive measures by taking into account not merely economic needs but also politics, psycho-

logy, transfer difficulties and other relevant factors. Within the policy of the State there should be scope for the initiative of individual traders, especially in co-operative steps. International trade will probably become permanently a smaller proportion of total trade, and will certainly not return to past conditions; but on new and constructive lines there should be a measure of revival. Finally, it may be noted that the report examines frankly the role played in present trade by the economics of war.

Physiology in Health and Disease

By Prof. Carl J. Wiggers. Second edition, thoroughly revised. Pp. 1124. (London: Henry Kimpton, 1937.) 42s. net.

THE second edition of Prof. Wiggers' book follows the first after an interval of only two years. Special emphasis has been laid on subjects of clinical importance and the book is really a general textbook of clinical science. Chapters are devoted to such subjects as oedema, sleep, acidosis, peripheral vascular disorders, blood-pressure, valvular lesions, fever and diet. The section dealing with the circulation is particularly detailed.

The book covers much the same ground as Samson Wright's "Applied Physiology"; but it is about 35 per cent larger. No one man could speak with the authority of detailed knowledge over so wide a field, and the judgments of this book sometimes appear superficial. Its main value lies in the fact that it contains a very large number of references to original work and to detailed reviews. It should be useful to students and to those who seek access to literature dealing with subjects outside their own speciality. Prof. Wiggers is a physiologist, and his book will probably be more admired by physiologists than by clinicians.

The Physics of Electron Tubes

By Dr. L. R. Koller. (International Series in Physics.) Second edition. Pp. xvii+234. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18s.

THE first (1933) edition of this book has already been favourably reviewed in NATURE (133, 968; 1934). The present second edition has been slightly enlarged, especially by the addition of short treatments of such topics as electron optics, secondary emission multipliers, "ignitrons" and positive ion emission.

The title of the book would be more appropriately "Introduction to the Physics of Electronic Devices", as it deals within its relatively short space not only with 'electron' tubes, that is, hard valves and photocells, but also includes gas-filled relays and even two chapters on photo-conductivity and photo-voltaic cells. The treatment is clear, bringing out the essential points. Intricate mathematics has been avoided by stating in such cases finished results; however, Richardson and Schottky's equation, and the $3/2$ power law have been derived in a special appendix.

Very useful for the beginner is a collection of problems (with solutions) and with the aid of a good list of references added to each chapter, he will be able to find his way to more detailed study of the subject.

A. B.

Ammonolatry: The Life Element*

By Prof. Henry E. Armstrong, F.R.S.

(To a muted, musical undercurrent reminiscent of *Aida*, in face of a moving, desert panorama with camels.)

FOR several months, while I have been confined to my room, I have had before me two unusual and remarkable books which are of special interest to me, at a time when we have to admit that far more consideration must be given to the manner in which chemists are trained. The books are E. C. Franklin's "Nitrogen System of Compounds" and N. V. Sidgwick's "Organic Chemistry of Nitrogen", in both of which I have particular reason to be interested.

About thirty years ago, soon after the great San Francisco earthquake (1906), I visited Leland Stanford University at Palo Alto. The founder was doing penance: he had been tossed from his pedestal and was standing upside down, with his head through the stone pavement: I believe he was ultimately restored to righteousness without a feature injured. Chemistry was well on its feet. The professor, Edward Curtis Franklin, was at an early stage in the inquiry, now so associated with his name and school, into the properties of liquid ammonia in comparison with those of water, especially as an electrolytic solvent: though boiling at -33.35° , it comes close to water in activity. Liquid ammonia was being brought into use at that time as a refrigerating agent, and Franklin had command of the technical product.

It may be mentioned here in parenthesis that Gore in his earlier work on the subject (1872-73) was forced to prepare the liquid separately for each experiment, by heating ammoniated calcium chloride in the tube containing the substance to be tested. He tested the solubility of more than five hundred substances. He had great difficulty in securing support for his work—in those prehistoric days it was considered to be of little interest. He made a similar study of liquid hydrogen fluoride, and all but isolated fluorine. Few are left to remember his persistent pioneering efforts in advocacy of pure research, for which he made a great personal sacrifice: unfortunately, he was not original. I had the privilege of being made his confidant and always regretted that he

had so little encouragement. We were then near to the renaissance period, but so low was the ebb of curiosity that Frankland, Vernon Harcourt and others were suggesting that a list of subjects for research should be prepared. Actually the main cause of activity was not Kekulé's benzene formula but the discovery by Kolbe and others, after the 1870 war, that research work could be made of commercial value. The poor professor disappeared but academic training began to lose its value; now, after a second war, in Germany, freedom of thought is gone. She may have gained much commercially but she has sold her scientific soul. Our task is to make the same change impossible here: it is already set in, largely through the influence of commercialism.

Franklin's reason for entering on the inquiry is stated by him as follows:

"In the autumn of 1896, Hamilton P. Cady, then an undergraduate, was working at the regulation course in quantitative analysis. Observing after a time that the young man was becoming bored with the task, the writer, at the time giving instruction in analytical chemistry, proposed to him that he prepare several of the cobaltamine salts and confirm the composition of one or two of them by analysis. Some days later, with a beautifully crystallised specimen of one of these interesting salts in his hand, Cady stated that the ammonia in these and other salts containing ammonia must function in a manner very similar to that of water in salts with water of crystallisation. He suggested furthermore that liquid ammonia would probably be found to resemble water in its physical and chemical properties. As a direct consequence of Cady's suggestion has followed all the work done in this country on liquid ammonia."

Franklin died on February 13, 1937. We have to lament the loss of a colleague who could still regard chemistry as a practical subject but take notice of theory in general. His work on ammonia, already of no slight value, may some day rank high when the great problem of electrolytic conductivity is discussed with knowledge and without prejudice: as yet, it never has been. Franklin makes close comparison, compound by compound, of corresponding members of the oxygen and nitrogen systems. The ammonia work, however, is far from sufficiently described in his book. I had hoped the original papers would have been largely reproduced in readable form. If his friends were to provide a reprint it would be a pious act and a great boon to students. None the less, it is a most valuable conspectus.

Sidgwick's "Organic Chemistry of Nitrogen" is a book of very different type. Franklin would

* The proof of this article was corrected by Prof. Armstrong only a week before his death on July 18. The article represents, therefore, the final expression of the frank and critical views which he held upon the training of chemists and subjects of research. Whatever significance may be attached to these views, the fact that, while on his dying bed, he desired to make the two volumes mentioned in the article the subject of a contribution to NATURE, is a remarkable tribute to the active attention he gave to scientific subjects right unto the last. Prof. Sidgwick's book, to which Prof. Armstrong refers, was reviewed in NATURE of July 3.—The Editor.

take us back to the worship of Jupiter Ammon, begun in the dry distillation of camel's dung. Sidgwick would have us 'resonate' to the latest doctrine of electro-valency. The first edition of his book was published in 1910; it was a positive thriller. Sidgwick gave me a copy, which I have always prized; this has rested on a shelf near to my elbow and has often been taken down; my hope that the new edition would have similar attraction is disappointed. Two Oxford fellows, T. W. J. Taylor and Wilson Baker, seem to have been mainly responsible for the new edition, but the names of a host of other helpers are given. Sidgwick only contributes seven pages of introduction and a page or two on *Chelate Ortho-nitro-phenol derivatives*, which show that he is now devoted to the fashionable morganatic game of crab catching, an appropriate exercise for the Upper reaches of the Thames.

The plan remains what it was. The intention is said to have been to give an account of the simpler organic compounds and to discuss some of the interesting problems which these properties present, giving so far as possible adequate explanation of the necessary physical background. The authors have not the practical experience and critical judgment necessary to carry out their task in a way to make the book of practical value to students who would train to be chemists—of whom there are very few at Oxford. It is not a beginners' book and makes high demands upon previous knowledge, without explanation plunging the reader forthwith into technicalities known only to the specialist and impossible for the ordinary reader to understand. Though highly discursive and scrappy at times, necessarily a book written at such length contains much that is interesting, but no training in judicial method is to be gained from its use.

At least half of what is regarded as the most intellectual of our youth is attracted to the University of Oxford; this element is all but absolutely classical in its outlook. Oxford needs medicine of a very different order from that represented in Sidgwick's book: medicine that will make it a school of practice in chemistry, not one of elocution. The University is receiving large funds but its traditions are such that it does not attempt to train men to be efficient and effective laboratory workers. It has grown up upon words and lives upon them. The Oxford way is to enforce knowledge of what is done as a preliminary to doing work—but you cannot learn a subject like chemistry without *doing* from the beginning and all the time. The book will suit Oxford youth able to memorize the purple patches and offer them up on the examination altar, hoping on leaving the Examination Schools to find an

emissary of I.C.I. awaiting their return with the prized admission card to an assured haven of research. They, however, will have had little or no effective training in chemistry but only parrot instruction in structural formulae.

In the first line of the brief introduction to the book the author at once plunges into the valency problem with full measure of 'noughts and crosses', mainly dealing with *Resonance*, blankly asserting that:

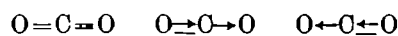
"The conception is the most important development which structural chemistry has had since it was extended to three dimensions by van 't Hoff in 1874. It is a result of the application of wave mechanics and could not have been deduced from classical dynamics; but its essential conclusions can be stated very simply. If a molecule can have two or more different structures in the ordinary organic sense of the term, then under certain conditions its actual state is neither one nor the other but something intermediate between the two, which partakes to some extent of the properties of both but cannot be expressed in the usual structural symbols. The molecule is then said to exhibit resonance and to be a resonance-hybrid of the two or more structures.

This is a declaration which I hesitate to endorse. In his recently delivered presidential address to the Chemical Society (*J. Chem. Soc.*, April), our would-be trumpeter of nitrogen speaks with even greater modesty and exceptional clearness. We are there told that it was a product of the obscure doctrine of wave mechanism.

"The general conclusions of the theory of resonance are of great practical importance, especially to the organic chemist. But it is not to be expected that more than a very few organic chemists will have either the time or the ability to master these mathematical operations. It is therefore obviously our duty to express—or to induce the wave-mechanicians to express—the results in the simplest terms that are possible and this can really be done quite easily. The use of the technical language of wave mechanics for this purpose is quite unnecessary and in fact misleading, for it makes the non-mathematical reader think that as he can't understand the language he can't understand the conclusions either, which is quite untrue; and not uncommonly, I think, it leads the non-mathematical writer to believe that if he knows the technical terms he must understand their meaning, which is by no means always the case."

I have known strange things said in chemistry but have never before been quite so stood upon my head.

Passing to the examples given, with carbon dioxide we have the three formulae:



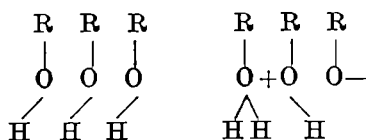
"According to the theory of resonance, since all these formulae represent linear molecules and should have about the same stability or heat of formation, resonance must occur and the actual state of the molecule will be something intermediate between

them which we call a resonance hybrid, which will have a greater stability and heat of formation and a rather smaller distance between the atoms, than correspond to any one of the formulae. Experiment shows that this is so. Further, since the last two formulae are really the same, they must be represented to the same extent in the actual state of the hybrid, which therefore should be non-polar, as it is found to be."

According to this, resonance would seem to be a state of suspended animation in a molecular system with a shortened waist. Is not this "Much Ado about Nothing"? In what way it is an advance upon van 't Hoff is not clear. Kolbe was angered that van 't Hoff should introduce metaphysics into chemistry—what he would have said to Sidgwick passes expression. I am open to the retort, I know, that van 't Hoff was justified, but he had a solid model to build upon.

One of the more important applications of the conception of resonance is to the explanation of the power of hydrogen to serve as a bivalent link. There is no doubt, says Sidgwick, that a hydrogen atom is able to hold two oxygen atoms together. To me the evidence is entirely inadequate, nor is his present argument impressive.

"The crystallographers," he says, "have actually measured the length of this O-H-O link (about 2.5 Å) which they call the hydrogen link but the idea which formerly prevailed that this link, like co-ordinate links in general, was due to the hydrogen taking up two more shared electrons (so that it had four in all) is now known to be impossible, since a hydrogen atom cannot hold four electrons with sufficient firmness. The only alternative explanation is that we have resonance between the ordinary form and one in which there is an oxonium cation and an R-O anion:"



Truly a soul-saving set of symbols. Faint praise ; scarcely hanging evidence. The nonchalance with which the inability to carry more electrons is treated and a new hypothesis at once found is amusing. Still better follows :

"The most extensive group of organic substances whose behaviour is determined by resonance is that of the aromatic compounds. It was recognised from the beginning that the two difficulties in the way of Kekulé's formula for benzene are, first, that we should expect two ortho di-derivatives ; secondly, that benzene should have the reactivity of an ethylene derivative, whereas in fact it behaves almost always as a saturated compound. The conception of resonance removes both of these objections at once : the first because we assume the state of the ortho-compound to be permanently half-way between the two formulae and the second on account of the in-

creased stability which the resonance must produce. The last point can be determined experimentally from the heats of formation."

Such a statement cannot be taken seriously and it suggests insufficient historical and practical knowledge of the subject. I was one of the earliest workers with benzene, beginning in 1868. We never treated Kekulé's formulae seriously—except for the purpose of registering the assumed disposal of substituent affinities : apart from the few who 'hammered' the idea for their own purposes, we thought of the two forms as present, if at all, in balanced proportions. The benzene symbol was used, not as a structural expression but as a convention in expressing interactions. We soon learnt that benzene had not the reactivity of an ethylene derivative. This led me to introduce the Centric formula.

The X-ray workers in course of time may help us out of our difficulty, but they are very slow. What are the forms of carbon : what of the form of that in benzene ? The paraffins are the only hydrocarbons containing diamond carbon. We know scarcely anything of paraffinoids generally. Edgar's work with heptanes shows that isomerides differ greatly, presumably owing to shape and difficulty of packing. Rumour goes that a paraffin has been made which won't pack and therefore declines to solidify—too resonant, I suppose.

Benzene, we know, contains a second form of carbon, which I would call *ethenoid*. The centres of the atoms are in a plane, not zigzagged, the distance between them less than in diamond carbon. What is hexamethylene—benzene with six "electronic" pits filled in ? It is little but a copy of benzene in appearance and properties.

During my lifetime the theory of valency has been developed from remarkably simple beginnings. When I began with Frankland in 1865, I heard his first course of lectures at the Royal College of Chemistry, published in his well-known book. He adopted Crum Brown's Graphite formulae, behind which lay the tetrahedral conception. Carbon was a wooden ball with four holes in it. He had assimilated Kekulé's formulae. I hold a paged proof of the later edition of his book in which he has written in all these. The original struggle between Kekulé and Frankland was over a fixed maximum of valency, that need not all be exercised but partly in abeyance. Kekulé as a joke copied Munchausen's method of shooting ducks on a ramrod.

Graphite is the puzzle—it seems to combine the two forms of carbon. This comes out very clearly in the model (Fig. 1).

The crystal is shown to consist of flat phenoid rings in parallel planes, 3-4 Å. apart, more than double the distance between two atoms in the

plane ring. When oxidized, oxygen atoms seem to penetrate directly into the wide space between layers and this plane is porous to other agents also. I seem to see the atoms as a bird-like structure, with unequal wings, one paraffinoid about double the length of the other one: the other, the shorter, ethenoid as in benzene.

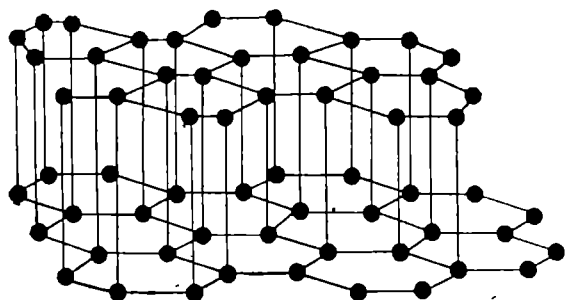
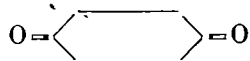


Fig. 1.

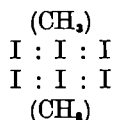
MODEL OF GRAPHITE. FROM *Chemistry and Industry*,
AUG. 14, 1936.

Two forms of valency ultimately emerged—which acquired precision only when one was seen to be fixed by the *Electronic Charge*; the other being that which Pickering and I termed *Residual Affinity*. I discussed this very fully in March 1886 in the *Proceedings of the Royal Society* in a paper on electrolytic conduction in relation to molecular composition, valency and the nature of chemical change. In the previous year (March 1885) I dealt fully with the conditions of chemical change, a subject entirely left out of account in modern times. Then in 1888 I discussed the origin of colour and formulated the explanation since known as the Quinonoid Hypothesis (*Chem. Soc. Proc.*, March 1888).

I postulated a triple unsymmetrical absorbing system, such as that in quinone.



I soon discarded mere material absorption and taking iodoform as type, assumed that the residual affinities of the iodine atoms came into play as absorbent centres.



In fact, I became dotty at an early stage in my career. I was specially fascinated at the time by fluorescent compounds and triphenyl methane derivatives. My colour hypothesis is applicable to all ethenoid properties, and what I set out to explain fifty years ago is little short of what Sidgwick would now explain. I doubt if there be much difference between us, but having read

the classics early, I have always been held up by the caution:

What's the use of Mercators
Tropics, Zones and Equators.
They are merely conventional signs.

Kekulé wrote an imperishable sign upon the fair face of our science when he introduced the simple hexagon. This expresses the one fact that is established—that six carbon atoms form a symmetrical complex, providing a convention which permits us to register and discuss isomerism in particular.

The colour of meta-compounds, I early asserted, was merely a case of the absorbent centres being in part formed between contiguous molecules—that is to say, extramolecular; whilst in para- and ortho-quinones it is within the molecule, intramolecular.

Whatever resonance hybrids may be, do or suffer, they have little practical significance. To take up time in indoctrinating students at the university with such vagaries is not justifiable. At the moment we are in sorest need of chemists—it were time that the University Grants Committee or similar body intervened to secure rational, practical training for those few who will give serious attention to the several subjects to be studied.

Students have to be taught according to their dispositions. The biological type is very rare; no greater perversion of the type exists than the ordinary biochemist, who is so-called because he works with material of living origin. The flag can be carried by very few. Mathematics beyond more than a very elementary stage is also without appeal to the chemist proper: the mathematician is a machine—prepared to let it be granted and act accordingly. The chemist should be inspired with feeling and only ask for truth and substance; he should go straight to Nature. Of course, the majority who inflict themselves upon the natural sciences are just machines. The only teacher is experience.

The fact is, we forget how much that is taught as chemistry is mere convention. The hands-across, down-the-middle, business of "The Lancets". The "bridged-ring" is just Huck Finn, let-on stuff, yet the majority swallow it whole. Kekulé so demoralized chemists by his Ring that they have no hesitation even in giving it a handle, a bridge. Benzene must be a solid block of atoms—in so far as atoms made of electrons can be solid.

For a book on the chemistry of nitrogen, the most wonderful of all the elements in forming character—the determining element of life—to be of outstanding value, it must make manifest the sympathy which only long experience in the laboratory begets and inculcate habits of scientific

thought that will be of service to the student who desires to be a working chemist or to teach the subject in our schools. It is possible to reach the standard of knowledge required for a 'first' without acquiring these habits; this would not matter were it not that Firsts go into schools and stagnate. The failure of Firsts in the schools is the out-

standing calamity of the costly attempt to introduce scientific training into education made during the past seventy years.

Chemistry at present is a sick man—"mostly conventional signs". Something less Snarkian is needed than "to measure the value of an idea in terms of incomprehensibility."

Darwin in Uruguay

By Dr. J. D. Falconer

H M.S. *BEAGLE*, under the command of Capt. Fitzroy, sailed from Rio de Janeiro on July 5, 1832, for the Plata and anchored at Montevideo on July 26. For more than a year the ship was employed in surveying the extreme southern and eastern coasts of South America. The Plata was used as a base and to it from time to time the *Beagle* returned. Thus Charles Darwin, the naturalist aboard, had several opportunities of making closer acquaintance with the northern shores of the estuary and more particularly with the natural history and geology of the Banda Oriental, by which name the Republic of Uruguay, to the east of the Río Uruguay, was at that time known.

During the nineteenth century, Maldonado Bay at the mouth of the estuary was a favourite anchorage for ocean vessels. A strip of sand lined the margin of the bay and provided a playground for the men of the sea. In 1832 Darwin spent ten weeks at Maldonado and procured "a nearly perfect collection of the animals, birds, and reptiles" of the vicinity. He described Maldonado as "a most quiet, forlorn, little town: . . . separated from the river by a band of sand hillocks about a mile broad: it is surrounded on all other sides by an open slightly undulating country, covered by one uniform layer of fine green turf, on which countless herds of cattle, sheep, and horses graze. . . . The scenery is very uninteresting; there is scarcely a house, an enclosed piece of ground, or even a tree, to give it an air of cheerfulness"¹. To this day Maldonado retains its secluded aspect, being overshadowed by the modern resort of Punta del Este on the eastern horn of the bay. The sands, however, are now grassed and treed over, the pastures fenced and decorated with plantations, rail and road communications developed and frequented, and the landscape dotted with houses and gardens and cultivated fields.

It was at Maldonado that Darwin's attention was directed to the occurrence of vitrified siliceous

tubes (fulgurites) in the sand dunes, similar to, but shorter than, those described from Drigg in Cumberland in 1814². These tubes, believed to be formed by lightning, are still found at Maldonado but less frequently than before, on account of the cover of vegetation.

Between Maldonado and Montevideo along the northern bank of the Plata, Darwin again remarked upon the absence of trees and the uninteresting character of the grassy plains, decorated only by occasional hummocks of granitic rock. He concluded somewhat hastily that in spite of abundant rain and a favourable climate "herbaceous plants, instead of trees, were created to occupy that wide area"³. However this may be, within the last hundred years there has been much successful afforestation, and along the shores of the estuary and in many parts of the interior the aspect of the country has been completely changed.

In November 1833, Darwin made an excursion into the south-western corner of Uruguay, from Montevideo to Colonia Sacramento, and thence to Mercedes on the Río Negro. By this time, after some experience of the pampas of Argentina, his opinions of the scenery and amenities of the Banda Oriental had undergone a change. He wrote: "I find that I look at this province with very different eyes, from what I did upon my first arrival. I recollect I then thought it singularly level; but now, after galloping over the Pampas, my only surprise is, what could have induced me ever to have called it level. The country is a series of undulations, in themselves perhaps not absolutely great, but as compared to the plains of St. Fe, real mountains. From these inequalities there is an abundance of rivulets, and the turf is green and luxuriant"⁴.

On this expedition, Darwin visited the Arroyo de las Vivoras and Punta Gorda on the left bank of the Río Uruguay. From Mercedes he rode to the Sierra del Pedro Flaco, 20 miles up the Río Negro, and examined the natural sections in the

cliffs of Perika. He returned in a direct line across country to Montevideo, having been absent from the port for fourteen days. The *Beagle* sailed from the Plata for the last time on December 6, 1833.

Prof. Karl Walther, of Montevideo, has been at some pains to identify the exact spot on the bank of the Río Negro that Darwin visited, and he has come to the conclusion that the "cliffs of Perika" are those of the Cerro de los Claveles at the confluence of the Arroyo Perico Flaco and the Río Negro*. The streams have here incised their channels below the level of the plains and the so-called Cerro is simply a projecting bluff overlooking the river. This locality has been marked by Prof. Walther by the erection of a stone in commemoration of Darwin's visit in 1833. There is, however, a considerable difference between the height of the river-bank, 30-35 m. according to Walther*, and that of the cliffs of Perika, about 50 ft. according to Darwin*. also in the composition of the lower part of the cliffs as recorded respectively by Walther and Darwin. It is thus permissible to doubt whether the actual section described by Darwin has yet been recognized. It is certain, however, that the river bank in this locality was Darwin's "farthest north" in Uruguay, and it was an admirable thought and a graceful tribute on the part of Prof. Walther to mark out a "Rincón Darwin" and to give the name of "Darwin Cliff" to the Cerro de los Claveles in recognition of "the importance of the geological observations initiated by the great British scientist"†.

Some play has been made of recent years in local scientific circles over the alleged polemic between Darwin and D'Orbigny about the occurrence at Punta Gorda beneath well-defined Tertiary strata (Entrerriano) "in the vertical cliff, nearly on a level with the river" of "a bed of red mud absolutely like the Pampean deposit, with numerous often large concretions of perfectly characterized white, compact toska-rock"‡. D'Orbigny, who had preceded Darwin in South America and to whom Darwin was much indebted for examining and naming his molluscan fossils, had not seen the section at Punta Gorda during his sojourn in Uruguay and Argentina in the years 1826-29, but he had stated that he was unwilling to believe that beds of the same nature with the Pampean formation ever underlie the ancient marine Tertiary strata§. He maintained that there could be no analogy between the lower beds at Punta Gorda, which were of marine origin, and the Pampean clay, which was of quite a different character "déposée dans un laps de temps très-court, comme le résultat d'une grande commotion terrestre"¶. Darwin steadily refused to accept this hypothesis and insisted that "from whatever source and through whatever means the great

Pampean formation originated, we here have unequivocal evidence of a similar action at a period before that of the deposition of the marine Tertiary strata"‡.

The incident left an unpleasant flavour which has not yet been dispelled. Difficulties of investigation and comparison, of translation and re-translation, keep the controversy alive, while almost every author who visits the locality provides a different interpretation. Kraglievich of Buenos Aires, now deceased, who knew the red mud of Punta Gorda, said that "its nature is not entirely equal to that of the true Pampean of Argentina, . . . being much more similar to the clay and loessitic sandstone of Uruguay"‡. Windhausen, also deceased, considered this sufficiently confirmative of Darwin's observation of a continental layer beneath the marine Tertiary beds‡. Prof. Walther supports D'Orbigny, and represents Darwin as having fallen into error§. He admits that at first sight the character of the rock at Punta Gorda is "loessoid or similar to Pampean clay"‡, but asserts that there is a distinct petrographical difference between the two deposits. This has been investigated by Frengelli‡, who states that under the microscope the Punta Gorda clay is almost entirely composed of particles of volcanic glass with grains of sand scantily accessory, while in the Pampean clays the volcanic material is accessory to fine sand and silt. Thus it would appear that volcanic dust which falls on the pampas at the present day fell sometimes much more abundantly in the same region in past ages, and that there is accordingly every justification for Darwin's suggestion of the recurrence of similar conditions during the accumulation of the great Pampean formation.

While, therefore, it is clear that in respect of Punta Gorda, Darwin cannot reasonably be accused of any serious error of observation, those of us who know something of the country he traversed will readily agree with Prof. Walther in admiring the fact that, in a hurried journey of fourteen days, he was able to recognize certain details of geological structure the significance and importance of which are still being debated by lesser minds after the lapse of a hundred years.

* "Narrative", 3, 45, 46 (1839)

† *Geol. Trans.*, 2, 528 (1814).

‡ "Narrative", 3, 53 (1839)

§ "Narrative", 3, 169 (1839).

¶ *Rev. Fac. Agr. Montevideo*, No. 8 (1933)

‡ "Geology", 3, 94 (1846).

‡ "Geology", 3, 92 (1846).

‡ "Geology", 3, 93 (1846).

‡ "Voyage", 27, 73 (1842)

‡ "Geology", 3, 94 (1846).

‡ *Rev. Soc. Am. Arg. Montevideo*, 2, 33 (1928).

‡ *Geología Argentina*, 2, 478 (1931)

‡ *Bol. I.G.P. Montevideo*, No. 13, 33 (1930).

‡ *Bol. I.G.P. Montevideo*, No. 12, 26 (1930).

Obituary Notices

Prof. H. E. Armstrong, F.R.S.

HENRY EDWARD ARMSTRONG, whose death on July 13 in his ninetieth year we regret to announce, was born on May 6, 1848, in Lewisham, where he lived all his life. Of the influences during his early youth which inclined him to chemistry, little is known, but when he left Colfe's Grammar School at Lewisham his father, acting on the advice of an engineering friend, allowed him to become a student at the Royal College of Chemistry, Oxford Street, in the summer term of 1865, actually Hofmann's last term before his departure for Berlin. Chemistry was the only subject taught, but the College was affiliated to the Royal School of Mines, then housed in Jermyn Street. A free lance, he attended such courses at the two institutions as he thought fit including among them those given by Tyndall, Huxley and Ramsay, being also for some unexplained reason an almost regular attendant on Saturdays at the operating theatre of St. Bartholomew's Hospital. This roving quest came to an end when Frazerland, who had followed Hofmann as professor and, towards the close of 1866, had been appointed with two other members a Royal Commission to inquire into the pollution of rivers in Great Britain, took him into the private laboratory, where together they developed the combustion *in vacuo* method of water analysis, which played so important a part in the campaign for ensuring the safety of the domestic water supplies of the country.

In October 1868, while yet young and impressionable, Armstrong went to Leipzig to work under Kolbe, an inspiring teacher, but remembered also as an unsparing and provocative critic. Graduating Ph.D. after five semesters, he returned to work with Matthiessen on alkaloids at St. Bartholomew's Hospital Medical School and, during the next twelve years, had charge of the chemistry classes for medical students preparing for the London degree; his appointment as professor of chemistry at the London Institution, Finsbury Square, followed a few months later. An earlier occupant of the chair had been Sir George Grove, inventor of the unpolarizable Grove cell and the hydrogen-oxygen gas battery: Armstrong's interest in the general problem of chemical interchange, and particularly of the part played by the depolariser, can be dated from his discovery of specimens of the battery in the Institution's laboratory and the purchase of a copy of Grove's memoirs.

Armstrong's next appointment was that of professor of chemistry in the City and Guilds of London Institute for the Advancement of Technical Education, founded in 1878, but until the Finsbury Technical College was ready for occupation in 1883, the work of his department had to be carried on during four years in temporary quarters at the Cowper Street Schools, Finsbury. A year later he was translated to the newly erected City and Guilds

College, South Kensington, where a novel type of institution came into being, self-governed academically by its four professors—chemistry, engineering, mathematics and physics—and independent of external examiners, which rapidly grew to be recognized as a great professional school of engineering. But in 1911, when the City and Guilds College by incorporation became the engineering section of the Imperial College of Science and Technology, its chemistry and mathematics departments were closed down, although provision was made for chemistry diploma students to finish their course under Armstrong's supervision—with its completion, chemistry ceased to be taught in the City and Guilds College, and the last of the laboratories of the department was dismantled in 1914.

The submergence of the chemistry department involved also the closing down of its crystallography laboratory, the only one in Britain, after an existence of rather more than a quarter of a century. Convinced that the most certain method of identifying a substance was to be found in its crystalline form, Armstrong in 1886 determined that, as an essential part of their training, diploma students in chemistry should measure any new crystalline substances they might prepare which were suitable for the purpose. To this end a course of laboratory instruction was arranged by Mr. H. A. (now Sir Henry) Miers, and under his direction and that of Pope and of Lowry who succeeded him, a wealth of material was accumulated, which led to the publication by Armstrong, conjointly with Colgate and Rodd, of a series of papers under the title "Morphological Studies of Benzene Derivatives" in the *Proceedings of the Royal Society* during 1910–14.

Thus ended an interesting and—if account be taken of the careers of students trained by its methods—a successful experiment in teaching chemistry on scientific, if unorthodox, lines. For Armstrong, such an ending was unrelieved tragedy. Thereafter, although a small suite of laboratories was placed at his service in the Royal College of Science building, it was no longer as an investigator but by controversy that his work as missionary for the propagation of the truth as he conceived it was carried on.

During the tenure of his chair at the London Institution, Armstrong maintained a steady output of research, but it was in an unexpected role that he first directed attention to himself. While working with medical students, but without previous training as a teacher, he—to use his own words—taught himself how to teach them chemistry and, aided by that effort, developed the system which became known as the heuristic method of teaching science experimentally in schools, in the advocacy of which, as opposed to the didactic method then followed, he never spared himself—or others—from the time he first championed the cause at the International

Conference on Education, convened in connexion with the Health Exhibition of 1884. In the paper submitted to the Conference, he outlined a constructive plan for training pupils "to observe and think and act with clearly defined purpose, the work being carried out with common materials and in relation to common phenomena". This scheme was elaborated in his contribution to the "Special Reports on Education" published by the Board of Education in 1888, and in the second report of the British Association Committee appointed in the same year "to inquire into and report on the methods of teaching chemistry in schools", whilst criticism of schoolmasters figured prominently in his addresses as president to the Chemical Society in 1894 and later to the Chemistry and Education Sections of the British Association. The heuristic method on the scale that Armstrong conceived it is dead: its fate could not be otherwise under an examination system—intensified since the widespread adoption of the School Certificate—which does not distinguish between the school and the academic outlook on science as a mental discipline.

Prior to the move to South Kensington, Armstrong had three major problems in chemistry continually in mind: the confusion about methods of determining constitution in the naphthalene series; the perplexing reactivities of camphor which served only to show the inadequacy of any formula for the substance based on the benzene model; and the mechanism of chemical change. Before his contribution to the elucidation of each is reviewed briefly, it should be mentioned that, as the College catered chiefly for engineers, the number of diploma students in chemistry was always small. Nevertheless, it was not long before the department as a school of research in organic chemistry attracted advanced workers from other institutions, doubtless in appreciation of Armstrong's pervading influence and a wise choice of members of his staff. He was constantly in the laboratory, his technical skill was always available when difficulties in manipulation arose, and his advice, encouragement, criticism and retentive memory never failed those who could benefit by them. If a measure of his stature as professor be desired, it may perhaps be gauged by the fact that, of those who worked under him as colleagues or pupils, not a few have achieved marked success in industry, whilst the others six either hold or have held university chairs and seven became fellows of the Royal Society.

The naphthalene research, resumed in 1886, in which Davis, Roemer, Lapworth and Wynne took part, was concerned with the bromination, nitration and sulphonation of the hydrocarbon and of its halogen and hydroxy derivatives and included a study of the mechanism of nitration; the investigation of many cases among sulphonic acids of the transference ('isomeric change') of the sulphonic group from one position to another within the molecule; and the preparation and identification of the complete number of di- and tri-chloronaphthalenes theoretically possible—ten and fourteen respectively—by reference to which the structure of any di- or tri-derivative of the

hydrocarbon could be ascertained beyond doubt. Incidentally, it may be mentioned that Armstrong's series of papers embodying evidence for his view that carbon compounds exhibiting colour are quinone-like in structure belongs also to this period.

Towards the solution of the problem of the constitution of camphor from the analytical side, Armstrong and his collaborators made many important contributions. With Miller in the early 'eighties, he identified no fewer than four C_{12} homologues of benzene in the products of the action of sulphuric acid and other dehydrating agents on the substance. Then he and Kipping, who joined the staff in 1891, investigated 'camphren', an oxygenated product of the interaction with the acid—an inquiry which led Kipping jointly with Pope to discover how to sulphonate, rather than to dehydrate, camphor and to unravel the intricate isomerism of the camphor-sulphonic acids thus obtained. Important, too, was the identification of the three positions in which substitution occurs in the camphor molecule: this followed from the investigations of Kipping and Pope for the π -derivatives and of Armstrong and Lowry for the α - and β -derivatives. It was while studying the nitration of dibromocamphor at the College that Forster's interest in camphor chemistry was kindled and there, too, that Lowry's study of the mutarotation of nitrocamphor in various solvents proved that 'isomeric change' is not spontaneous but dependent on the presence of a catalyst.

Armstrong's unwavering advocacy of Faraday's view that "ordinary chemical actions . . . are themselves electrical" led him to define "chemical action as reversed electrolysis". The arguments by which this thesis was defended are to be found in the presidential addresses to the Chemistry Section of the British Association at Aberdeen in 1885 and Winnipeg in 1910; the presidential address to the Chemical Society in 1895; and in frequent contributions to ephemeral literature during the last half century. From first to last he never ceased to urge the view that solution is in effect a manifestation of chemical activity, the production of an electrolyte in aqueous solution being dependent on the combination of solvent and solute. Hence the prolonged controversy with Arrhenius (and Ostwald) whose theory of electrolytic dissociation in solution he regarded not only as unnecessary but erroneous—to be denounced with almost religious fervour as a chemical heresy. Although the Arrhenius conception has lent itself to modification, predicated among its later developments association of the ions of the solute with the solvent, and in its primitive form is now mainly of historical interest, the hydrate theory of solution has not emerged from the merely qualitative stage and involves too many unverifiable assumptions to make headway. Armstrong's experimental contribution to the discussion, in which Caldwell, Eyre, Worley and others assisted, is to be found in the thirty-two papers published during the period 1906–14 in the *Proceedings of the Royal Society* under the title "Processes Operative in Solution", the sixth of which gave, in 1908, the most complete statement of his theoretical views.

A few years earlier than, but parallel with, this inquiry into the nature of solution, Armstrong's interest in biological problems, never long in abeyance, led to an equally protracted study of the nature and mode of action of enzymes being undertaken under his guidance, about which, when it was begun, little exact information was available. In the first eight of the twenty-three papers, all of which save the first are to be found in the *Proceedings of the Royal Society*, E. F. Armstrong (Salters' Company's research fellow at the College, 1902-5) showed quantitatively that the action of sucrorclastic enzymes as hydrolytic agents is controlled or retarded by the products to which they give rise and that from glucose by interaction with maltase, isomaltose, but with emulsin, maltose is synthesized. Later, the two Armstrongs with Horton isolated a β -glucase (prunase) both from the mixture of enzymes known as emulsin, and, more readily, from various species of *Prunus*, which was used by them to ascertain the distribution of cyanophoric glucosides in a variety of herbage plants and its variation with locality and season. Mention, too, must be made of the elder Armstrong's investigation of the activities of urease, linase and lipase—including the synthesis of fats by the aid of the last-named—carried out in conjunction with Caldwell, Eyre, Gooney and Horton among others which led to the conclusion that action takes place wholly at the surface of the colloidal particles of the enzyme in suspension—not between substances in solution—the enzyme having the double function of attracting the hydrolyte and of determining its hydrolysis. Not the least interesting of the series was a paper by the Armstrongs on the action of chloroform, toluene and similar substances in stimulating enzymic action in living structures which they suggest may lead to an understanding of the physiological function of the esters, terpenes and scents secreted by plants and of anaesthetics.

Of the many educational and agricultural bodies with which he was associated, two in particular gave Armstrong much pleasure: he was appointed a member of the Council of Almoners of Christ's Hospital in 1896 on the nomination of the Royal Society, and, after many years as deputy chairman of the Committee of Education, became its chairman in 1930, holding office until his health failed; and he represented the Chemical Society on the Lawes Agricultural Trust Committee at Rothamsted from its inception in 1889, becoming its vice-chairman in 1918 and its chairman so recently as last May. Frequently of late years in addresses and in articles from his pen, the national importance of pure (non-pasteurized) milk, natural foods and honest beer was urged as also the improvement of grass and other crops necessary for their production. His last public speech was made at a 'barley' meeting of farmers at Warminster in July 1936.

Fond of the open country and a frequent traveller abroad in middle life as Armstrong was, Borrowdale in spring and autumn became for many years his beloved holiday resort. Field geology was one of his hobbies: he was for many years a member of the Geologists' Association, and photographed the chalk

from Yorkshire to Dorset to supply the illustration for the monographs on this formation prepared by the late Dr. Rowe of Margate. Another was his garden, and in the unrivalled colours of flowers he found the utmost pleasure: the æsthetic side of his nature found its satisfaction, too, in other ways—he was an enthusiastic opera-goer and a discriminating lover of pictures. Let it be added that no account of his life would be complete without a tribute to the memory of his wife, whose serenity and comprehending sympathy during the fifty-eight years of their married life were to him boons ever gratefully acknowledged.

Armstrong was *doyen* of the Royal Society, having been elected to the fellowship in 1876; he had been a fellow of the Chemical Society since 1870, one of its honorary secretaries during eighteen years, and its president during two; LL.D. of St. Andrews, D.Sc. of Melbourne and Madrid; honorary livery man of the Leathersellers' Company; Davy medallist of the Royal Society; Albert medallist of the Royal Society of Arts; Messel medallist of the Society of Chemical Industry; and Horace Brown medallist of the Institute of Brewing.

Temperamentally, Armstrong allowed feeling to influence his judgment to a degree unusual in an exponent of experimental science. Few of his speeches and writings were free from this intrusion: in his view, as expressed in the article "Chemistry" in the thirteenth edition of the "Encyclopædia Britannica" (1926), "Chemistry however is an art as much as a science and the chemist is full of feeling which cannot be quantified". Essentially an individualist, he did not find it easy to co-operate with others even for causes that aroused his enthusiasm and, if "apostolic blows and knocks" were not forgotten in the advocacy of his views, an autobiographical note in a recent article (1932) is not without significance: "Somewhat arrogant and extreme perhaps in his denunciation"—the opinion passed by George Eliot on Savonarola in the poem to Romola—will probably be the criticism passed on me by my friends. The situation is saved by her remark 'But a *Frater* *predicator*, who wanted to move the people, how could he be moderate?' " Nevertheless, those who knew only this side of Armstrong failed to recognize that these were but the defects of his qualities. Lacking his disinterestedness, his essential goodness of heart and his idealism, he could not have won and kept the good-humoured acceptance as an institution which became his in the post-War years. The attitude of mentor, the wounding criticism from a too facile pen: these need not be remembered now—rather we have to mourn the passing of a man whose devotion to chemistry, not least in its social implications, was the master passion of his life. W. P. W.

We regret to announce the following deaths:

Prof. Percy Gardner, emeritus professor of classical archaeology in the University of Oxford, on July 17, aged ninety years.

The Marchese Marconi, on July 20, aged sixty-three years.

News and Views

Long Distance Air Record

THE Russian pilot, Colonel Michael Gromoff, with two companions, flying an Ant 25-1, landed at San Jacinto, California, on July 14—a flight estimated to be of about 6,625 miles from Moscow, over the North Pole which lasted 61 hours 7 minutes. The existing record of 5,675 miles, was held by the French airmen Codos and Rossi. The Soviet Government has been interested in this route, which follows practically a direct line across the North Pole. The pilot's log mentions the points Moscow, south-west Novaya Zemlya, North Pole, northern British Columbia, Oregon, San Francisco, and San Jacinto. So recently as last June, Chkaloff with two others on a similar machine flew over the same course, reaching Portland, Washington, a distance of 5,600 miles. The machine, also an Ant 25-1, was specially fitted for long-distance work, carrying extra fuel tanks and liquid oxygen, presumably for flying at considerable altitudes. The total loaded weight of the machine was $11\frac{1}{2}$ tons, about 6 tons of which is stated to have been fuel for the flight.

ONE result of this flight, although possibly of a negative order, is the confirmation of the fact that the severe storms encountered, added to many hundreds of miles of ice-bound regions in which forced landings would be impossible, make it questionable as to whether such a route can ever be a commercial possibility, even though it may be the shortest distance from northern Europe to North America. Apart from this, such flights have an obvious interest to the Russian authorities, whose internal air transport and military defence problems over the long distances in northern Siberia, are of a very similar nature. Colonel Gromoff is a well-known Russian test pilot, who has been connected with the development of Russian aviation since about 1917. His name has been particularly associated with the principal Russian research station, the Moscow Central Aerodynamic Institute. It is interesting to remember that he broke a world record in 1934 with a continuous flight of 7,765 miles in a closed circuit.

Commercial Production of Oil from Coal

ON July 14, the House of Lords debated a Motion by Lord Mottistone that plant for obtaining oil from coal should be set up in Durham and South Wales in the interests both of national defence and increase of employment. Lord McGowan said that the experience of Imperial Chemical Industries, Ltd., has established the technical possibility of such processes but at capital and operating costs so high that the process, even with the assistance of existing protection, is not attractive to private capital. Success would have to depend not on private initiative, but on Government policy. The production of heavy oil for marine purposes from coal is at present un-

economical. The effect on employment ought not to be exaggerated. A plant capable of producing 150,000 tons of petrol annually provides work for 6,000 persons of whom 2,500 would be miners. Low-temperature carbonization and hydrogenation are complementary processes, and increased use of smokeless household fuels would promote both national security and national welfare. Hydrogenation processes, he emphasized, are a question of high national policy and beyond the purview of an ordinary limited liability company. Reference was made to the Fischer process and other methods of developing the use of coal. Lord Hutchinson, in reply, said the Government is awaiting the report of Lord Falmouth's Committee before deciding its policy for the production of oil from coal. Meanwhile, it is encouraging the establishment of plant for carbonizing coal at low temperatures, and another will be in production in South Wales next year.

Observations of the Longest Eclipse

INFORMATION has come to hand of the success of Prof. J. Q. Stewart, of Princeton University, and Mr. T. Stokley, director of the Planetarium in Philadelphia (representing the Franklin Institute and the Cook Observatory), in observing the recent total solar eclipse for an uninterrupted period of 7 min. 6 sec. from the S.S. *Steelmaker* of the Isthmian Steamship Co. The ship was at $133^{\circ} 38' W.$, $9^{\circ} 49.5' N.$ and the sun's altitude was $75^{\circ} 8'$. Owing to the ship's motion, totality lasted an extra four seconds for the observers. Prof. Stewart was engaged in visual study of the corona, while Mr. Stokley took photographs of the corona and measures of its total brightness at mid-eclipse. Preliminary measures show that this was of the same order as that of the full moon, while the observers on Canton Island have reported a value about half the full moon. The difference is in the opposite sense to what would be expected from purely geometrical considerations of the amount of low corona uncovered. The eclipse is described as a bright one. Despite the shadow extending around in all directions for seventy-seven miles, there was no need of flashlights to read the instruments, while ordinary newspaper print could be read with ease. Only Venus, Mercury and a few first magnitude stars could be seen, and there was indication of a high layer of haze in the sky. The corona was of late intermediate type, approaching maximum, made up of radial spikes and with no very long streamers.

Price Chair of International Economics

THE Council of the Royal Institute of International Affairs announces the appointment of Prof. Allan G. B. Fisher, of the University of Western Australia, to the newly established Price chair of international economics at Chatham House. The purposes of the chair is to provide the Institute with the means for

more intensive research into world economic problems than has hitherto been possible. Prof. Fisher is the first occupant of this chair, and will consequently inaugurate the new development in the Institute's activities which has been rendered possible by the recent generous gift of £20,000 made by Sir Henry Price for this specific purpose. Prof. Fisher, who was born at Christchurch, New Zealand, in 1895, has been professor of economics in the University of Western Australia since the beginning of 1936. He has contributed widely to periodicals dealing with economics, and has published two books, "Some Problems of Wages and their Regulation in Great Britain since 1918", and "The Clash of Progress and Security". Prof. Fisher hopes to take up his new post at Chatham House early in 1938.

Avebury

Two years ago, Mr. W. G. A. Ormsby-Gore, then First Commissioner of Works, urgently directed attention to the necessity of taking steps by means of a planning scheme to preserve the surroundings of Avebury, constituting in their entirety, as he pointed out, the most imposing monument of prehistoric civilization in the whole world. He then expressed the hope that it would not be long before such a scheme was initiated. There is now a prospect that this hope may be fulfilled. A scheme under the Town and Country Planning Act, 1932, has been prepared, which, if the necessary financial provision is made, will be put into operation before the main Wiltshire Planning Scheme, for the planning and preservation of the village of Avebury and its immediate surroundings. This scheme involves the prohibition of building in certain areas, and its restriction in others. The area covered by the prehistoric remains will be preserved for ever from building, and this, with the willing co-operation of the owner, also applies to the grounds and building of the Manor House, of which part dates from before 1648, part from the latter half of the sixteenth century. Over the main part of the downland, upon which the charm of the monuments and their appeal to the historic imagination so intimately depend, no new building will be allowed, except for agricultural purposes and necessary extensions of existing buildings, while the harmonious character of new cottages will be ensured and the planting of trees continued. To some small extent the village has encroached on the monument, but condemned cottages will not be re-erected. The agricultural character of the district will be preserved, and provision made for its future prosperity by the setting aside of adequate sites for new buildings.

This scheme will cost money. It is estimated that a sum of £11,000 will be required to meet the cost of compensation and other charges necessary to carry out the provisions of the scheme. Towards this, the sum of £4,000 already has been promised privately. An appeal for the balance is made by Sir Ernest Wills, Lord Lieutenant of Wiltshire, the Marquess of Bath, chairman of the County Council, Sir Philip

Sassoon, First Commissioner of Works, Mr. W. G. A. Ormsby-Gore, Lord Baldwin and others. The National Trust has undertaken to receive subscriptions and hold the funds for the purpose of the Scheme, which will be controlled partly by a special body composed of representatives of the County Council, the Rural District Council, the Parish Council, H.M. Office of Works, the Council for the Preservation of Rural England, and the Wiltshire Archaeological and Natural History Society, and partly by the National Trust. In view of the number of prehistoric monuments of the first importance in the neighbourhood of Avebury—Windmill Hill, Silbury Hill, Overton Hill, the Avenue, the Roman Road, to name the most prominent only—the price of preservation is small, and the appeal should meet with a ready response from the public.

Mesolithic Site in Surrey

An important mesolithic site consisting of a group of pit-dwellings has been excavated by Dr. J. G. D. Clark near Farnham, Surrey. It was discovered by Mr. W. F. Rankine, a local archaeologist, and has been described as "without any parallel in this country". (*The Times*, July 20.) The pits are circular and some three feet deep by about twelve feet across. One of the dwellings shows the site of a hearth, in which the blackening by fire can still be seen. Several hundred microlithic implements have been found, as well as a fine pointed-butt axe or pick, about five inches long. It is suggested that the settlement may be dated at about 3000 B.C., that is towards the close of the Mesolithic period, to which Dr. Clark in his studies of the Mesolithic period in Northern Europe has assigned a dating of from 8000 B.C. to 2500 B.C., when the full-fledged Neolithic culture takes its place. It would appear that this find gives an entirely new conception of the character of the mode of life of the Mesolithic peoples, which here at least would appear to have entered on a more or less settled stage. Other sites previously investigated afford little or no indications of permanent habitations, the inhabitants having lived in shelters, wind screens or skin tents as did the prehistoric inhabitants of North America and the less advanced of the recent Indians.

Necessities of Scientific Training

In his presidential address delivered at Harrogate on July 6 to the Society of Chemical Industry, Lord Leverhulme emphasized the value of a scientific training whether a man's business career is on the technical side of industry or not. Scientific method and the scientific habit of thought have an application far beyond the confines of technical research and technical processes, and Lord Leverhulme referred in particular to the importance and value of a scientific study of markets involved in market research and forecasting, as well as to the development of scientific methods of management commencing with the ideas and methods of Taylor. Referring to the synthetic production of an increasing number of our raw materials, he suggested that this development indicates an economic revolution, the proximity and

scope of which are as yet insufficiently appreciated and that the time is not far distant when man, largely independent of the accident of geographical or climatic environment, will rely very considerably on the chemist to provide substitutes. The chemist is a brilliant example of the truth that scientific research leads through the elimination of waste to the conservation of resources. In an age of industrial research directed to the production of immediately practical results, the question arises whether, in the highly developed sciences, we have gone too far in the direction of intensive scientific research with the object of gaining immediate benefits at the expense of more general research in the less developed sciences which might ultimately yield social benefits of no less value, though more remote. Lord Leverhulme suggested that if the law of diminishing returns operates in scientific research, it might well be better to devote more of our resources to the less developed and less immediately profitable sciences.

Chemistry, Past and Present

IN Prof. G. G. Henderson's absence, owing to the death of Mrs. Henderson, his medallist's address at Harrogate on July 6 to the Society of Chemical Industry, "A Retrospect of Chemical Science," was read by his colleague at Glasgow, Dr. D. T. Gibson. Prof. Henderson, an original member of the Society, who in 1888 was responsible for organizing the first annual meeting in Glasgow, reviewed developments in chemistry in the last sixty years, including present-day tendencies, and in referring to post-War advances in applied chemistry in Great Britain, commented on the increasing demand for the services of chemists not only by chemical industries but also by many other industries, and on the marked appreciation of the importance of chemical research. In particular, he referred to the importance of the contribution of the chemical engineer in the development of chemical industries, as indicated by the provision of facilities for his training, and the foundation of the Institution of Chemical Engineers and of the Chemical Engineering Group of the Society. The future prosperity of Great Britain, Prof. Henderson urged, largely depends on the support given to the progress of science and especially of chemistry, and in this matter a united profession is of the utmost importance if its influence on public opinion or on Government departments is to be effective. For this reason, he pleaded for generous support of the Chemical Council and the scheme for a Chemistry House, and in particular urged that important firms employing considerable numbers of chemists should do more to encourage their staffs to become individual members of at least one of the publishing societies.

"Applied Anthropology"

IN view of the frequency with which, it is now generally recognized, problems of administration among backward peoples are intimately bound up with matters of belief and custom, and give rise to problems of which the many ramifications cannot be understood, or perhaps even perceived, without

anthropological study, or upon which it may be necessary to seek the advice of the expert anthropologist, an announcement made by the Royal Anthropological Institute is both welcome and opportune. The Council of the Institute, it is stated, has appointed a Standing Committee on Applied Anthropology, which will meet at regular intervals for the discussion of problems of culture contact and the application of anthropological knowledge to the government of subject races. The Committee will seek to stimulate popular and official interest through the publications of the Institute, representations to Colonial Governments through the Colonial Office, and personal contacts with officials. It will also endeavour to further the organization and systematization of research in this field by means of discussion within the Committee and with experts engaged in research, and by promoting field-work according to a considered plan. A programme of typical questions affecting administration and upon which further research is desirable, has already been drawn up. In view of the wide connexions of the Institute and its close relations with those having expert knowledge in every part of the Empire, the work of the Committee cannot fail to be of the greatest utility in promoting a wise and enlightened policy in the administration of the affairs of the less-advanced races for whom the Imperial Government is responsible.

Need for the Study of Human Biology

IN an address at the celebrations of centenary of the University of Michigan on June 17, Prof. Raymond Pearl emphasized the necessity of evolving a science of human biology broad enough to synthesize our knowledge of man's mental and spiritual nature as well as of his physical nature if civilization is to survive. Our rapid advance in material things, while in wisdom and goodness little or no advance has been made, renders our development so lopsided as to threaten a catastrophe. The data for the unification of human knowledge do not yet exist, and one of the main challenges of the present situation to the man of science is that by natural aptitude and training he is the best equipped to obtain such data. Prof. Pearl believes that the universities, rather than specially founded independent institutions, offer the best environment for scientific research, and the achievements of the last hundred years encourage the belief that progress will continue.

The Bournemouth Outbreak of Typhoid Fever

THE report of the late Dr. Vernon Shaw, on his investigations into the outbreak of enteric or typhoid fever that occurred in Bournemouth, Poole and Christchurch in August and September 1936, has been issued by the Ministry of Health (Reps. on Pub. Health and Med. Subjects, No. 81. London: H.M. Stationery Office. 9d. net). The outbreak was first brought to the notice of the Ministry on August 21, 1936, and Dr. Shaw began his investigations the following day. He was informed that thirty cases of enteric fever had been notified during the preceding

twenty-four hours, and that a number of other patients, scattered throughout the three towns, were under observation. The only factor common to all the patients was the consumption of raw milk retailed by one distributor. It was concluded that the milk was infective for a period of about thirty-one days preceding August 22, and the approximate number of persons who contracted the disease was 718, of whom 518 were residents, and of these fifty-one died. No source of infection could be discovered among those distributing the milk, nor at the retailer's depot. The supply was collected from thirty-seven farms scattered throughout a large part of Dorset. Dr. Shaw was satisfied that the outbreak was due to the consumption of raw milk, and that the dealer's supply was infected by the contributions of one or possibly two producers whose milk in turn was infected by water from a contaminated stream. Immediately the outbreak was recognized, the distributor, acting on Dr. Shaw's advice, pasteurized the whole of his supply, and no unpasteurized milk was distributed after the morning round on August 22. This measure was immediately successful in terminating the outbreak.

Poetry and Astronomy

DR. F. W. Grover, professor of electrical engineering, Union College, Schenectady, N.Y., has contributed to the *Scientific Monthly* of June an article in which are brought together a number of striking passages in poetry referring to astronomical objects and phenomena. Milton, Dante, Tennyson and Longfellow are naturally given the chief prominence in these extracts, but there are also beautiful passages from Browning, Housman and others. Dr. Grover refers appreciatively to Mr. Alfred Noyes's "Watchers of the Sky", but wonders why the new knowledge of the starry heavens makes so small an appeal to contemporary poets, whose fancies rarely stray into this virgin field. "Yet," he says, "it would be a fascinating task, and one demanding no mean ability, to picture the whirl of the spectroscopic binaries, and the rhythmic oscillation of the Cepheid variables, to describe the individualities of the giant and dwarf stars, or to soar in imagination to the confines of an expanding universe."

Progress in Gliding

RECENT numbers of the *Sailplane and Glider*, the official organ of the British Gliding Association, give evidence not only of the advances that have been made in the technique of motorless flight, but also of the scientific knowledge that is producing. The development of aeroplanes has been so spectacular that development of sailplanes may be overlooked. But these have attained an airspeed of 87 m.p.h., a straight line distance of 813 miles and a height of more than 19,000 feet; records all beyond those of power planes in 1911. It has long been a reproach that sailplanes were dependent on hills and winds; but an effort was made last June to meet this by the organisation of a cross-country circular tour. A definite route of 415 miles, beginning and ending at

Darmstadt, was laid out, the time allowed being ten days and each separate flight was to start with an aeroplane tow to not more than 500 metres. Of the eight pilots who got away, four completed the course in the time, the first taking only seven days. The use of 'thermals'—ascending currents apart from clouds—has become more widespread. Of late, at four or five English gliding centres, pilots have been pulled up to a few hundred feet by a winch and have got away without any help from the wind or from a hill.

On the scientific side, the practice of soaring inside clouds, as well as the use of thermal currents and of cold fronts, has given valuable meteorological knowledge. Soaring in clouds not infrequently proves adventurous. Last June, for example, a German pilot went into a cloud to gain height and his rate of ascent increased from 4 m. a second to beyond what his variometer would register. When he was at 16,400 feet he tried in vain to get out of the cloud; he was tossed up and down, thoroughly chilled and bombarded with hail; the climax came when a wing broke off. However, the pilot with difficulty got clear, and descended to safety in his parachute. Naturally those who take such risks want to learn all they can about the conditions; and while some carry special recording instruments, others work out the paths of air in thermals or make and study fast-motion cloud pictures. As an illustration of the data brought by such means may be quoted the records of pressure, temperature and humidity obtained during a flight from the Chiemsee across the Tyrolean Alps into Italy; the pilot rose to 10,800 feet to cross the Gross Venediger. Meteorologists doubtless have shrewd ideas as to what goes on in such places as cloud-cells and lenticular clouds; but there, as well as in many other regions, definite observations must have the highest possible value.

Monthly Meteorological Elements

IN the *Meteorological Magazine* of June there is a new feature that has been developed as a result of a proposal made by Prof. A. Wagner at the International Meteorological Conference at Copenhagen in 1929, that monthly mean values of various meteorological elements should be broadcast as soon as possible after the end of each month for selected meteorological stations. The arrangements for carrying out this proposal were completed and ratified at the Warsaw Conference in 1935, and provided for the inclusion in the broadcasts of mean pressure in millibars or millibars and tenths of a millibar, mean temperature in degrees and tenths, total rainfall in centimetres, and, for certain places, resultant air transport for the month. Since the first broadcasts were made in June 1936, the selected stations have increased in number, and data for Russia, Siberia and America are now included. The figures for May 1937, except those for air transport, have been discussed in the journal mentioned above, pressure and temperature being plotted so as to show cartographically the main features of those elements of the weather for that month over a large part of the northern

hemisphere. The interesting fact emerges that the excess of temperature above the average for 1901-30 in the British Isles, which ranged from 1° to 3° F., was also experienced throughout Europe and the greater part of North America, the excess being more than 5° F. over the north-east of Europe, most of Scandinavia and northern Canada and part at least of the Nile valley. The warmth of Europe and North America is seen to be associated with, if not due to, a lowering of mean pressure in the arctic regions and Siberia, combined with an excess of pressure over most of Europe, the United States and southern Canada. This information was available at the Meteorological Office within seven days of the conclusion of the month under review.

Wear of Motor-Car Engine Cylinders

THE problem of cylinder wear has now become very serious in commercial and public service vehicles, according to an article in the January issue of the *Nickel Bulletin*. This is due to the new designs giving higher efficiency, and also the use of aluminium pistons. Wear is considered to be due to a combination of two causes: mechanical abrasion and the corrosive attack of the cylinder walls by the products of combustion. The former predominates in vehicles running for long periods with a hot engine such as motor-buses used for long-distance runs in daily service. The latter effect is the more important for vehicles which run intermittently with long waits between runs, like delivery vehicles. In these the engines never get properly warm. The development of nickel cast iron has provided a satisfactory solution. The addition of one or two per cent of nickel to a suitable composition of base iron has produced cylinder castings which are readily machinable and yet have a high Brinell hardness. Recently the manufacturers of many commercial vehicles have obtained excellent results by using heavily alloyed iron. The cylinders of both petrol and Diesel vehicles are now being regularly made of irons containing 4-5 per cent of nickel with or without proportions of chromium and molybdenum. Improved machinability is obtained by slowly cooling the castings from a temperature of about 650° C. When this course is followed, the original hardness is restored after machining by air-cooling the material from a temperature of about 850° C. In France, this hard type of iron has been used for several years with satisfactory results for air-cooled motor-cycle cylinders.

International Union of Biological Sciences

PROF. M. J. SIKS (Wageningen, Netherlands), secretary of the above Union, reports that the next General Assembly will probably be held in July 1940 at Stockholm immediately before the seventh International Botanical Congress. The president is Prof. E. D. Merrill (Harvard) and the vice-president, Prof. D. M. S. Watson (London). The report in *NATURE* (136, 612; 1935) on the International Botanical Congress at Amsterdam in September 1935 referred to the establishment of a liaison between the Congress and the Union. Dr. F. Verdoorn (Leyden), secretary

of the Botanical Section of the Union, reports on the work of this Section, which was deputed to execute the resolutions passed by the Congress and to assist the various commissions and committees then appointed. He reports that an index of current plant science periodicals, prepared by the Commission for Documentation, will be issued during 1937, and that the Commission for Urgent Taxonomic Needs is preparing an "Index Herbariorum". Suggestions or questions bearing on botanical nomenclature should be sent to Dr. T. A. Sprague, Royal Botanic Gardens, Kew, secretary of the Commission of Nomenclature.

Scientific Annual Publications: New ASLIB List

A SIXTEEN-page booklet has been issued by the Association of Special Libraries and Information Bureaux as a supplement to the ASLIB Book List, containing classified particulars of 212 recommended annual publications of scientific and technical interest, published in the English language. The publications are arranged by subjects, and include representative U.S.A. publications as well as those of the League of Nations and many of H.M. Government reports, etc., which are not often found in Press guides. The list should be of considerable service to information officers and those in charge of reference libraries or intelligence departments. The List can be obtained from the Association of Special Libraries and Information Bureaux, 31 Museum Street, W.C.1, at a charge of 2s. per copy to subscribers to the ASLIB Book List and 3s. 6d. to non-subscribers.

International Congress of Anthropological Sciences

ARRANGEMENTS are now announced for the second International Congress of Anthropological and Ethnological Sciences to be held at Copenhagen on August 1-6, in accordance with the decision taken at the first congress in London in 1934. It will be under the patronage of H.M. the King of Denmark and Iceland. The Congress will meet in seven sections, covering respectively physical anthropology, psychology, demography, ethnology, ethnography in six sub-sections according to geographical areas, sociology and religion, and linguistics and writing. Arrangements have been made for exhibitions and demonstrations in connexion with the subjects to be discussed, among them anthropological material of the Eskimo and Scandinavians of Greenland in the Middle Ages, and from the prehistoric burials of Denmark, and the skulls of Lagoa Santa, Brazil. There will be a demonstration of the relation of the ancient dwellings of Denmark and the structural systems of prehistoric times, which will take place at the Lyngby Folk Museum, where there will also be an exhibition of Danish national dances, including those of the Faroe Islands. A collection will be on view of medieval Icelandic manuscripts referring to the discovery of Greenland and Vinland, as well as the manuscript of Pomo de Ayala on the Kingdom of the Incas and Peru, recently published by the Institut d'Ethnologie de Paris, and manuscripts of the Iranian Avesta. The Ethnographical Museum, which has been closed for several years for enlarge-

ment and is the oldest in Europe, having been founded in 1846, will be reopened to the public for the first time at the meeting of the Congress. At the close of the session, an excursion will be made through Denmark, on which visits will be paid to kitchen-middens, Megalithic tombs, tumuli of the bronze age, iron age fortifications, the new Viking ship recently discovered at Ladby, and other antiquities of the Middle Ages. Subscriptions (members 30 Danish crowns, associates 15 Kr.) may be addressed to the Treasurer of the Congress, Nationalmuseet, 10 Ny Vestergade, Copenhagen, K.

Seventeenth International Geological Congress

THE seventeenth International Geological Congress is being held in Moscow on July 20-30, as noted in NATURE of January 23, p. 143. Many tours for the delegates have been arranged; for this purpose guide-books have been prepared giving detailed descriptions of the routes, all the interesting outcrops of mineral strata, the deposits of useful minerals, etc., with maps, plans and sectional drawings. Every delegate has a set of twenty-eight guide-books, and a newly issued geological map of the Soviet Union; each tour is being conducted by a Soviet geologist. According to a report issued by the Soviet Union Year Book Press Service, 403 foreign delegates, representing forty-six different countries, are attending the Congress; they include 139 from the United States, 50 from Great Britain, 33 from France, 20 from Japan and Manchukuo, 18 each from Germany and South Africa, and 11 from Sweden. Of Soviet geologists, 1,600 have intimated their desire to be present, but as many of them are at present engaged in field work, not all of them will be able to attend. The delegates will spend two days in Leningrad, where a session of the Congress will be held, and visits will be paid to the geological museums of the Mining Institute, the Central Institute of Scientific Research, the Arctic Institute, to give representatives of foreign countries an opportunity of becoming acquainted with the general characteristics of the mineral resources of the Soviet Union. In Moscow, the Congress will hold its sessions at the Observatory, where the institutes of the Academy of Sciences of the U.S.S.R. have also arranged an exhibition of collections relating to mineralogy, geochemistry and useful minerals, and the Palaeontological Institute is showing its collection of Perm vertebrates of the North Dvina Gallery. Among the subjects coming up for discussion at the Congress are: problems of oil and world oil resources; geology of coal deposits; the Pre-Cambrian system and its useful minerals; the Perm system and its stratigraphical arrangement; the inter-connexion of tectonic processes, magmatic formations and ore deposits; tectonic and geochemical problems of Asia; deposits of rare elements; geophysical methods in geology; geology of the Arctic and Antarctic.

Beit Fellowships for Scientific Research

THE Trustees have awarded Beit fellowships for scientific research, tenable at the Imperial College of

Science and Technology during the academic year 1937-38, as follows: extensions of fellowships already satisfactorily held for one year to Dr. N. Kemmer, for the continuation of his work on the theoretical studies in nuclear physics, under the direction of Prof. S. Chapman; and to E. K. Woodford, for the continuation of his research in plant physiology, the work to be done under the supervision of Prof. F. G. Gregory; new fellowships tenable for one year, but renewable for a second, to D. W. Goodall, for research on the physiology of the tomato plant, under the direction of Prof. F. G. Gregory; H. A. C. McKay, for an investigation of chemical problems by the radioactive indicator method, under the direction of Prof. J. C. Philip; A. K. Powell, for research on the various strains of *Heterodera Schachtii*, under the direction of Prof. J. W. Munro. The Trustees have also awarded a special Beit research scholarship to Dr. A. G. Gaydon, for research in spectroscopy under the direction of Prof. G. P. Thomson.

Announcements

GHEIMRAT PROF. ERICH LEBER, professor of surgery in the University of Munich, and the chief representative of plastic surgery in Germany, has been awarded the Goethe Medal for art and science on the occasion of his seventieth birthday.

THE sixth International Montessori Congress will be held in Copenhagen under the auspices of the Danish Minister of Education on August 1-10. Dr. Maria Montessori will give an address entitled "Educate for Peace". Further information can be obtained from the General Director, International Montessori Association, 1 Hampstead Hill Gardens, London, N.W.3.

ACCORDING to official reports, the birth-rate in Soviet Russia is steadily increasing. Last January, the number of births registered was 21.7 per cent higher than in January 1936, and in the first quarter of this year it was about 30 per cent higher than in the corresponding quarter of 1936. Of the Union republics the Ukraine records the largest increase for the quarter, namely, 70 per cent.

THE University of Reading proposes to reprint, in type similar to that of the original and accompanied by wood-cuts of the original drawings, the "Observations Anatomicae Selectiores Amstelodamensium", 1667-73. This work, the record of the observations of the Amsterdam School on the anatomy of seven mammals, four birds, the tortoise, the frog and thirteen fishes, is rare and its contents not widely known among biologists. Prof. F. J. Cole, to whom subscriptions for copies (1 guinea each) should be sent, is contributing a critical introduction.

ERRATUM.—In the announcement in NATURE of July 17, p. 104, of the award of the Johannes Schmidt Medal to Mr. H. G. Maurice the words 'thirteenth annual meeting' should have been 'thirtieth annual meeting'.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 158.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Packing Fractions of Krypton and Xenon

THE lines produced in mass spectra by hydrocarbon molecules have always played a predominant part in the accurate measurements of mass. This is particularly so in the use of the doublet method, since their high masses, due to the hydrogen, tend to provide easily resolvable doublets with ordinary atomic lines. With methane and ethane there is no difficulty in producing all the lines of the C_1 and C_2 groups, but when propane is used in a cylindrical discharge tube, only the first four lines of the C_2 group, 36, 37, 38 and 39, have a workable intensity. These were used in the measurements of the isotopes of chlorine¹. Fortunately, the lower pressure discharge in an eight-inch bulb gives all the lines up to C_2H_4 , though the even ones, 40, 42, 44, are weaker than the others. This has enabled comparisons to be made with the multiply charged lines of krypton and xenon, giving direct measurements of their packing fractions much more accurate than the indirect ones made ten years ago². The following are the results:

Doublet	Number of doublets measured	Difference in packing fraction	Difference of mass
$^{86}Kr++ - C_2H_2$	4	18.28 ± 0.2	0.0635
$^{84}Kr++ - C_2H_2$	19	20.20 ± 0.15	0.0828
$^{82}Kr++ - C_2H_2$	20	21.73 ± 0.15	0.0913
$^{80}Kr++ - C_2H_2$	18	23.10 ± 0.15	0.0993
$^{136}Xe+++ - C_2H_2$	14	20.16 ± 0.1	0.0867

Presence of traces of argon in the tube prevented any accurate determination of ^{86}Kr . Measurements of $^{136}Xe+++$ by the doublet at 44 were unsatisfactory owing to the presence of CO_2 , but its packing fraction appears to be nearly the same as that of ^{136}Xe , and is given provisionally.

The following are the packing fractions and isotopic weights deduced from values of hydrogen and carbon of 1.00812 and 12.00355 respectively:

Symbol	Packing fraction	Isotopic weight
^{86}Kr	- 7.30	77.9430 ± 0.0020
^{84}Kr	- 7.70	81.9369 ± 0.0015
^{82}Kr	- 7.60	83.9362 ± 0.0015
^{80}Kr	- 7.40	85.9363 ± 0.0015
^{136}Xe	- 4.46	128.9424 ± 0.0020
^{134}Xe	(- 4.4)	(131.942)

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
July 9.

¹ NATURE, 126, 1094 (December 26, 1936).

² Proc. Roy. Soc., A, 115, 506 (1927).

The Two Crystalline Modifications of Insulin

PROF. E. B. MATHEWS' first examination of Abel's crystalline insulin showed the presence of two types of insulin crystals¹. One of these, the so-called prismatic or needle variety, had marked birefringence and a development of faces strongly suggestive of rhombohedral symmetry, the crystals being elongated along the trigonal axis. Crystals of this type are commonly wedge-shaped, and very small wedge-shaped crystals have also been obtained by Scott² by crystallisation of insulin from acetate buffers at pH 5.2. The more common variety of insulin crystals are those obtained first by Abel³ from phosphate buffers at pH 6.2. These are very small flat rhombohedra appearing isotropic as usually viewed along the trigonal axis, but having actually positive birefringence. X-ray examination has here shown the presence of a simple rhombohedral unit cell⁴. It has been usual in the literature to describe these two forms—prismatic and rhombohedral—as polymorphic modifications⁵.

Through the kindness of Prof. F. L. Pyman, I have now had the opportunity of examining also insulin crystals of the prismatic type by the X-ray method. Two preparations were available. One of these consisted of very small crystals roughly wedge-shaped in outline and frequently twinned in cross forms as described by Mathews. As these crystals were only 0.05 mm. long and less than 0.01 mm. across, they could not be used for X-ray measurements. But there seems no doubt that the second preparation is identical with this, though here the crystals showed no identifiable faces. They were roughly needle-shaped masses up to 0.3 mm. long and rather less than 0.1 mm. in cross-section, extinguishing uniformly between crossed nicols and showing, as do the small wedge-shaped crystals, positive birefringence.

These needle-shaped crystals gave on X-ray examination photographs identical in the spacings and intensities of the X-ray reflections with those obtained from the original 'rhombohedral' crystals. The crystal structure is therefore the same in the two forms, and these are not polymorphic modifications though the change in habit is certainly very striking. Even here there is evidence that forms intermediate between the two varieties may occur. One sample of insulin, recrystallized from sodium dihydrogen phosphate and acetic acid, consisted very largely of small crystals showing nearly equal development of rhombohedral and prismatic (or more probably steep trapezohedral) faces, which gave them at first sight the appearance of rhombic dodecahedra. These crystals were much too small for X-ray examination, but the possession of positive birefringence combined with the symmetry leaves little doubt of their identity with the other two varieties.

In one respect only do the X-ray photographs of the needle crystals appreciably differ from those of the original rhombohedra. They all show a much more marked diffuse ring with a spacing of about 4.5 Å., a value we have come to consider characteristic of the presence of 'amorphous' proteins*. Here it may be due to imperfections of the crystal following perhaps partial breakdown. But amorphous proteins such as gelatin are known to have a marked effect on the habit of both organic and inorganic crystals; and it seems possible that a similar influence appears here, amorphous insulin or a breakdown product being included in the crystals and being itself responsible for the adoption of the prismatic form.

D. CROWFOOT.

Dept. of Mineralogy,
Oxford.
June 29.

- * Abel, J. J., Gelling, E. M. K., Rouiller, O. A., Bell, F. K., and Wintersteiner, O., *J. Pharm. Exp. Ther.*, **81**, 84 (1927).
 * Scott, D. A., *Trans. Roy. Soc. Canada*, (n.s.), **26**, 275 (1932).
 * Abel, J. J., *Proc. Nat. Acad. Sci.*, **18**, 133 (1933).
 * Crowfoot, D., *NATURE*, **136**, 591 (1935).
 * Cf. "Insulin" by D. W. Hill and F. O. Howitt (p. 51).
 * Cf. Arbuthnot, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **29**, 235 (1935).

Absolute Configuration of the Naturally Occurring α Amino-Acids

THANKS largely to the extensive researches of Levene and his collaborators, it now appears to be well established that, as suggested by Clough in 1918¹, the naturally occurring α amino-acids all possess the same configuration. Until recently, the absolute configuration was not known for any optically active compound, but in the course of a theoretical calculation of rotatory power, Boys² deduced a rule giving the absolute configuration of any enantiomorph from the sense of its rotation—namely, "that a dextro compound has the configuration such that, when the largest group is nearest to the hypothetical observer the other groups in order of diminishing size appear in a clockwise rotation".

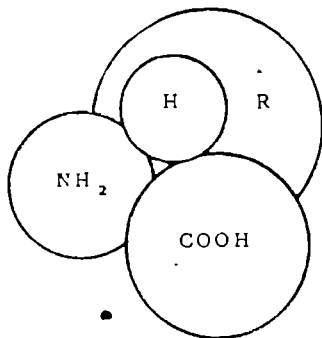


Fig. 1.

Boys's rule, which appears to have been accepted by Levene and Lowry, can only be applied with certainty in the absence of interactions of the solvent with the solute molecule, a condition which is far from being fulfilled by the amino-acids; marked solvent action is indicated in several cases by a complete change of sign of the rotation with temperature or with pH. The configurations of the amino-acids have, however, been correlated with those of

other compounds in which solvent action is less; from the recent paper of Levene and Mardashev³, the naturally occurring amino-acids have the configuration of laevo-rotatory 2-amino-hexane, a compound to which Boys's rule may be applied with more confidence.

If the validity of the rule and its applicability to this amine be accepted, then the naturally occurring α amino-acids, which amount to more than 95 per cent of most proteins, can be assigned the absolute configuration given in Fig. 1.

R. O. RAINY.

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Tropical Medicine.
June 22.

¹ Clough, G. W., *J. Chem. Soc.*, **118**, 525 (1918).

² Boys, S. F., *Proc. Roy. Soc., A*, **144**, 655 (1934).

³ Levene, P. A., and Mardashev, S., *J. Biol. Chem.*, **117**, 707 (1937).

Use of Krypton-filled Ionization Chambers for Cosmic Ray Measurements

SOME years ago, compressed air and nitrogen were replaced by argon in cosmic ray ionization apparatus¹, argon being approximately twice as effective as nitrogen, which in turn is more effective than air.

Krypton is now used for filling special incandescent electric lamps, and is thus more easily available than hitherto. It was *a priori* probable that this gas of high atomic number would give much more favourable results than argon. The Gesellschaft für Lindes Eismaschinen, Germany, has kindly supplied me with compressed gas containing 94.5 per cent krypton and 5.5 per cent xenon. An ionization chamber was filled with the gas under a pressure of 12 atm. Only a few measurements could be carried out with the apparatus, as in consequence of an accident the greater part of the gas was lost. Nevertheless, the results obtained seem to be of interest to workers in that domain of science.

I had at my disposal two almost identical ionization chambers which were alternately filled with dry air under atmospheric pressure and with compressed krypton, argon or nitrogen. The chambers were of steel 5 mm. thick, had a volume of about 900 cm.³ each and their central electrodes were connected with Lindemann electrometers; they were exposed to the γ -rays from 0.4 mgm. radium at a distance of 120 cm.

Denoting by I_{air} the ionization in air of normal pressure and temperature, it was found:

$$I_{\text{N}_2}^{15.5 \text{ atm}}/I_{\text{air}} = 9.5; \quad I_{\text{Ar}}^{15 \text{ atm}}/I_{\text{air}} = 18.9; \\ I_{\text{Kr}}^{12 \text{ atm}}/I_{\text{air}} = 40.2.$$

The ionization at these relatively low pressures is roughly proportional to pressure². Reducing all measurements to the same pressure of 12 atm., we obtain the following relative ionization values for nitrogen, argon and krypton: 7.4; 15.1; 40.2. The nitrogen and argon used were of high purity; with commercial products, the superiority of krypton would be still more marked.

The γ -ray and cosmic ray ionization are generally proportional to each other. I undertook some experiments to test it in the case here concerned. My results are too incomplete to be quoted. It has been found, however, that the ionization due to cosmic rays is more than twice as great in krypton as in argon. It is thus obvious that the substitution of argon by krypton in ionization chambers will give a gain even more considerable than that which was

formerly obtained by substitution of air by argon. The usefulness of krypton for Geiger-Müller counters in cosmic ray research is also obvious.

Part of the expense for this investigation was covered by a grant from the Ministry of Education.
 St. ZIMMERLI.

Main School of Agriculture,
Physical Laboratory,
Warsaw.
June 10.

¹ Compton, A. H., and Hopfield, J. J., *Phys. Rev.*, **41**, 539 (1932).
² Hopfield, J. J., *Phys. Rev.*, **43**, 675 (1933).

Ionization Energy of Li^+ and He

As a disagreement was found by Robinson¹ between measured and calculated values for the ionization potential of Li^+ , I have made a direct calculation by the method described by Hylleraas². The ionization potential in the 13th approximation is found to be 610,058 cm^{-1} . This result is in good agreement with the value 610,054 cm^{-1} obtained from the Hylleraas' extrapolation formula for $Z = 3$.

To this value the following corrections are to be applied³: ϵ_2 (mass polarisation correction—the elementary mass correction is contained in R_2 and therefore already taken into account), H_1 (relativistic change of mass with velocity), H_2 (magnetic interaction between the orbits), H_3 (spin correction, arising from a characteristic term in the Dirac theory), H_4 (relativistic correction for the remaining ion with one electron).

I have calculated the most important of these corrections, H_1 and H_4 , using the best wave function with four terms. Bethe has made the same calculation using a less accurate wave function.

TABLE 1 RELATIVISTIC CORRECTIONS.

Correction unit	H_1 $\alpha^2 R$	H_2 $\alpha^2 R$	H_3 $\alpha^2 R$	Total $\alpha^2 R$	Total (cm^{-1})
New value	153.8	-125.1	-20.3	+8.4	+49
Bethe's "	130.4	-111.6	-20.3	-1.5	-8

H_4 is found to be very little ($= -2 \text{ cm}^{-1}$). Other corrections seem to vanish in our approximation.

TABLE 2.

Unperturbed ioniz. pot. (cm^{-1})	Total cor- rections H (cm^{-1})	Mass pol. corr. ⁴ (cm^{-1})	Total calculated (cm^{-1})	Experimental value ⁵ (cm^{-1})
610,058	47	-5	610,100	610,079 $\pm$ 25

For He the agreement is not so good: the calculated value is 198,325 cm^{-1} (the unperturbed value is calculated by Hylleraas) and the experimental result is 198,305 $\pm$ 15 cm^{-1} (measured by Paschen). It seems that the theoretical values (even for heavier elements) lie somewhat higher than the experimental values, so the disagreement cannot depend upon the use of the variational method.

H. A. S. ERIKSSON.

Institute of Mechanics and
Theoretical Physics,
Uppsala. June 7.

¹ Robinson, *Phys. Rev.*, **51**, 14 (1937).

² Hylleraas, *Z. Phys.*, **65**, 200 (1930).

³ Bethe, "Handb. d. Physik", vol. 24/I, p. 224, et seq.

⁴ Edlén, *Norsk Acta Reg. Soc. Sci. Ups.*, (7) 9, No. 6, and Robinson, *Phys. Rev.*, **51**, 14 (1937).

The O-H Raman Frequency in Inorganic Acids

THE band characteristic of the OH group has been recorded in the Raman spectra of many hydroxides and alcohols. It has not so far been observed, however, in the case of the stronger acids. Using the improved technique of complementary filters recently developed by Ananthakrishnan¹, and giving long exposures varying from six to twelve days, I have succeeded in obtaining spectra with sulphuric acid and crystals of iodic, selenious and telluric acids, in which the band is clearly seen in the 4046 Å. excitation. Table 1 gives the frequency shifts. The value for boric acid is taken from Ananthakrishnan's paper².

TABLE 1.

Substance	Raman frequencies of the OH band (cm^{-1})		
	Beginning	Middle	End
H_2SO_4 (100%) liquid	2794	2985	3172
HIO_3 crystals	2834	2979	3125
H_2SeO_4 "	2978	3067	3141
H_2TeO_4 "	2985	3121	3257
H_3BO_3 "	—	3172, 3256	—

The following points may be noted: (1) The OH frequency in these acids is represented by a band which is weak, broad and diffuse as compared with the other vibration frequencies. (2) The OH group, which gives a sharp line at 3608 in potassium hydroxide and a broad band at about 3660 in ethyl and methyl alcohols, gives a much lower frequency in the inorganic acids. (3) There is a progressive fall in the characteristic frequency shift and a diminished intensity of the band with increasing strength of the acid. (4) In the case of sulphuric acid, the band appears to be resolved into two components.

The fact that the OH band has not hitherto been recorded in the Raman spectra of acids has been regarded by some investigators³ as supporting the hypothesis of the existence of the so-called hydrogen bond⁴ in oxy-acids and their salts. Now that the OH band has actually been recorded, this view evidently requires some modification. We have in fact to postulate the existence of the OH bond in acids as well, but considerably weakened as compared with the strength of the bond in alkalis and in weak acids. It may be mentioned in this connexion that Badger and Bauer⁵ have recently observed an infrared absorption band in the region of 3μ in sulphuric acid, and they ascribe it to the presence of the OH group. These authors have drawn the inference that the so-called hydrogen bond and the hydroxyl bond postulated by Bernal and Megaw⁶ are only extreme cases of one and the same phenomenon. This view appears to be supported by the investigation reported above.

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Physics Department,
Indian Institute of Science,
Bangalore.
June 13.

¹ Ananthakrishnan, R., *Proc. Ind. Acad. Sci.*, A, **5**, 76 (1937).

² Ananthakrishnan, R., *Proc. Ind. Acad. Sci.*, A, **5**, 200 (1937).

³ Hilbert, G. B., Wulf, O. R., Hendricks, S. B., and Liddell, U., *NATURE*, **136**, 147 (1935).

⁴ Latimer, W. M., and Rodebaugh, W. H., *J. Amer. Chem. Soc.*, **42**, 1419 (1920).

⁵ Badger, R. M., and Bauer, S. H., *J. Chem. Phys.*, **5**, 300 (1937).

⁶ Bernal, J. D., and Megaw, H. D., *Proc. Roy. Soc.*, A, **151**, 384 (1935).

Surface Migration of Barium

J. A. BECKER¹ has described experiments from which he concluded that barium, deposited on one side of a flat tungsten ribbon, could, under given conditions, move to the opposite side. The thermionic emission measurements from each side of the ribbon indicated that barium deposited on one side migrated until each side was covered with half the original amount.

We have been engaged in observing the behaviour of oxide-coated emitters on nickel and tungsten, for which purpose we have used an electron microscope. In the light of Becker's results, we were surprised to find that, although barium could spread across a nickel or tungsten surface on which it had deposited, it could do so only when evaporation was possible. Our results did not, therefore, provide any direct evidence of surface migration.

We have since repeated Becker's experiments with both nickel and tungsten. The apparatus used by Becker is only briefly described in the references^{2,3} given, but in his paper⁴ on the diffusion and migration of thorium on tungsten, he describes in detail the apparatus employed. In our experiments, we used an apparatus similar to that described there. In this apparatus, precautions are taken to separate the thermionic emission from each side of the ribbon.

Our results have failed to reveal any evidence of surface migration of barium either on nickel or tungsten. In each case, the thermionic current measured at any time from the clean side was considerably less than one per cent of that obtained from the contaminated side, even after 16 hours' running at 1,100° K., the temperature at which Becker concludes migration rapidly takes place.

We hope to publish full details of both our electron microscopic and thermionic investigations in the near future.

Research Staff,
M.O. Valve Co., Ltd.,
G.E.C. Research Laboratories,
Wembley.
June 17.

M. BENJAMIN.
R. O. JENKINS.

¹ *Trans. Amer. Electrochem. Soc.*, **55**, 100 (1929).

² *Trans. Faraday Soc.*, **28**, 155 (1932).

³ *Phys. Rev.*, **42**, 428 (1933).

The Ground State of the Se₂ Molecule

THE diatomic molecules of the lighter elements of the sixth family of the Periodic Table, like O₂, S₂, SO, have ³Σ terms as their ground states. There is some doubt if this still prevails with the heavier elements of that group. Spectroscopic investigations have so far not been able to show whether the ground states of Se₂, Te₂, SeO, etc., are ³Σ or ¹Σ states.

So it appeared worth while to ascertain the magnetic properties of Se₂ vapour. With all precautions necessary to avoid contamination by oxygen, selenium was sealed in a silica tube under vacuum, and the influence of a magnetic field on it was determined at different temperatures between 20° C. and 1,100° C. The vapour in the tube consists of Se₂ and Se₈, being practically all Se₂ at low temperatures and changing more and more to Se₈ as the temperature rises. Along with the formation of diatomic molecules, a strong paramagnetic influence appeared, rapidly increasing as the quantity of

diatomic vapour increased. This establishes the fact that the ground level of Se₂ is ³Σ.

A full account will be given in the *Proceedings of the Indian Academy of Sciences*, Bangalore.

Experiments on tellurium to the same effect are in progress.

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Laboratories,
Lahore.
June 18.

S. S. BHATNAGAR.
H. LESSEHM.
MOHAN LAL KHANNA.

A Psycho-geometrical Representation of Personnel Organization

LARGE industrial and other concerns represent their personnel organization diagrammatically by means of a chart having the form of a genealogical table. Properly constructed, this chart gives concise information as to individual rank and duties and relations, but no information regarding fundamental functions and mentality types at different levels. Moreover, the chart conveys the impression of descent instead of growth, differentiation and organic unity. It is therefore biologically unscientific and inadequate for administrative educational purposes.

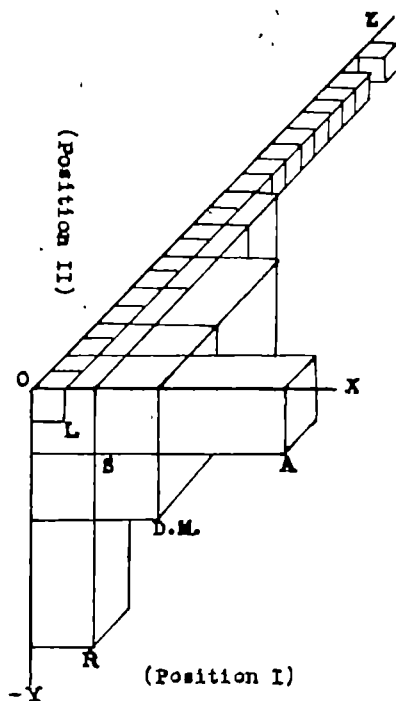


Fig. 1.

The above defects can be remedied by employing the co-ordinate system. In Fig. 1 (of which a solid model in colours has also been constructed), the OX axis represents breadth of knowledge or the administrative function, and O-Y depth of knowledge or the research function. It will be apparent that the administrative mind is represented by a horizontal rectangle (A), the research or advisory mind by a vertical rectangle (R), and departmental management, supervision and labour by squares of decreasing size (D.M., S and L). A, R and D.M., though always different in form and function, may be equal in area or total knowledge and ability. These conceptions

constitute a helpful guide in educational training, including the important matter of mental contact. The projection (*OZ* axis) represents numbers only. It enables diagrams to be constructed representing the functional organization, in terms of mental types, of different concerns. Tentative trials have yielded interesting results. This method of representation, therefore, in psychological hands, has a research value.

It may be noted that *OX* also measures responsibility and power in the administrative sense. Remuneration increases from *O* to *X* in rapid geometrical progression ($r=2$); from *O* to *Y* it tends to increase only in slow arithmetical progression ($d=1$). This is due largely to demand and the factor of scarcity. It may be noted that knowledge and information characteristically pass along the path *YOX* and decisions or orders along *XOY*.

In Position II, the appearance of a building is not altogether fortuitous, since there is a fixed and real relationship between numbers and space, even if that between rank and altitude is only analogical. It may be noted that the modern idea of 'functional control' (for example, a personnel department 'intruding' into all other departments in respect of its function) can be represented clearly by lines drawn obliquely in the *XOZ* plane.

In the next two positions the figure facilitates the explanation of other ideas of considerable importance, but with which it is unnecessary to deal in the present communication.

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June 5.

Phosphorus and Calcium Deficiency Diseases as Two Aetiologicaly Distinct Entities

Phosphorus Deficiency

VITAMIN D deficiency in most species of animals leads to the development of rickets, and Kay's suggestion that the real cause of experimental rickets produced under conditions of vitamin D deficiency is the assimilation of insufficient dietary phosphorus is interesting. Certainly this opinion is strengthened by the observation that low vitamin D rickets is indistinguishable from that produced by phosphorus-deficient diets in the presence of abundant vitamin D. The disease is referred to as rickets in the immature animal and as osteomalacia in the adult.

Theiler produced evidence in 1932 that rickets or osteomalacia in bovines kept under conditions of abundant vitamin D was invariably associated with insufficient dietary phosphorus. Subsequent work at this Institute has shown this to be true for other species of domestic animals in addition to the ox. Experimental rickets, due only to insufficient phosphorus in a diet adequate in all other respects, has been produced in cattle, goats, sheep, pigs; and, recently, indications of it have been observed in the horse. Details of these experiments are being published and leave no doubt that insufficient dietary phosphorus is the causal factor in the production of rickets under conditions of vitamin D sufficiency, while insufficient calcium in the diet does not produce rachitic lesions but an entirely different bone disease.

Calcium Deficiency

It is well known that low calcium in the rations of horses, especially if excess phosphorus be present,

produces osteodystrophia fibrosa (Sturges and Crawford, Kintner and Holt, Niimi, Theiler, etc.) but not rickets. Actually, true rickets in the horse has not yet been described in the literature. Furthermore, osteodystrophia fibrosa (osteofibrosis) is known to occur also in the goat, the dog and in some other animals, but so far its occurrence has not been associated with calcium-low diets.

At this Institute an 8-months old calf receiving daily in the diet 3 gm. calcium (CaO) and an excessive quantity of phosphorus (30 gm. P_2O_5), developed marked osteofibrosis and bone atrophy after 13 months. Abundant vitamin D was present. Two calves of the same age and receiving the same ration except that the phosphorus content was reduced to 15 gm. P_2O_5 developed osteoporosis and severe osteofibrosis during the same period. A fifteen months old steer receiving daily in his ration 4 gm. CaO and insufficient phosphorus (4 gm. P_2O_5) developed rickets as a result of the phosphorus deficiency shortly after the beginning of the experiment and osteofibrosis in virtue of the calcium deficiency after 31 months, severe rickets and bone atrophy still being present. The same ration supplemented to contain abundant calcium (31 gm.) produced severe rickets and osteoporosis due to the phosphorus deficiency, but no osteofibrosis in a steer of the same age.

Moderate osteofibrosis was produced in a goat and in a pig receiving low calcium high phosphorus in their diets, but possibly the wide ratio of calcium to phosphorus was also responsible for the severity of the disease. Osteofibrosis has not yet been produced in sheep fed on a diet low in calcium.

Osteoporosis is merely the result of increased bone resorption; it is indicative of abnormal $\text{Ca}:\text{P}$ metabolism, and is a transient stage in the evolution of some osteodystrophic diseases. It invariably accompanies the development of both rickets and osteofibrosis.

The most probable explanation for the relative rapidity with which rickets was produced by phosphorus-deficient diets compared with the appreciably longer time osteofibrosis took to develop when the rations were low in calcium, is that the functions of these two minerals in the animal body differ widely. Practically all the body calcium is required for bone formation and is present in the skeleton, whereas the demands for the much more widely functioning phosphorus are far more varied than for calcium. In other words, the need for metabolic phosphorus, other than that required for ossification, probably plays as important a part in the production of rickets as a deficiency of phosphorus for bone formation alone, and hence rickets due to phosphorus deficiency appears more rapidly than osteofibrosis due to a deficiency of dietary calcium.

It is interesting to note that, in all Marek's experiments with pigs, osteofibrosis was produced only when calcium was low or lower than phosphorus. No significance was attached by Marek to this apparent association of osteofibrosis with reduced calcium in the diet, probably because the work was done under conditions of vitamin D deficiency, and hence rickets developed in every case where osteofibrosis was produced, thus masking the association of osteofibrosis with abnormal calcium metabolism.

Our conclusion is that when enough vitamin D is present, a deficiency of phosphorus in the diet of cattle, sheep, goats and pigs produces rickets only, whereas a deficiency of dietary calcium produces

osteofibrosis uncomplicated by rickets—certainly in cattle and horses and probably also in pigs and goats. Osteoporosis in invariably associated with both diseases.

Onderstepoort,
South Africa.
May 18.

P. J. DU TOIT.
A. I. MALAN.

Kay, H. D., "Experimental Rickets as a Phosphorus Deficiency Disease", *NATURE*, **151**, 468 (1943).

Kintner, J. H., and Holt, B. L., *Phil. J. Sci.*, **48**, 1 (1932).

Marck, J., and Wellman, O., "Die Rachitis" (Berlin: Gustav Fischer, 1932).

Niml, K., and Aoki, M., *J. Jap. Soc. Vet. Sci.*, **3**, 354-358 (1927).
Sturges, I. W., Administrative Report for 1917. Report Govt. Vet. Surgeon, Ceylon (1918).

Theiler, A., *Deut. Schweiz. Naturforsch. Gesell.*, **66**, Abt. 1 (1932).

Effects on Ovariectomized Rats of Progesterone Alone and in Combination with the other Sexual Hormones

An experiment on ovariectomized rats in relation to this question has been performed by Selye, Browne and Collip (1936)¹. They obtained progestational changes in the uterus and vagina of four out of six rats injected daily for 19 days with 30 γ of oestrone and 400 γ of progesterone.

We performed our experiments on 101 ovariectomized rats, which were injected with progesterone alone (up to 500 γ daily) or in various combinations with oestrone (the dose of oestrone varying from 1 γ three times a week to 30 γ daily) or oestradiol (30 γ daily or three times a week). The dose of progesterone used in these combinations varied from 500 γ to 3000 γ daily. Preliminary injections of 6 γ of oestrone were given four times a week for 10 days before the first progesterone injection was added. The period of injection was usually 20 days or, in a few experiments, 27 days.

The injection of progesterone alone (500 γ a day) brought about only a slight hypertrophy of the uterine epithelium and an occasional cystic mucification of some of the cells of the vaginal epithelium. The uterus and vagina remained atrophic, the average increase in weight being very small.

With the combined injections with oestrone or oestradiol, the nearest approach histologically to the picture of the normal pregnancy uterus and vagina was obtained by the use of 1 γ of oestrone three times a week with 1,500 γ of progesterone daily. Increasing the dose of oestrone, even to only 6 γ , or decreasing the dose of progesterone, resulted in a decrease or, with some doses, even in the disappearance of the progestational changes, especially those in the uterus. Even the combination of 30 γ of oestradiol three times a week with 3,000 γ of progesterone daily (that is, increasing both doses simultaneously) gave uterine progestational changes which were less than those obtained with the first combination 1 γ : 1,500 γ .

While, however, with some of the combinations mentioned above the histological structure of the uterus and vagina showed typical progestational changes, both the size and weight of these organs with all doses were considerably less than those during pregnancy (the sterile horn of a pregnant rat was used for the comparison of the uterine changes). In fact, the uterus was even much smaller than that of the normal rat in diestrus.

We have shown previously² that the so-called 'male' hormones, especially testosterone and testosterone propionate, when combined with oestrone, produce progestation-like changes in the sexual organs of ovariectomized rats, while at the same time these organs hypertrophy considerably. It is also known that the male sexual hormones (not identified) are present in the female organism. Taking these facts into consideration, various doses and combinations of testosterone, testosterone propionate and Δ^4 -androstenedione (150-500 γ daily) were added to the combination of progesterone and oestrone. A considerably improved general development was obtained in the uterus and vagina which, with some combinations of the hormones, approached that seen in pregnant animals. The myometrium considerably increased. The progestational changes in the mucosa, however, decreased somewhat after these additions.

The nearest approach to the 'pregnant' uterus and vagina was obtained in most of the rats injected with the following combinations and doses:

- (1) test. prop. 300 γ + prog. 2,000 γ + oestrone 6 γ ;
- or (2) test. prop. 500 γ + prog. 500 γ + oestrone 6 γ ;
- or (3) testosterone 500 γ + prog. 1,500 γ + oestrone 1 γ ;
- or (4) testosterone 500 γ + prog. 500 γ + androstenedione 500 γ + oestrone 6 γ .

We wish to express our gratitude to Prof. W. Schoeller and Messrs. Schering, Ltd., for kindly supplying us with progesterone, to Messrs. Ciba, Ltd., in particular to Dr. K. Miescher, for the supply of testosterone, testosterone propionate and androstenedione, and to Prof. A. Girard for oestrone and oestradiol.

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K. HALL.

Lister Institute of Preventive Medicine,
London, S.W.1.
June 25.

¹ Selye, Browne and Collip, *Proc. Soc. Exp. Biol. and Med.*, **34**, 198 (1936).

² Koronchovsky and co-workers, *NATURE*, **135**, 434; **136**, 185 (1935); **137**, 404 (1936). *Biochem. J.*, **30**, 2534 (1936); **30**, 558 and 1514 (1936); **31**, 467, 475 and 790 (1937). *J. Path. and Bact.*, **48**, 91 and 345 (1936).

Excretion of Nitrogen by Leguminous Plants

SINCE 1927, Virtanen and co-workers¹ have published results of numerous experiments which confirm and greatly extend the observation of Lipman² that certain leguminous plants when fixing nitrogen excrete part of this into the quartz sand substrate, and if a non-leguminous plant is present, it may utilize the excreted form. The extensive data compiled by Virtanen and collaborators prove definitely that true excretion occurs with several of the legumes, but there exists an equally impressive body of experimental data which demonstrates conclusively that excretion is not *universally* obtained.

The original experiments of Lipman included only twenty-six cultures free of combined nitrogen thus capable of supplying clear-cut evidence. With respect to excretion, six of these were positive and twenty were negative. Examination of Stalling's data³ shows no evidence of benefit to wheat when grown with soy beans. Ludwig and Allison⁴ report no excretion with cow-pea, lucerne, vetch and sweet pea, as does Bond⁵ with soy bean.

Since 1933 we have studied this problem using in most of our experiments a pea-oat mixture, but in certain ones lucerne, soy beans and red clover were included. In fifteen experiments, more than two hundred plant cultures grown under a wide range of

experimental conditions have been examined, but in no case has excretion been detected either by benefit to non-legume in association or through analysis of the sand.

At the invitation of Prof. Virtanen and with the aid of Dr. S. v. Hausen, I conducted experiments at the Biochemical Institute in Helsingfors during the fall of 1936. In spite of unfavourable weather, which restricted nitrogen fixation, definite evidence of excretion was obtained with peas grown in sterile containers. The experiments were repeated this spring at Madison under identical conditions with the exception of the sand used—and of necessity with different environmental conditions, for example, type of greenhouse and weather conditions. In these experiments, excretion has been detected in *part*, but not *all*, the cultures independent of the quantity of nitrogen fixed. The cause of the discrepancies is not readily apparent, but the chief factor in associated cultures appears to be the manner of development of the plants. Our experiments indicate that excretion may be profoundly affected both qualitatively and quantitatively by the species of plant, nature of substrate and in associated cultures by the relative rate of growth of the different species. An environment that delays the reproductive stage appears to favour the excretion process.

Without minimizing the importance of Prof. Virtanen's studies, especially as they relate to the chemical nature of the excreted compounds, it is emphasized that excretion of nitrogen by leguminous plants is not universally obtained, even under experimental conditions which are apparently identical. For this reason the questions as to whether the phenomenon actually occurs in the field and to what extent it is responsible for the beneficial effects of associated culture of legumes and non-legumes remain unanswered. Until the factors which control the process are defined and the origin of the discrepancies known, it should be recognized that application to practical agriculture is only an attractive possibility and not an established fact.

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(John Simon Guggenheim Memorial Foundation Fellow 1936).

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Virtanen, *J. Soc. Chem. Ind.*, **54**, 1015 (1935).

¹ Lipman, *N.J. Agric. Expt. Sta. Bull.*, **253** (1912).

² Stallings, *Soil Sci.*, **31**, 253 (1925).

³ Ludwig and Allison, *J. Bact.*, **31**, 93 (1930).

⁴ Bond, *NATURE*, **130**, 676 (1937).

Succession of Broods of *Lebistes*

THERE seems to be a point in the natural history of *Lebistes* which is not generally known among those using this fish as a 'laboratory animal' in Great Britain. As it affects certain types of research very markedly, the following information will be of interest to those using this fish.

As a result of one mating, a female *Lebistes* may produce a succession of broods over a period of from six to eight months. From personal experience, I cannot vouch for the length of time mentioned (my authorities are Mellen and Lanier) as I am only now in the process of testing it, but that spermatozoa do remain alive within the body of the female and fertilize one brood after another is definitely established. The exact details of my data may be of interest. Mr. Gillespie sent me up some specimens

from the Zoological Society of Scotland's Aquarium on February 3 last. As a result of the rigours of the journey, all were dead by the morning of February 5 except two females. Hoping for the best, I got no more, and one of the two, which has had no other companion except the other original one since, has produced the following broods: February 22, 3; March 28, 20; April 25, 58; May 27, 28. Judging from her present appearance, she is again an expectant mother!

G. L. PURSER.

Marischal College,
University of Aberdeen.
June 22.

Method for Fixing Neutral-red in Supra-vital Stained Blood Smears

IN blood smears from horses stained according to the ordinary methods Giemsa and May-Grünwald Giemsa, we encounter serious difficulties in the examination: first, to differentiate between large lymphocytes and small monocytes, secondly, to determine *qualitative* changes in the white blood corpuscles. In order to remedy this, we have employed as a supplementary method, in an extensive investigation into the white blood picture in the case of infectious anæmia in horses, supra-vital staining with neutral-red.

We mix in a test-tube neutral-red with citrate blood at body temperature in the ratio of 1:15,000. The test-tube is placed in a thermostat at 37° for 40 minutes. In the meantime, it is shaken up a couple of times. After that we make an ordinary cover-glass smear, allow it to dry in the air for 24 hours, fix it with a saturated picric acid solution, and then stain it with Mayer's hamalin (that is, Mayer's original recipe without citric acid), and embed in cedar oil.

In this slide thus prepared from *normal* horses, there is a large granulated deposit of neutral-red in monocytes, eosinophiles and basophiles, while no neutral-red grains are discovered in neutrophils and lymphocytes. The difference between the neutral-red in lymphocytes and monocytes makes differentiation easy. In slides from horses suffering from infectious anæmia, there occurs during an attack of fever a more or less large deposit of neutral-red also in the neutrophils. It is often connected with degenerative changes. The degeneration is demonstrated by vacuoles in the protoplasm and karyopyknosis with strong lobation of the nucleus. We have been unable to discover in the sick horses any changes in the amount of neutral-red deposit in the other white corpuscles.

This method does not, of course, present any opportunity for the study of the live white corpuscles as does the method described by Simpson¹ and by Sabin², but in contradistinction to the latter it makes it possible to study the cells at leisure when fixation of neutral-red has been reached. The nuclear staining also largely facilitates the investigation. A great advantage is also the possibilities it presents in the study of qualitative changes in the neutrophile leucocytes.

A. HJÄRNE.

H. BERTHELSSEN.

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Veterinary College,
Stockholm.

¹ Simpson, *Univ. of California Pub. in Anat.*, **1**, No. 1.

² Sabin, *Bull. Johns Hopkins Hosp.*, **34**, 277, (1923).

Heterogeneous Equilibria with Deuterium

THE heterogeneous equilibria between hydrogen and the metallic chlorides have been extensively studied, notably by Berger and Crut¹ using a static

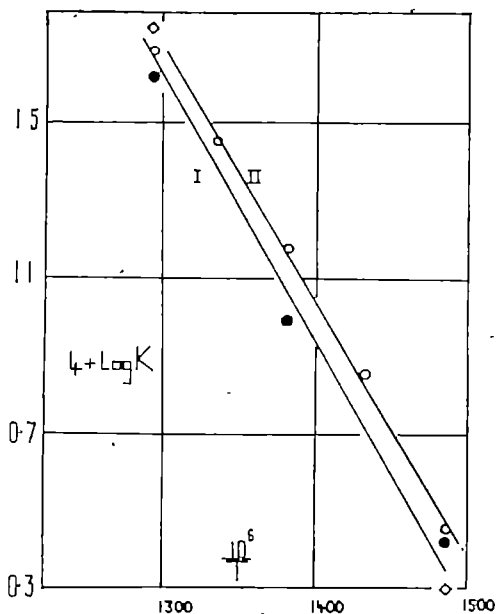


Fig. 1.

GRAPH I FOR HYDROGEN; GRAPH II FOR DEUTERIUM.

⊙, PARTINGTON AND TOWNDROW. (H₂)
○, " " " " (D₂)
⊗, JELLINEK AND ULOTH. (H₂)

method, and by Jellinek and his collaborators² using a dynamic method. More recently, Kapustinsky³ has studied the reduction of cuprous chloride with both

TABLE I

	H ₂ + CoCl ₂			D ₂ + CoCl ₂				
T°	673	723	773	673	698	723	748	773
10 ⁴ /T	1486	1383	1294	1486	1433	1383	1337	1294
4 + log K	0.413 P. & T. 0.295 J. & U.			0.447 0.854 1.179 1.456 1.685				
	0.990 P. & T. 1.749 J. & U.							

hydrogen and deuterium, using a static method. The agreement among the results of different authors is not very satisfactory and we are engaged in further investigations of heterogeneous equilibria involving hydrogen and deuterium.

A static method has been used to study the reduction of cobalt chloride by hydrogen and deuterium. The cobalt chloride is heated with the gas at constant volume, the temperature being measured by a thermocouple, and pressure by a mercury manometer. The extent of the reaction is deduced from the increase of pressure due to the reactions:



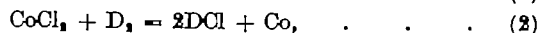
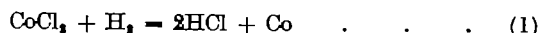
The values of the equilibrium constant

$$K = \frac{C_{\text{HCl}}}{C_{\text{H}_2}}$$

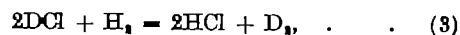
obtained for hydrogen are in good agreement with those found by Jellinek and Uloth by a different method.

Table I shows the values of the equilibrium constant for hydrogen and deuterium at various temperatures. In Fig. 1 the logarithm of K is plotted against $1/T$, where T is the absolute temperature at which K is measured.

If K_1 , K_2 are the equilibrium constants for the reactions:



respectively, then $K^* = K_1/K_2$ is the equilibrium constant for the homogeneous reaction:



namely, $K^* = C_{\text{D}_2} \cdot C_{\text{HCl}}^2 / C_{\text{H}_2} \cdot C_{\text{DCl}}^2$

Urey and Rittenberg⁴ have calculated values of K^* at different temperatures on theoretical grounds. These are compared in Table II with values obtained experimentally by Kapustinsky and ourselves.

TABLE II

	1 + log K*				
T°	769	700	600	558	575
Urey and Rittenberg	0.96	0.94	—	—	0.91
Kapustinsky	—	—	0.78	0.70	—
Partington and Towndrow	0.92	0.89	—	—	—

The heats of reaction ($Q_p = \Delta U$) of reactions (1) and (2) above are deduced from graphs I and II to be $-31,850$ gm. cal./mol and $-30,790$ gm. cal./mol respectively, at a mean temperature of 450°C . The value given in the International Critical Tables for reaction (1) is $-32,860$ gm. cal./mol at 18°C . (determined thermochemically).

On plotting $\log K^*$ against $1/T$ a straight line is obtained from which the heat of reaction (3) is deduced to be $-1,100$ gm. cal./mol.

As would be expected from theoretical considerations, the value of K^* tends towards unity with increasing temperature, and the difference from unity may be shown to be negligibly small at 800°C .

The investigation is being extended to other types of reaction.

J. R. PARTINGTON.
R. P. TOWNDROW.

Queen Mary College,
London. June 14.

¹ Berger and Crut, *C. R.*, 178, 977 (1921).

² Jellinek and Uloth, *Z. phys. Chem.*, 119, 161 (1926); Jellinek and Budat, *Z. phys. Chem.*, 144, 144 (1929).

³ Kapustinsky, *J. Amer. Chem. Soc.*, 53, 400 (1931).

⁴ Urey and Rittenberg, *J. Chem. Phys.*, 1, 143 (1933).

The Corona by Reflection from the Moon

THE light from the photosphere of the sun will illuminate not only the hemisphere of the moon facing the sun but also a zone five miles wide beyond the great circle bounding the hemisphere. A further zone five miles in width will be illuminated by those radiations emanating from the corona, if the height of the corona be regarded as equal to one radius of

the sun. The intenser light of the relatively low inner corona will fall on a narrow strip of this lunar zone, bordering upon the edge of the surface upon which the photospheric light is falling.

Let the slit of a spectrograph be placed across the illuminated portion of the moon's surface so that half the slit is projecting over the apparently unilluminated lunar surface. It will thus cross this five mile zone, which will be reflecting corona light. The spectrogram should reveal first a strip of the usual reflected sunlight; then, theoretically, the emission lines of the high chromosphere; and then the typical corona spectrum.

The practical difficulties involved are the very long exposure times which would be required to gather sufficient reflected corona light to give the image, and the very exacting requirements of guiding.

If one of the powerful long-focus telescopes were used for this investigation, and a 15-inch image of the moon were formed at the plane of the slit, then a five-mile strip of the moon's surface would be 0.95 mm. at the slit. Hence the need for very accurate guiding is obvious, so that the edge of photospheric illumination will not encroach upon this critical millimetre of the slit.

Since earthshine is strongest upon the moon during its early phase, this would not be a good time, but at and near half moon would seem to be the most favourable period.

In Fig. 1, AM is the radius of the sun; MN indicates the region of the corona; B is the moon; PEM is tangent to both moon and sun, and QFN is tangent to moon and corona. Thus EG bounds the photospherically illuminated portion of the moon, while EG and HF define the zone illuminated only by coronal light. Obviously this narrow strip of the moon's surface presents the largest target as viewed from the earth at first and third quarter.

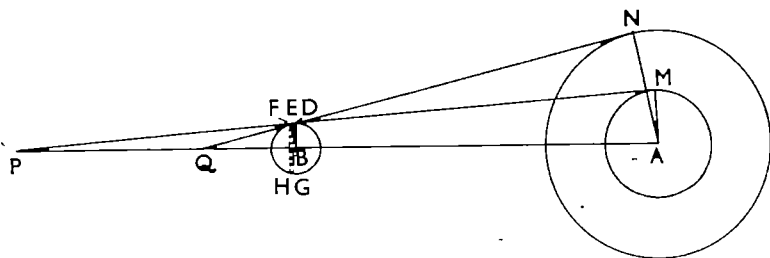


Fig. 1.

The director of Mount Wilson Observatory has expressed his interest in this proposed method of investigating the corona, and suggests the desirability of having the method tried out at more than one observatory.

A. VIBERT DOUGLAS.

McGill University,
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May 11.

Viscosity of Binary Mixtures

THE equation¹

$$\log \eta = N_1 \log \eta_1 + N_2 \log \eta_2 \quad (1)$$

which is advanced by Dr. Lederer to give η , the viscosity of an ideal binary mixture, assumes that N_1 and N_2 are the physical molecular weights of the liquids 1 and 2 the viscosities of which are respectively η_1 and η_2 .

Now, if S_1 and S_2 are the association factors for the respective liquids, then the relation between m_1 and m_2 , the chemical molecular fractions of the liquids, and N_1 and N_2 is:

$$N_1 = \frac{m_1/S_1}{m_1/S_1 + m_2/S_2} = \frac{m_2 S_2}{m_1 S_2 + m_2 S_1} \quad (2)$$

$$= \frac{m_1}{m_1 + m_2 S_1/S_2}$$

If $S = S_1/S_2$, then

$$N_1 = \frac{m_1}{m_1 + m_2 S} \text{ and } N_2 = \frac{m_2 S}{m_1 + m_2 S} \quad (3)$$

S in equation (3) is, therefore, the ratio of the association factors of the liquids 1 and 2, respectively.

In Dr. Lederer's communication¹ the factor S is defined as the degree of association of component 2, but it would appear more correct to define S as the ratio of the association factors as derived in (3) above.

A further matter of interest is that the value of S varies (for the system benzyl benzoate in toluol at 25° C.—Kendall and Munroe's data) by 4 per cent about the mean value, as shown in the accompanying table.

m_1	$S = S_1/S_2$	
0.2357	0.803	
0.4331	0.818	
0.6503	0.840	Mean value 0.836
0.7890	0.862	
0.9002	0.860	

m_1 is the chemical molecular fraction of benzyl benzoate in toluol taken from Kendall and Munroe's data. Kendall and Munroe, however, showed that the freezing point data of solutions of benzyl benzoate in toluol were normal, whence $S_1 = \text{unity}$; hence the average value of $S_2 = 1.197$, that is, the average degree of association of toluol is 1.197 in this solution.

Dr. Lederer referred the value 1.197 to benzyl benzoate as an association factor, and in so doing appears to be in error.

It may be observed that an excellent test for the veracity of equation (1) above would be provided by an ideal binary mixture of components of approximately equal viscosity characteristic, because it is clear from relation (1) that if $\eta_1 = \eta_2$, then $\eta = \eta_1 = \eta_2$. Such a mixture should, of course, show no heat effects on mixing and have the

general characteristics which guided Kendall and Munroe in accepting benzyl benzoate in toluol as an ideal mixture. An approximate test obtains with the system propyl acetate + benzol—a system showing but a small heat effect on mixing—and, in this case, the value η is less than η_1 or η_2 , whence equation (1) cannot apply. Dr. Lederer's fundamental equation

$$\log \eta = m_1 \log \eta_1 + m_2 \log \eta_2 - \int \frac{qm}{4.57T^2} \quad (4)$$

however, provides for such cases where the integral involving the molecular heat of solution qm must be evaluated.

J. S. GOURLAY.

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¹ NATURE, 129, 27 (1937).

Use of the Word Substrate

IN recent years, the practice has grown up among workers in surface chemistry of using the word 'substrate' to denote the bulk phase underlying a surface film, regardless of the fact that this word has been in general use for a much longer time to denote the substance upon which an enzyme acts. The name as applied to a bulk phase on which a surface film rests would seem harmless enough in most cases, but since it is almost certain that, in enzyme action, the substance acted on is adsorbed, probably locally and one molecule thick, on the surface of the enzyme, the same word 'substrate' will have to do duty *both* for the underlying, and more

bulky, enzyme, *and* for the small molecules upon which the enzyme acts!

If the words 'substratum', or 'underlying liquid' (or solid, as the case may be) were used instead of substrate for the denser phase adjoining a surface film, I think this inconsistency, and possible source of confusion, in nomenclature, would be simply avoided.

N. K. ADAM.

Sir William Ramsay Laboratories of
Physical and Inorganic Chemistry,
University College,
London, W.C.1.
July 1.

Points from Foregoing Letters

THE isotopic and peaking fraction of krypton atoms of mass 78, 82, 84, 86, and of xenon atoms of mass 129, have been determined by Dr. F. W. Aston, by comparison with hydrocarbon 'doublets', by means of the mass spectrograph.

Dr. D. Crowfoot reports that the birefringent insulin crystals of prismatic type obtained by crystallization from acetate buffers at pH 5.2 gives similar X-ray patterns to those shown by the usual rhombohedral form, except for a more marked diffuse ring which may be due to the prevalence of amorphous matter, probably responsible for the prismatic form.

The probable absolute configuration of the naturally occurring α amino-acids has been demonstrated by R. C. Rainey by the application of Boys's rule to 2-amino-hexane, the configuration of which has recently been correlated with that of the amino-acids by Levene and Mardaahew; solvent action prevents the direct application of the rule to the 'amino-acids themselves.

Dr. St. Ziemecki, by replacing argon in a pressure ionization chamber for cosmic ray measurements by krypton, finds the effect was an increase of the ionization current, which was approximately 2.7 times greater than with argon at the same pressure. Thus by using krypton-filled chambers, it is possible to reduce greatly the pressure employed and hence the weight of the apparatus, which is of importance in measurements in high regions of the atmosphere.

By applying a number of corrections (due to mass-polarization, relativistic change of mass with velocity, magnetic interaction between the orbits, etc.) to the calculated value of the ionization potential of lithium atoms, H. A. S. Eriksson finds a value of 610,100 cm.⁻¹ in fair agreement with the experimental value. For helium, the agreement is not so good. Theoretical values are somewhat higher than experimental ones.

A band in the region of 3000 Å. of the Raman spectra of several inorganic acids observed by Dr. C. S. Venkateswaran is attributed by him to the presence of the OH group. The author gives a table showing the frequency limits of the bands in the cases of sulphuric, iodic, selenious, telluric and boric acids and, from their broad and diffuse nature, deduces that the OH group, though present in these acids, is much weaker in strength than the OH group present in the alkalis.

The surface migration of barium on to the opposite side of nickel and tungsten ribbon used in thermionic emission valves, as reported by J. A. Becker, is not

confirmed by Dr. M. Benjamin and R. O. Jenkins, even after sixteen hours running at 1,100° K.

Prof. S. S. Bhatnagar, Dr. H. Lessheim, and Mohan Lal Khanna find that the diatomic vapour of selenium is paramagnetic, which fact agrees with the view that the ground¹ level of Se₂ is ³Σ.

Experiments on animals are described by Dr. P. J. Du Toit and A. I. Malan to show that rickets result from a deficiency of phosphorus, even in the presence of vitamin D. Lack of calcium, on the other hand, leads to osteofibrosis.

Dr. V. Korenshevsky and K. Hall find that suitable combination of female and male sex hormones (progesterone, oestrone, testosterone and androstenedione) bring about normal pregnancy changes in the uterus and vagina of ovariectomized rats.

Prof. P. W. Wilson describes experiments made at Helsingfors, Finland, and others at Madison, U.S.A., in which both positive and negative results with respect to excretion of nitrogen by leguminous plants were obtained. He emphasizes that the existence of these negative findings together with the lack of clear definition of the conditions required for the occurrence of the phenomenon, make it impossible to decide at this time if the excretion plays a significant part in Nature.

The case of a female *Lebistes* (the 'millions' fish which devours mosquito larvae) which, as a result of a single mating has produced a succession of broods over a period of several months, is reported by G. L. Purser.

A method of staining smears with neutral-red, enabling one to differentiate between lymph-cells and small monocytes and to indicate qualitative changes in the white blood corpuscles (in infectious anaemia in horses) is described by A. Hjarre and H. Berthelsen.

The equilibria between cobalt chloride, and hydrogen and deuterium have been studied by Prof. J. R. Partington and R. P. Towndrow. Values of the equilibrium constant have been obtained at different temperatures, and from these the heats of reaction have been calculated.

ERRATUM.—Referring to his letter entitled "Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop", which appeared in NATURE of July 10, p. 70, Mr. Yoshio Ishida writes that owing to an error in the manuscript, 'oblate' should read 'prolate', and vice versa.

Research Items

Votive Offerings from Chichen Itza, Yucatan

ACCORDING to a recent announcement of the Carnegie Institution of Washington, D.C., some remarkable votive or possibly foundation offerings were found in the course of recent excavations at Chichen Itza, the famous city of the New Empire of the Maya of Yucatan, which flourished from the middle of the eleventh century of our era almost down to the coming of Columbus and the time of the Spanish conquest. The Carnegie Institution, which is working in co-operation with the Bureau of Pre-Hispanic Monuments of the Mexican Government, has been engaged in the exploration of El Castillo, the pyramid temple of the Maya god Kukulcan. This temple, built on top of a pyramidal structure, encloses completely, it has been found, an earlier temple and pyramid—a method of construction followed elsewhere in Yucatan. Excavation for the purpose of exploring the inner temple has led to some remarkable discoveries. In 1935, for example, a rectangular treasure box of limestone was found at the foot of a stairway. Its lid was a single stone, two and a half feet long by two feet wide. Among its contents were two turquoise mosaic plaques of great beauty, necklaces of coral, turquoise and jade, carved jade beads and pendants, and about 2,000 loose button-shaped beads of turquoise. The later find, made last season, was even more remarkable. In the inner chamber of the buried temple, of which the back wall was studded with the heads of human femora, presumably from sacrificial victims, there was found another box of squared limestone blocks, inside which was a throne fashioned from a single block of stone carved to represent a jaguar and painted a vivid red. The spots of the jaguar are represented by inlays of apple-green jade. The eyes are large hemispherical pieces of jade, the teeth and fangs of hard white stone. Its greatest length is two and three quarter feet, its greatest height to the top of the head, two and a quarter feet. Resting on the jaguar were a turquoise mosaic plaque, a shell necklace and a carved jade pendant. With much wisdom and judgment, the Mexican Government has decided that these finds shall remain *in situ* for the inspection of students and visitors.

Population Study of the Song Sparrow

MARGARET M. NICH has published a study, which extended over eight years, of a song sparrow population ("Studies in the Life History of the Song Sparrow 1. A Population Study of the Song Sparrow", *Trans. Linn. Soc. New York*, 4, April 1937. 1 dollar 50 cents). Each adult bird was marked individually with coloured bands. The various aspects of the life-history are clearly set out, from which a selection follows. The bird is a partial migrant at Cleveland, Ohio. About half the nesting males are resident, about half migrate. Of the females, only a tenth to a third are resident. A few individuals of both sexes changed status in different years. There was no evidence that the males with the larger territories, more vigorous song or brighter plumage, were more successful than their fellows in obtaining mates. There is not, apparently, a reservoir of unmated

birds of either sex to fill gaps due to mortality in the breeding season. The influence of warm waves of temperature on the commencement of song, migration and egg-laying is observed, and graphs show that the temperature-threshold at which each occurs is different at different times of year. Young often settled near their parents' territories, of which detailed genealogies are given, and one brother and sister mated. There is a detailed analysis of nesting success and survival of young and adults, and in a discussion of population limitation the importance of local changes in the environment is stressed. Territorial behaviour is considered to prevent overcrowding. There is also detailed information on weight, eggs, feeding times and other aspects of the breeding biology, and one chapter discusses the habits of the parasitic cow-bird. This is an important monograph, and the Linnean Society of New York has rendered a real service to ornithology by publishing it at such a moderate price.

Pituitary Extracts and Gastric Ulcers

A SERIES of papers by Prof. E. C. Dodds, working with various collaborators (*Proc. Roy. Soc., B*, 123, 22; 1937), gives a full account of some interesting observations on the effect of extracts of pituitary on the stomach. It has been found that extracts of the posterior pituitary containing the pressor principle produce gastric ulcers when injected in large doses into various animals. This observation provides a new way of studying methods of treating gastric ulcers. The production of ulcers appears to be due to the fact that the extracts inhibit gastric secretion, whether this secretion is due to histamine, insulin, sham feeding or pilocarpine. The action is primarily on the volume of the juice secreted. A continuous secretion of juice is probably necessary to protect the mucous membrane. A method is described for recording the gastric secretion and the blood flow simultaneously in an anesthetized cat's stomach. Stimuli causing secretion induce increased blood flow and if the increase in blood flow is prevented, secretion does not occur. The injection of pituitary extracts inhibits both blood flow and secretion. In normal animals blood flow and secretion are closely co-ordinated, but after hypophysectomy this co-ordination disappears. The possible significance of these results is widened by the observation that pituitary extracts have a similar action on pancreatic secretion. These facts are possibly related to the action of these extracts on the excretion of urine.

Early History of the Potato

DR. R. N. SALAMAN delivered the Masters Lectures of the Royal Horticultural Society last autumn, on "The Potato in its Early Home and its Introduction into Europe" (*J. Roy. Hort. Soc.*, 62, Parts 2, 3, 4 and 6; 1937). A mass of archaeological material has been marshalled to show that the potato was cultivated in South America at least so early as A.D. 200. Many representations of the tuber as a motif for the pottery of several epochs of South American history are illustrated, and show that the life of the Indian was closely linked with this plant.

Dr. Salaman also shows that the potato satisfied the conditions demanded by the physical setting of the Inca civilization, and provided a supply of food where the cereal grains failed. He agrees with Vavilov, Bukasov and other Russian investigators, that potato cultivation originated in two distinct areas—in the plateaux of Peru and Bolivia, and in Chile and the island of Chiloe. The Russians believe, on botanical grounds, that the southern focus of development supplied the ancestry of our present-day 'Irish' potato; but Dr. Salaman, using arguments provided by history, believes that the Peru-Bolivian source is much more likely. The potato entered Europe by two channels, namely, by way of England, and via Spain. Introduction into England, according to Dr. Salaman, cannot be readily dissociated from the names of Drake and Raleigh, in spite of the modern tendency to deprive these gentlemen of the honourable place in horticulture which tradition assigns to them. Dr. Salaman has ante-dated the first record of potato culture in Europe by fifteen years, with his proof that tubers were grown in the neighbourhood of Seville in 1572. He has also established the documented history of the crop for a very early period.

Fault-movements and the Safety of Reservoir Dams

In searching for reservoir sites among the coast ranges of California, engineers have found the most satisfactory features in certain fault-line valleys. The major faults of the district—the San Andreas, Hayward and Calaveras faults—have made possible the development of longitudinal valleys along parts of their courses, valleys so narrow that they can be closed by dams of moderate length. Dams have, indeed, been made across each of the three faults mentioned, and the question has been asked: Can a safe dam be built in a fault-line valley of a presumably active fault? Mr. G. D. Louderback has endeavoured to answer the question and to state the conditions that should be satisfied in their construction (*Bull. Seis. Soc. America*, 27, 1-27; 1937). He shows how the activity of a fault may be determined by mapping the epicentres of recurring small earthquakes, and the map given of the three faults with the centres of the earthquakes of the years 1932-35 clustered along a great part of the course of each, reveals that they are all definitely active faults. The experience of past earthquakes makes it clear that provision must be made for a horizontal displacement of 15-20 ft. and a vertical one of 5-10 ft. The dam should therefore be 60 ft. wide at the crest with slopes of about 2:1. To avoid fracture, outlet pipes should be laid parallel to the active fault. Lastly, the dam and all its subsidiary structures should be built so as to resist a strong shock and also the effects of slumping and landsliding.

A Coefficient of Humidity

Among the series of papers of the State Meteorological and Hydrological Institute of Sweden is one (No. 11) entitled "A Coefficient of Humidity of General Applicability", by Anders Angström, which sets out certain ideas that were first discussed at the 1936 meeting at Edinburgh of the Union for Geodesy and Geophysics. The author points out the desirability of having some function which will indicate the humidity or aridity of any climate in respect of the soil, that is, which will take into account both the rainfall and the evaporation. A function of this kind was used by Lang in 1920, who took simply

the ratio of the annual precipitation to the sum of the mean temperatures of the frost-free months divided by twelve, while Martonne in 1926 took the ratio of the annual precipitation to $10 + T$, where T is the annual mean temperature (in each of these two cases temperature is measured in centigrade). Angström suggests an alternative function, having the advantage over the two cited that it is a continuous function of temperature and can be used in the study of arctic climates. It is represented by the expression 1.07^t , where t is the mean temperature. He finds that this function is closely proportional to the mean duration of precipitation for a month in the latter is measured in hundreds of minutes, and that it is very nearly equal to the humidity function of Martonne for monthly mean temperatures between 0°C . and 20°C . A table is given which enables the new function to be read off quickly in terms of t , and two maps show its distribution in January and July over north-west Europe and adjacent polar regions, including Iceland, Greenland and Spitsbergen.

Monomolecular Films

THE study of the orientation of the molecules in monomolecular films has become of such importance that Messrs. E. Havinga and J. de Waal, of the van 't Hoff laboratory of the University of Utrecht, have worked out a technique for the production and investigation of such films by electron diffraction methods, and have published an account of it in the issue of March 15 of *Revue des Travaux chimiques des Pays-Bas*. The film in the case described was of barium stearate prepared on the clean surface of water and floated by lowering the water slowly on to a thin solid film of nitro-cellulose or of gold leaf placed below the surface of the water. The film of nitro-cellulose itself was prepared by placing a drop of a solution of nitro-cellulose in amyl acetate on a clean water surface. On evaporation of the solvent, a film of about 300 Å. thick was produced. An electron tube producing electrons of about 40 kilovolts path was used, and it was found that in addition to the diffraction pattern due to the support, in each case a hexagonal pattern of spots was produced which is attributed to the barium stearate film. Full details of the most suitable technique are given.

Two Visual Binary Orbits

DR. R. V. D. R. WOOLLEY and L. S. T. Symms have recently published a paper in which they discuss the orbits of OΣ 38 (γ, Andromedæ) and β 101 9 Argus (*Mon. Not. Roy. Astro. Soc.*, 97, 6; April 1937). Both stars have completed at least one revolution, so that the periods can be determined with considerable accuracy. Orbits have been already published, and those given by the authors have been obtained by applying differential corrections to previous orbits. A description of the method for applying these corrections is given in each case. The ephemeris for the first binary shows a very small separation near periastron, and micrometer measures here would be useless. It is suggested that an interferometer might be used in 1946-47 when the separation is $0''.02-0''.03$, as the star is bright. The period is 56 years (a year greater than the period found by Hursey), the eccentricity and inclination being 0.92 and 109.2° respectively. In the case of β 101, the eccentricity and inclination are also high, the values being 0.69 and 77.8° respectively. The period of this binary is 23.18 years.

Growth Factors

A DISCUSSION meeting on "Growth Factors" took place at the Royal Society on Thursday, June 24. The discussion revealed the emergence of a line of biochemical application which hitherto has been obscured by the diversity of its interest.

For a number of years, sporadic reports have been published by workers in the fermentation industries and bacteriology that the growth of yeast and bacteria depends not only on the provision in the diet of gross sources of energy and nitrogen, but also on illusive materials—'bios', 'accessory growth factors', akin to the 'vitamins', responsible for the notioning of special phases of animal metabolism even for the growth of animals. More recently, these tentative findings have been reinforced by workers in other specialized fields, for example, in anatomy and protozoology, and, by the use of modern biochemical technique and knowledge, it would now appear that the case established in the nutrition of animals is equally established in the nutrition of the most diverse varieties of cells; namely, that all cells from the lowliest bacterium to the cells of the highest animals are enabled to carry out the series of reactions between the sources of energy and nitrogen, which result in the production of energy and growth, only by the agency of other substances mostly of a nature akin to those already described in animal metabolism—vitamins. The only notable difference between the various forms of life is that these accessory substances are normally synthesized by some cells but not by others, and thus in the former case these substances need not be supplied in the nutrient diet.

The proceedings were opened by Prof. F. Kögl, of Utrecht, with a review of the present state of knowledge of the plant hormones, auxin- α and - β and steriauxin (β -indolylacetic acid). The auxins were at first thought to exert their effect on cell elongation, but now it is recognized that they regulate plant growth in many ways. Auxin- α , for example, is thought to account for the phenomenon of phototropism. Auxin- α lactone loses its activity under the action of ultra-violet light, and thus the shaded side, maintaining a greater concentration of activity, would elongate and produce the effect of phototropism. The action of heteroauxin seems to be primarily associated with the formation of roots on stem cuttings. This action is, however, not dependent on chemical structure, since a number of unrelated substances have a similar effect, recalling the non-specificity of oestrogenic compounds described by Dodds and co-workers.

Prof. Kögl also gave an account of his 'biotin', a sulphur-containing substance of great potency which may be the chief component of 'bios', originally described by Wildiers as a necessary growth factor for yeast. Biotin has also been shown to have an effect on the growth of higher plants.

Dr. P. Fildes (London) reviewed the subject as it appears to the medical bacteriologist, tracing the evolution of the vitamin concept for bacteria from Wort and Ingram's growth factor for *John's* willus (1912) to the present time, when vitamin B₁ has been proved to be essential for *Staphylococcus* and propionic acid bacteria, and nicotinic acid or coenzyme for *Staphylococcus* and the influenza

bacillus. He laid stress on the facility with which bacteria can adapt themselves to altered nutritional conditions, and ascribed the fact that parasitic bacteria specially require growth factors to a loss of synthetic function which has resulted from long association with an environment in which these factors are preformed. These dependent bacteria can readily be trained back to their 'original' state, in which they can synthesize the factors and so do not require to be supplied with them. In a series of different species of bacteria, each ultimately requiring coenzyme for growth, it was shown that the complexity of the nutrients from which coenzyme can be synthesized depends upon the synthetic power of the bacteria at the time of examination.

M. André Lwoff (Institut Pasteur, Paris) pointed out that certain bacteria and Protozoa cannot grow without a supply of haemin, because they are unable to synthesize it from iron compounds in the nutrients. The importance of haemin is ascribed to its function as a stage in the synthesis of cytochrome in Keilin's system. Its effect is to increase greatly the oxygen consumption of organisms starved of it.

M. and Mme. Lwoff have demonstrated that the long-known 'vitamin factor' of the influenza bacillus is none other than Harden and Young's coenzyme or Warburg's co-enzyme. Metabolic studies have shown that coenzyme acts as a co-dehydrogenase for various substrates and much increases the oxygen uptake of influenza bacilli and anaerobic glycolysis. Both haemin and coenzyme function as bacterial growth factors as components of the dehydrogenase-cytochrome system of Keilin and Warburg.

Mr. B. C. J. O. Knight (London) gave an account of the *Staphylococcus* and *Sporogenes* factors referred to by Dr. Fildes. He showed that the former consists of nicotinic acid, a constituent of coenzyme and of the two halves of the vitamin B₁ molecule—the pyrimidine and thiazole rings. The activity of each compound depends strictly on certain chemical configurations. The *Sporogenes* factor has not been finally determined, but there is evidence that it may have a much wider importance than merely the regulation of the metabolism of the obligate anaerobes.

Dr. G. M. Richardson (London) described uracil, a component of nucleic acid, as an essential factor in the anaerobic growth of *Staphylococcus*. Uracil is synthesized by the organism aerobically, and therefore under these conditions its effect on growth cannot be demonstrated. Anaerobically, however, the synthetic power of the organism is sufficiently depressed to make the demonstration possible. No metabolic function has hitherto been ascribed to uracil.

In the discussion which followed the more formal proceedings, there appeared to be complete agreement between the various speakers not only in detail but also in the wider implications of the discussion. Dr. E. R. Holiday (London) referred to the demonstration of nicotinic acid in Knight's crude *Staphylococcus* factor by means of absorption spectra. M. Lwoff recalled other factors which have been found by his colleagues in the Pasteur Institute, namely, the forms of sulphur necessary for the growth of certain fungi (Volkonsky) and the sterols found by Mlle. Caillaud to be necessary for flagellates.

A Method of Determining Stellar Rotation*

WHILE rotational speeds of stars can be estimated from photographs of stellar spectra, the actual deduction of these speeds and the demonstration that the star is rotating depend on rather abstruse mathematical calculation which, however, leads to a comparatively simple working routine. A knowledge of stellar rotational speeds, while obviously worth determining in any event, has several immediate applications, such as assessing the age of the stellar system, and is especially important in discussing the state of affairs in stellar atmospheres, a high rotational speed tending to offset gravity and promote ionization. If the rotational speed of a star is determinable, then the 'proper' spectrum of the star can be deduced; that is, the light emitted by any element of the star's surface, as distinct from the 'integrated' spectrum directly observed. Owing to the minuteness of a stellar image in a telescope, the light from the whole of the star's surface passes into the spectroscopic, and the rotational speed of a star cannot be measured as can that of the sun by observing the Doppler displacement of the Fraunhofer lines from one limb as compared with the other.

Prof. Carroll's method depends on the fact that the observed shape of a stellar absorption line (that is, the graph of intensity plotted against wavelength) has certain peculiarities if the star is rotating.

If a star be rotating, then different elements of area on the surface of the star are moving towards or away from the observer with velocities in the line of sight which depend on their position on the stellar surface and the rotational speed of the star. Thus, the spectra from the different elements do not simply superpose, as they would in a non-rotating star, but are displaced somewhat with respect to each other, thus resulting in a shallow broadened line. The final observed line shape therefore depends on two factors, namely, (a) the shape of the line emitted by any element of the star and (b) the rotational displacement. The first factor is quite unknown—previous methods of estimating stellar rotational speeds, however, depended on assuming this to be known—but the second factor can be detected by the new method.

The equations connecting the 'proper' shape $\mathfrak{I}(\xi)$ of a line and the observed shape $\Theta(\xi)$ are

$$\Theta(\xi) = \frac{1}{a} \int_{-1}^{+1} \mathfrak{I}(\xi + \beta t) g(t) dt$$

where a is a numerical factor and equal to $\int_{-1}^{+1} g(t) dt$,

and $g(t)$ is a function that depends on the way the brightness of the star varies over its disk, and β is the rotational speed of the star.

The solution of this equation is¹:

$$\mathfrak{I}(\xi) = \frac{1}{2\pi i} \int_0^\infty \frac{e^{-u\xi}}{G(u)} \int_0^\infty \Theta(x) e^{-ux} dx du,$$

where $G(u) = \frac{1}{a} \int_{-1}^{+1} e^{-ut} g(t) dt$;

but this is unusable as it stands as $\Theta(x)$ is to be integrated over a certain contour in the complex domain and $\Theta(x)$ is only known for real values of x . Analytical investigation shows a simple way out. We form the real part of the Fourier transform of $\Theta(\xi)$

$$\text{namely, } f(u) = \int_{-\infty}^{\infty} \Theta(\xi) \cos u\xi d\xi, \text{ which is easily}$$

done and plotted as a graph of $f(u)$ against u . It appears that, if the star be rotating, $f(u)$ must vanish (have zeros) at certain values of the product $u\beta$. Now we find, by plotting $f(u)$, the values of u for which $f(u)$ vanishes and hence by simple division the value of β .

It is, of course, possible for $f(u)$ to vanish for other reasons; the importance of the method lies in the fact that, if $f(u)$ has several zeros, they must give (or some of them), if the star is rotating, consistent values of β . A further test is that the values of f from different lines must be the same. Thus, if several zeros from several lines all yield substantially the same value for β , we can feel with some confidence that the observed line shapes are really produced by rotational broadening. As the theoretically calculated values of $u\beta$ for which $f(u)$ vanishes depend somewhat on the law of darkening involved in $g(t)$, it is theoretically possible to test this law as well. Having found β , a further simple computation (forming $\mathfrak{I}(\xi)$ from its transform) yields the 'proper' shape of the emitted line.

A similar method can be applied to the problem of stellar expansion.

In interpretation of this procedure, it was explained that any arbitrary function of the type considered might be represented by a 'spectrum' of harmonic constituents. (Fourier's integral theorem) the result obtained meaning that, if the observed line shape is due to rotation, certain of these harmonic constituents must necessarily be absent. Practical tests for this give the information (a) whether the star is rotating, (b) the speed of rotation, that is the equatorial velocity in the line of sight, and (c) thus enabling the 'proper' shape of the lines in the stellar spectrum to be found.

Unfortunately, the lines to be examined are, if the rotational speed be high enough to be readily determinable, wide, faint, shallow lines, and the technique of stellar photographic spectrophotometry is strained to the uttermost in providing sufficiently accurate measurements of line shape. Prof. F. J. M. Stratton of the Solar Physics Observatory, Cambridge, is collaborating with the Natural Philosophy Department of the University of Aberdeen in attempting to produce sufficiently good observations, and very promising results are now being obtained.

In the case of one star, namely, Algol, independent measurements of rotational speed are available, and the direct measurements give 26 km./sec. as the equatorial line of sight velocity for this star, compared to 26 ± 3 km./sec. determined by Prof. Carroll's method, using an exceptionally well determined profile of the line Mg^+ at 4481 Å. obtained by Struve at Yerkes Observatory.

* Summary of a lecture on "Rotating Stars" delivered before the Newcastle-upon-Tyne Astronomical Society at Armstrong College, on March 11, by Prof. J. A. Carroll.

¹ *Mem. Nat. Res. Ast. Soc.* 22, 473, 508, 680 (1933).

Aluminium Manufacture in Great Britain

WITH the exception of silicon, aluminium is probably the most abundant metal in the world, forming nearly one eighth of the earth's crust. Owing to the ready manner with which it combines with oxygen, it is never found, as most other metals are, in the metallic state. In a paper in the 'Aluminium Section' of the March issue of the 'Trade and Engineering Supplement' of *The Times*, Mr. W. Murray Morrison gives an outline of the position which the aluminium industry now occupies in the British Isles.

In 1921, the Lochaber Power Co. was formed and developed a large water-power station. When completed, this scheme will be capable of developing 100,000 h.p. continuously, and will be by far the largest hydro-electric development in Great Britain. The British Aluminium Co. operates three reduction works, at Foyers, Kinlochleven and Lochaber. These are supplied with pure aluminium oxide from their works at Larnie in Ireland and Burntisland in Scotland. These works in turn are supplied with crude ore, bauxite, from the Company's own mines, vast deposits being owned by it in the south of France and in some British colonies. There is one other producer of the crude metal in Great Britain, namely, the Aluminium Corporation, the supplies of alumina for which are produced at Hebburn-on-Tyne and reduced to the metal at Dolgarrog, North Wales.

The final forms in which aluminium reaches the public cover a very wide field. The two forms in which it is best known are for cooking utensils and foil. The advantages of aluminium vessels for cooking are their lightness, cleanliness, hygienic qualities and

heat conductivity, together with their immunity from chipping, rusting and burning; these properties have made them very popular. Aluminium foil has almost entirely replaced other kinds of metal foil and is adopted for the wrapping of cigarettes and chocolates, the capping of milk bottles and tea-chest linings.

In connexion with motor-cars, aluminium pistons are now very commonly employed. Aluminium, which is only one third the weight of iron or copper, made possible the remarkable increase in the speed of transport which has taken place during the last fifty years. Motor-vehicle owners are keenly alive to the fact that it costs a given sum to convey a given weight a given distance in a given time. There is an additional advantage of using aluminium in road vehicles, as the increased lightness sometimes saves an appreciable part of the motor tax in Great Britain and allows the vehicle to run at a higher speed.

In air transport, where lightness is a paramount consideration, aluminium and its alloys play a very important part. Only one metal lighter than aluminium, namely, magnesium, is used as the major constituent in the manufacture of light alloys. The production of magnesium is closely allied to the aluminium industry. For these two metals and their alloys the aircraft industry depends for many of its components.

In electrical transmission, aluminium has been most useful. In Great Britain, the transmission lines of the National Grid alone employ more than 20,000 miles of steel-cored aluminium cable.

Association for the Study of Systematics in Relation to General Biology

AN opening meeting of the "Association for the Study of Systematics in Relation to General Biology" was held in the rooms of the Linnean Society (by kind permission of the president and council) on Friday, June 25. The chairman of the Association, Dr. Julian Huxley, presided over a gathering of seventy-four biologists.

In his introductory remarks, Dr. Huxley outlined the history of the Association. He said that the movement commenced with informal meetings in the autumn of 1936 between certain members of the staff of the Royal Botanic Gardens, Kew, and the John Innes Horticultural Institution at Merton. These led to the formation, on May 3, 1937, of a joint zoological and botanical "Committee on Systematics in Relation to General Biology". This committee eventually changed its title to the present form, and a council and seven committees were elected. The council at present consists of the following biologists: J. S. Huxley (*chairman* of the Association), H. W. Parker (*zoological secretary*), J. S. L. Gilmour (*botanical secretary*), W. T. Calman, G. S. Carter, M. B. Crane, C. D. Darlington, C. Diver, E. B. Ford, R. Ruggles Gates,

H. Godwin, J. W. Gregor, M. A. C. Hinton, J. R. Norman, J. Ramsbottom, O. W. Richards, N. D. Riley, E. J. Salisbury, Miss B. Schafer, T. A. Sprague, W. B. Turrill, B. P. Uvarov, E. B. Worthington, Sir W. Wright-Smith.

Dr. Huxley then explained the aims of the Association, which may be summarized under the following heads:

(1) To examine the theoretical and historical bases and the practical aims of taxonomy, and especially the relation of phylogeny to cytogenetic and taxonomic data.

(2) To examine the criteria employed in defining species and other systematic categories in different groups and the possibility of obtaining greater uniformity in their usage.

(3) To consider how far in the light of cytogenetic, ecological, physiological, embryological, and paleontological data, existing classification might require to be modified and new subsidiary terminology to be introduced. Further, to investigate the relation of any such subsidiary terminology to the International Rules of Nomenclature.

(4) To investigate the data and material already available, either taxonomic or bearing on taxonomy, with the view of correlating them with general biological principles and of establishing generalizations in comparative systematics.

(5) To press for the appointment of additional taxonomists and other biologists to the staffs of museums and other appropriate institutions.

(6) To arrange for research into the relative importance of the various factors, internal and external, operative in different groups in producing speciation and other evolutionary processes.

(7) To co-operate in the production or improvement of handbooks on British animals and plants and in the eventual publication of a British Fauna and Flora on uniform biological lines.

(8) To suggest useful lines of biological work to natural history societies and to amateurs and to assist in its co-ordination.

(9) To investigate the best methods of teaching systematics and field work in universities and schools.

(10) To stimulate discussion and to promote co-operation between workers in different branches of biology on problems of taxonomic interest.

The committees so far formed, together with the particular items of the aims of the Association with which they are concerned, are as follows:

(1) Taxonomic principles (items 1-3). Convener: Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew.

(2) Comparative systematics (item 4). Convener: Mr. J. R. Norman, British Museum (Natural History), Cromwell Road, S.W.7.

(3) Research (item 6). Convener: Dr. W. B. Turrill, Royal Botanic Gardens, Kew.

(4) Handbooks (item 7). Conveners: Captain C. Diver, 40 Pembroke Square, W.8; Mr. M. B. Crane, John Innes Horticultural Institution, Merton, S.W.19.

(5) Natural History Societies (item 8). Convener: Mr. H. W. Parker, British Museum (Natural History), Cromwell Road, S.W.7.

(6) Education (item 9). Convener: Miss B. Schafer, John Innes Horticultural Institution, Merton, S.W.19.

(7) Publications (other than handbooks). Convener: Dr. C. D. Darlington, John Innes Horticultural Institution, Merton, S.W.19.

At the close of the meeting, fifty-three biologists, in addition to the existing council and committees, gave in their names as members. Any other biologists wishing to join the Association should send their names and addresses to one of the secretaries, stating in which particular committee they are interested. For the present there is no subscription or formal method of election.

Annual Conference of the Museums Association

THE forty-eighth annual conference of the Museums Association was held in Newcastle-upon-Tyne in the week commencing July 5. The chief impression which one gained from the Conference was that museum officials are considering their problems in a new and more critical manner.

The keynote was set by Alderman Charles Squire in his presidential address. As chairman of the Leicester Museums Committee for the past twenty-seven years, he could speak with authority, and did not hesitate to criticize the general failure of municipal councils to make adequate provision for their museums. Museums and art galleries have a high place in the educational and social scheme, and are not yet getting the support which they deserve. Alderman Squire also referred to the valuable work that could be done by museums in assisting to preserve local records and the amenities of the countryside.

Another critical paper was one by Dr. W. E. Swinton (British Museum, Natural History), on "Natural History Museums and the Community". Too many small natural history museums might have as their motto "How best to kill a love of Nature", and Dr. Swinton strongly advocated the elimination of useless material and better display of the collections, so that these might inspire the visitor with a greater interest in plants, animals and rocks in their natural settings. The paper dealt with many other points of practical importance, especially the need for having as curator one who was not only a scientific worker, but also a man of action.

In the same general field there was also a valuable discussion on "Simplifying Habitat Groups", to which Mr. R. K. Perry (Liverpool), Mr. T. Russell Goddard (Newcastle), Mr. W. E. Mayes

(Leicester), and Mr. R. Wagstaffe (Stockport) contributed. It was pointed out that in a zoological exhibit it is most valuable to have an indication of the natural habitat of the birds or animals displayed, but that the elaborate group, to be found in the larger American museums, is far too expensive for the smaller English institutions. The proposals made were in the direction of suggesting habitat by branches of trees, by plants, or by other background material, and by the careful arrangement of the specimens in natural attitudes.

On the archaeological side, current museum methods were again criticized, the speaker being Mr. Ian Richmond, of Armstrong College. Mr. Richmond answered the question: "What does an archaeologist expect of a museum?" He suggested that the museum should contain a full series of local maps, especially those showing human distribution at different epochs; that one exhibit at least should display all the objects and clues that had been obtained from a single excavation; and that, wherever possible, comparative series of exhibits should be set up. He also appealed for a simple classified system of storage of all material not on exhibition.

Within the scientific field there were some important papers of a descriptive nature. Thus, Col. E. E. B. Mackintosh, director of the Science Museum, described the special exhibitions which have been developed at that Museum since 1911. It is interesting to learn that these very successful displays, which in recent years have covered such subjects as refrigeration, rubber, electro-deposition, noise and smoke abatement, electric illumination and television, take from six to twelve months to prepare, and that

the cost of the exhibitions has varied from less than £500 to more than £3,000 (the latter cost being borne by the industry concerned).

In his account of the Hancock Museum, Mr. T. Russell Goddard explained that this institution is financed entirely by the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. It was characteristic of the scientific life of the past century that so much public service had been performed by voluntary effort; but at the present time the finances of the Society are scarcely adequate to maintain the Museum in an effective manner.

Lastly, a valuable account was given by Dr. Kathleen B. Blackburn (Armstrong College) on modern methods of pollen analysis in relation to archaeological finds from peat. Mr. H. A. Hyde (National Museum of Wales, Cardiff) also dealt with this subject, and stressed its importance to the museum curator.

On the art side, Dr. John Rothenstein, director of the City Art Galleries, Sheffield, described the work which is being done in his Galleries to give school-children a greater perception and understanding of contemporary art (especially in the form of household objects), while Mr. Richard Bach, of the Metro-

politan Museum of Art, discussed the vigorous way in which art collections are brought to the people in New York by the Museum's "Neighbourhood Circulating Exhibitions".

In general discussions the problem of bad museums was considered more than once, and Mr. S. F. Markham (Hon. Empire Secretary, The Museums Association), after carefully defining such museums, advocated that steps should be taken to close them. Dr. C. Hay Murray, in a paper on "Museums as Department Stores", suggested that the curator should regard himself as a salesman, and study the methods of the shopkeeper. No less important, but of a more domestic nature, were papers by Mr. Laurence Vail Coleman, director of the American Association of Museums, on "The Philosophy of a Museums Association", and by Mr. S. D. Cleveland (Manchester) on "The Future of the Museums Association". Judging from the keen interest which the Conference aroused, that future will be an active and successful one.

The next Conference of the Association (of which the headquarters are at Chaucer House, London, W.C.1) will be held at Belfast in the first week of July 1938.

Flight in the Stratosphere

ALL countries which are interested in aviation have been considering the possibility of extending their activities to aircraft in the stratosphere. The greatest advantage in flying very high is that much higher speeds can be obtained for the same expenditure of power as the density of air is so much lower in the stratosphere than at ground-level. The Schneider trophy was won, for example, at a speed of 430 m.p.h. with an engine which gave 2,200 h.p. In the stratosphere, a speed of about 800 m.p.h. could be obtained for the same power. To drive the Schneider trophy winner at the latter speed near the ground would require an engine of 30,000 h.p. If stratosphere flight were possible at 600 m.p.h., then New York would be only five hours from London; so that by local time a passenger from London would arrive at New York before he started.

In vol. 7 of the Cambridge University Engineers' Association Year book recently published, Captain J. L. Pritchard points out some of the difficulties involved in flying in the stratosphere, and concludes that these will probably prevent stratosphere flight becoming a regular service, at least in the present generation. In fact, the increasing engine temperatures due to the difficulty of getting greater cooling may make regular flights in the stratosphere impossible until a new source of power is discovered.

The output of the internal combustion engine can only be maintained if the weight of oxygen it takes in per minute is maintained constant. At an altitude of 60,000 feet, the density of air is only about a tenth of what it is at ground-level. To maintain its output the engine would have to run ten times faster than at ground-level or take in ten times the volume of air.

The former alternative is impracticable so the weight of the air would have to be kept constant by supercharging. During this process, the pressure of the air is raised to about that at ground-level and the temperature by about 300° F. As most of the heat given in the air supplied has to be dissipated, extra cooling is necessary. Despite its low temperature, the low pressure of the atmosphere at this height is a disadvantage. Supercharging requires greater weight of equipment; in fact, the higher the aeroplane the greater its requisite weight.

In 1931, Prof. Picard discovered another fact which increases the difficulties of arranging for cooling. He found that at a height of ten miles, the temperature outside his gondola was -87° F., whilst inside the temperature was 140° F. This was due to the radiant heat absorbed by the gondola. As a method of getting over these difficulties the rocket principle has been suggested. This doubtless would work better at low temperatures than at the ones at which it has been tried. It has to be remembered also that the velocity of sound in the stratosphere is about 700 m.p.h., a speed which enthusiasts think aircraft might attain. Some engineers think that the aeroplane will have a critical speed at this speed, but it is not known how it would get through this critical speed. For this speed, the aeroplane would probably require small wings and the landing speed might have to be about 130 m.p.h.

As an offset to these disadvantages, there would be a great saving of fuel for the journey and the time would be much shorter. In the event also of an emergency landing, there would be a much greater choice of landing grounds, as it would be possible to travel 140 miles with the engine cut off by gliding from a high altitude.

University Events

BELFAST.—In connexion with the annual meeting of the British Medical Association recently held in Belfast, the following honorary degrees have been conferred: *doctor of laws*: Dr. G. C. Anderson, medical secretary of the British Medical Association; Sir E. Farquhar Buzzard, professor of medicine in the University of Oxford, physician to His Majesty the King, and president of the British Medical Association; Dr. H. Morley Fletcher, consulting physician at St. Bartholomew's Hospital and former president of the Association of Physicians; Prof. E. W. H. Groves, emeritus professor of surgery of the University of Bristol: *doctor of science*: Prof. S. P. Bedson, professor of bacteriology in the University of London; Dr. A. Felix, of the Lister Institute, known for his researches on typhus and enteric fevers.

CAMBRIDGE.—The Frank Smart studentship in botany will be vacant on October 1, 1937. Any graduate of the University is eligible for the studentship, which is valued at £210 a year. Further information can be obtained from Prof. F. T. Brooks, at the Botany School.

The Benn W. Levy research studentship in biochemistry will become vacant on October 1. Applications for its tenure should be addressed to Sir F. Gowland Hopkins at the School of Biochemistry before July 24.

LEAMING.—The Clive Behrens lectureship has been instituted by means of an endowment of £1,000 given by the Hon. Mrs. Behrens. The lecturer will be appointed biennially to give a series of four, five or six lectures on a subject germane, and of importance, to the practice of agriculture.

LONDON.—Mr. A. A. Miles has been appointed, as from October 1, to the University chair of bacteriology tenable at the University College Hospital Medical School. Since 1924 he has been University reader in bacteriology at the British Postgraduate Medical School.

Prof. J. H. Dible has been appointed, as from October 1, to the University chair of pathology tenable at the British Postgraduate Medical School. Since 1929 he has held the George Holt chair of pathology in the University of Liverpool.

OXFORD.—E. H. Leach, Oriel College, has been appointed to the new lectureship in physiology on the foundation of William Hulme at Brasenose College.

M. S. Wills, University College, has been awarded the Scott scholarship in physics for two years from October 1.

F. G. W. Knowles, Oriel College, has been elected to the Naples biological scholarship for the year 1937–8.

F. Fulton, Pembroke College, has been awarded the Radcliffe scholarship in pharmacology.

A special number of the *University Gazette* has been issued containing notices of the scholarships and exhibitions announced for the year 1937–8 by the men's colleges. In all, there are about 210 scholarships and 105 exhibitions open for competition. Of these, 37 and 16 are to be awarded for natural science, 13 and 6 for mathematics, 6 and 2 for either natural science or mathematics, and 8 and 5 for any of five subjects of which natural science and mathematics are two.

Science News a Century Ago

A Fatal Parachute Descent

IN Airy's "Autobiography" in the notes on the events of 1837 is one stating, "On July 24th I saw the descent of the parachute by which Mr. Cocking was killed. I attended the coroner's inquest and gave evidence a few days later". Robert Cocking was landscape painter, who in his earlier days had been a member of the City Philosophical Society with which Faraday was connected. In August 1814, he had lectured to the Society on aeronautics and had received a medal from the Society of Arts. In 1833 he made a curious form of parachute like an inverted truncated cone, 34 ft. in diameter at the top, which was formed of a circular metal tube 2 in. in diameter. A wooden hoop 3–4 ft. in diameter formed the lower edge, and between the hoop and tube was stretched strong linen. It weighed about 150 lb. Being most anxious to try it, he prevailed upon Green, an aeronaut, to ascend in a balloon from the Vauxhall Gardens on the evening of July 24, with Cocking, and his parachute suspended beneath the balloon. Having travelled as far as Lee, Cocking released himself, the parachute collapsed and he was killed.

The inquest was held at the Tiger's Head, Lee and attracted a great deal of notice. Airy had watched the balloon through a telescope, and he and other scientific men gave evidence at the inquest. Green, in his evidence, said that he had an unconquerable objection to parachutes which he considered quite useless and not likely to lead to any good end. In the course of the inquest, Faraday's name was mentioned as having spoken with Cocking at the Gardens before the ascent, and on July 31, Faraday wrote a letter to *The Times* in which he referred to the lecture of Cocking, and his recollection of the inventor's "companionship, abilities and kindliness". The verdict at the inquest was that, "We find that the deceased Robert Cocking, came to his death casually and by misfortune, in consequence of severe injuries received by a fall out of a parachute of his own invention and contrivance, which had been appended to a balloon; and we further find that the parachute did move to his death, and therefore that such parachute ought to become a deodand and forfeited to the Queen". Cocking, who was sixty-one years of age, was buried in a grave next to that of Halley and Pond at Lee.

Telegraphic Communication on Railways

WHEN Wheatstone and Cooke patented their electric telegraph, Robert Stephenson and the directors of the London and Birmingham Railway sanctioned the laying of wires between the Euston Square and Camden Town stations. Towards the end of July 1837, the telegraph was ready and Dr Andrew Wynter in his "Curiosities of Civilisation" said: "Late in the evening of the 25th of that month, in a dingy little room near the booking-office at Euston Square, by the light of a flaring dip-candle which only illuminated the surrounding darkness sat the inventor, with a beating pulse, and a heart full of hope. In an equally small room at the Camden Town station, where the wires terminated, sat Mr Cooke, his co-patentee, and among others, two witnesses well known to fame—Mr. Charles Fox and Mr. Stephenson. . . . Mr. Cooke in his turn touched the keys and returned the answer. 'Never did I feel

such a tumultuous sensation before,' said the Professor, 'as when all alone in the still room I heard the needles click; and as I spelled the words, I felt all the magnitude of the invention, now proved to be practical beyond cavil or dispute.' The telegraph thenceforward, as far as its mechanism was concerned, went on without a check, and the modifications of the instrument, which is still in use, have been made for the purpose of rendering it more economical in its construction and working, two wires at present being employed, and in some cases only one."

Artificial Digestion

THE *British and Foreign Medical Review* of July 1837 contains the following information: "Dr. T. J. Todd of Brighton with the assistance of Mr. Schweitzer of the German Spa, Brighton, has been performing experiments with the artificial digestive fluid, in imitation of those of Schwann in Berlin and has arrived at some new and interesting results not attained by Dr. Schwann. The digestive fluids with which Dr. Todd operated were prepared from the stomachs of the ox, the horse, the dog and the cat. Some, also, prepared from the upper portion of the small intestines, was found not less powerful. The presence of the acid is essentially necessary in the preparation; when Mr. Schweitzer endeavoured to procure the digestive fluid with distilled water alone, or when he treated the mucous membrane in the same way with a weak alkaline solution, a rapid putridity stopped all further proceedings. Various animal and vegetable substances were submitted to the action of these digestive fluids, at the ordinary temperature of the atmosphere, and the contact result in all the instances had been that these substances have been resolved into their elementary organic globules."

"There has been no exception to this, so far as the experiments have extended, and these include among vegetable substances the artificial digestion of boiled cauliflower, of bread, and of vermicelli, not dressed; and among animal substances, the white of egg boiled, the coagulation of blood, butter, fat, the muscular fibre of mutton and of fish boiled and raw, filaments of the sciatic nerves raw, and scrapings of bone. The products of these artificial digestions especially of the vegetable substances compared with chyme taken from a dog which had been feeding upon ground oats, were very much alike, except that the watery part had been removed from the chyme."

Cure for Drunkenness

THE issue of the *Indian Journal of Medical and Physical Sciences* of July 1837 contains the following information: "A native of Norway, aged 40, who had from his youth been accustomed to dram drinking, was attacked with delirium tremens. His medical attendant to cure him of his dangerous propensity, prescribed the daily dose of a mixture of two drachms of sulphuric acid and twenty-four ounces of whisky. The result was remarkable. In three months' time he got such a dislike to all kinds of spirituous liquors that he could not bear to swallow a drop of anything stronger than beer. The dose of the above mixture taken, was four wine-glasses daily, and the cure had been of a year's standing at the time of the communication of the case."

Societies and Academies

Dublin

Royal Irish Academy, May 10.

W. J. McCALLIEN: Structure of the Rathmullen District, Co. Donegal. An account is given of the Crana quartzite in the district between Rathmullen and Milford. It can be split into three divisions. The structure of the quartzite group is described, and emphasis is laid on the value of the epidiorite sills in the interpretation of the structure. The base of the quartzite is believed to be a slide, which is folded and overfolded. The Killygarvan limestone, which is younger than the Crana quartzite, is correlated with the Culdaff limestone.

Cape Town

Royal Society of South Africa, April 21.

Archæology of the Oakhurst Shelter, George. (1) A. J. H. Goodwin: Course of the excavation. A description of general methods of excavation, stratigraphy, and cultural remains as observed on six visits to the Oakhurst Shelter. (2) Disposition of skeletal material. An account of the graves, their cultural age and associations, positions of burial and grave furniture. (3) M. R. Drennan: The cave-dwellers. An anthropometrical and descriptive account of the adult population of the shelter. (4) Children of the cave-dwellers. An anthropometrical account of the child population of the shelter, stressing growth and development in relation to the adult group. (5) J. F. Schofield: The pottery. An account of the pottery found in the superficial deposits at Oakhurst shelter.

P. W. LAIDLOR: An unusual grooved stone.

J. F. SCHOFIELD: Pottery from the Umgazana and Zigzag caves.

Cracow

Polish Academy of Science and Letters, April 5.

TH. BANACHIEWICZ: The inverse of a Cracovian, and a general solution of a system of linear equations.

W. JACYNA: The differences in the indications of gas thermometers. A helium thermometer at constant pressure gives higher readings than a helium thermometer with the gas at constant volume if the temperature is higher than -100°C .

F. GORSKI: The polarimetric titration of the oxyacids. The author adds an excess of ammonium molybdate, to increase the rotatory power, and titrates with a standard solution of the optical isomer of opposite sign. Errors due to various secondary factors are thus eliminated.

MMRS. H. KRZYMIMIENIEWSKA and S. KRZYMIMIENIEWSKI:

(1) The Myxobacteria—cellulose-degrading agents. Description of Myxobacteria, especially the family Sorangiaceae, capable of living on cellulose in the presence of free oxygen. These bacteria can be grown on a synthetic medium containing cellulose and nitrates. (2) The degradation of cellulose by the Myxobacteria.

J. BADIAR: The cytology of yeasts.

W. NIEMIŁOWSKI and R. WOJCIŚIAK: The geographical extension of forms of the species *Erebia manto*, especially in the eastern Carpathians.

J. ZACWILICHOWSKI: Experimental researches on the behaviour of acquired characters in the descendants of *Lymantria dispar*.

B. HRYNIEWICZ: Count Michel-Jérôme Lecomte-Suminski, and his study of the development of ferns.

Moscow

Academy of Sciences, (O.R., 14, No. 8; 1937.)

V. S. IGNATOVSKIY: The Laplacean transformation (5).

P. KOROVKIN: A generalization of Taylor's series.

V. SOKOLOVSKIY: Concerning a problem of the theory of shells.

N. STRELBICKIY: The factor of safety as an indicator of strength equality of structures.

E. P. OSTROVSKIY: Generation of powerful sound vibrations by magnetostriction.

K. CH. KEKULOV: Action of non-adequate stimuli on receptors.

A. E. FAVORSKIY and M. D. BONE: Methods of determination of the constitution of carbohydrates of the series C_2H_{2n-2} .

P. SCHORIGIN and S. A. SKOHLINSKAJA: The decomposition of ethers (and esters) of cellulose by a solution of metallic sodium in liquid ammonia.

F. M. SEMIACHIN and A. I. LAZAREVA: (1) A study of periodic precipitation in aqueous media in capillaries, in the formation of barium carbonate, copper chromate and silver sulphate. (2) Comparative study of periodical precipitations in aqueous media by the Morse and the Ostwald methods.

L. G. DOBBUNOV: Characteristics of the growth and mineral nutrition of hemp with simultaneously maturing male and female plants.

N. V. MOROSOVA-VODJANITSKAJA: Some data on the vegetative productivity of the Black Sea.

Rome

National Academy of the Lincei (*Atti*, 24, 323-392; 1936).

E. BOMPIANI: Projective invariants in the theory of surfaces (1). Rapid reconstruction of the theory of projective applicabilities.

L. TONELLI: Problem of Plateau (1).

N. ABRAMSCU: Study of a surface in the region of one of its points, and a new interpretation of the cubic given by the tangents of Darboux and Segre.

E. CASTELNUOVO: A class of rational surfaces which admit co^2 transformations projective in themselves.

A. ERDŐLYI: The generalization of a formula of Tricomi.

L. ROTH: Semi-rational varieties in three dimensions.

L. CESARI and F. CONFORTO: The equation of the three moments for a continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span (2).

L. LABOCCHETTA: A more general form of Kepler's third law.

G. ARRIGHI: Isocarene oscillations about the configurations of general equilibrium.

R. MANTONI ANSIDDI: Raman spectrum of aromatic hydrocarbons with condensed nuclei (1). Anthracene and phenanthrene, and their molecular symmetry.

G. B. BONINO: Molecular symmetry of thiophene (2).

G. NATTA and R. RIGAMONTI: Electron diffraction examination of some vinyl polymers.

E. TRIA: Relation between temperature and activity of the glycogenolytic ferment in the liver of poikilotherm animals.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the day mentioned:

PROFESSOR OF CIVIL ENGINEERING, IRRIGATION AND HYDRAULIC in the Thomson Civil Engineering College, Roorkee, United Provinces India—High Commissioner for India, General Department, Indi House, Aldwych, London, W.C.2 (July 31).

HEAD OF THE DEPARTMENT OF ENGINEERING, ARCHITECTURE AND BUILDING of the Bradford Technical College—The Principal (July 31)

ASSISTANT ENGINEER in the Mechanical and Vehicle Engineering Section at the Headquarters of the Ministry of Transport—The Establishment Officer (July 31).

ASSISTANT CURATOR in the Rock Garden and Herbaceous Department of the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. (August 2).

PERMANENT ASSISTANT (metallurgy) in the Admiralty Technics Pool—The Secretary of the Admiralty (O.R. Branch) (August 7).

PROFESSOR OF FORESTRY in the University of Aberdeen—The Secretary (November 1).

ASSISTANT LECTURER IN CIVIL ENGINEERING in the Imperial College of Science and Technology (City and Guilds College)—The Secretary.

TEACHER OF ENGINEERING in the Oldham Municipal Technics College—The Director of Education, Education Office, Oldham.

LECTURER IN MATHEMATICS and LECTURER IN CHEMISTRY in the Kingston Technical College—The Principal.

LECTURER IN ENGINEERING in the Brighton Technical College—The Education Officer, Education Office, 64 Old Steine, Brighton, 1

ABSTRACTOR of scientific and technical literature at the Shire Institute, Didsbury, Manchester—The Director of Research.

Official Publications Received

Great Britain and Ireland

P. H. P. (Political and Economic Planning). Report on the British Social Services: a Survey of the existing Public Social Services in Great Britain with Proposals for Future Development. Pp. 204 (London: P. H. P.) Paper boards, 7s. 6d.; cloth, 10s. 6d. [18]

London School of Hygiene and Tropical Medicine. Report of Meeting of the Ross Institute Industrial Advisory Committee held at the Council Chamber of the Rubber Growers' Association on Friday 29th May 1937. Pp. 24. (London: London School of Hygiene and Tropical Medicine). [30]

The Story of the General Register Office and its Origins from 1532 to 1937. Compiled by the Registrar General and illustrated by certain Exhibits shown at the General Register Office, Somerset House Strand, W.C.2, in commemoration of the Centenary 1837-1937 of the General Register Office and Registration Service in England and Wales. Pp. 80+6 plates. (London: H.M. Stationery Office.) 6s. net. [30]

Transactions of the Royal Society of Edinburgh. Vol. 69, Part 2 No. 5: The Early Stages in the Development of the Ferret; the Formation of the Mesoblast and Notochord. By Dr. William J. Hamilton. Pp. 165-193+7 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 6s. 3d. [30]

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1936. Pp. 35. (London: H.M. Stationery Office.) 9d. net. [1]

Scottish Education Department. Report on the Royal Scottish Museum, Edinburgh, for the Year 1936. Pp. 19. (Edinburgh and London: H.M. Stationery Office.) 3d. net. [1]

* Other Countries

Imperial College of Tropical Agriculture. The Principal's Report for the Year 1936-36 and the Accounts for the Year ended August 31 1936. Pp. 36. (Trinidad and London: Imperial College of Tropical Agriculture.) [23]

Rapports sur la photoluminescence présentés à la Réunion Internationale de Photoluminescence, Varsovie, 20-25 Mai 1936. Publié par la Société Polonaise de Physique sous la rédaction de Prof. Dr. S. Pleszkowski et Dr. W. Kapusinski. (Vol. 5 des Acta Physica Polonica.) Pp. ix+431. (Wilno: Acta Physica Polonica.) [25]

Report of the Committee on the Measurement of Geologic Time presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, May 1, 1937. Pp. ii+77 (Washington, D.C.: National Research Council) [30]

Ringsbætt Fjörðs Natúrhístória: Brakvands-ferðin 1915-1933. Udgivet af A. O. Johansen og H. Blagvad, under redaktion af E. Spärck. (Udgivet paa Carlsbergfondets Bekostning.) Pp. vi+265 (København: Andr. Fred. Høst and Søn.) [30]

National Geological Survey of China. Paleontologia Sinica, Serie C, Vol. 7, Fascicle 5: On the Mammalian Remains from Locality at Choukoutien. By W. O. Pei. Pp. 120+6 plates. (Peiping: The French Bookstore.) [1]

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 151: Experimental Research on the Effectiveness of Aerons and Elevators. By Taiiro Ogawa and Katsu Ito. Pp. 249-420. (Tōkyō: Kōgyō Tōsho Kaisha Ltd. Kaisha) 1.00 yen. [1]

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Vol. 140

Freedom of Science and Learning

SO much has been said recently upon the subjects of academic freedom and intellectual liberty that there is a tendency for the terms to become catchwords, as in the much-used phrase "Poverty in the midst of plenty". If this were the main result of the reiteration of the principle that scientific inquiry can only develop to its full extent in an atmosphere of political freedom, it might reasonably be suggested that there has been too much talk about liberty but too little done to secure it. Fifty years ago, as Prof. Hogben reminded us in his Conway Memorial Lecture—"The Retreat from Reason"—T. H. Huxley, in an address on technical education, used the pregnant words "The great end of life is not knowledge but action"; and this principle may be applied very appropriately to the reaction that has resulted from a knowledge of conditions deliberately created to restrict scientific work to particular classes, and thus to destroy the international character of the pursuit of scientific truth.

The group of British scholars and scientific workers who, under the leadership of Lord Rutherford, formed the Academic Assistance Council in 1933 wished to defend the principles of university freedom by actions rather than words. As the Council's report*, which has recently been published, says, the Council has relied on the propaganda of practical achievement; not of protest or agitation. The achievement disclosed by the report is remarkable. Of the approximately 800 refugee University teachers from Germany, 485 are permanently re-established and 320 have been provided with temporary positions enabling them

to continue their scientific work. This work has been accomplished during a period of economic depression, which has weakened the absorptive capacities of the universities and increased national protectionist activities in the learned professions of all countries. The report emphasizes that the Council itself is directly responsible for only a part of this achievement; the Council is the institutional expression of a spontaneous activity in the university world to assist the displaced scholars. It is, therefore, the index of a great co-operative achievement by the free universities, the success of which, in contrast to the relatively unsatisfactory progress made towards a solution of the refugee problem in general, proves that it depends chiefly not on motives of compassion but on convictions that the principle of university freedom is involved, and is implicitly defended by assistance for the refugee scholars.

The report is a demonstration of how vigorous is the determination to defend liberty. The work in itself has strengthened that liberty. University teachers, co-operating in the work of academic assistance which the Council has kept consistently on a basis of political neutrality, and associating with the exiles who have suffered by the destruction of liberty, must have learned during the past four years to value more highly the practical advantages of their own freedom. Furthermore, the proof that in a crisis men of science can rely upon the moral and effective support of their colleagues in other countries must have increased that security which is a condition of freedom. It cannot be hoped that the leaders of intolerance and irrationalism will be deterred by the knowledge that their victims will be sheltered in the asylum of liberal countries; but we may hope that

* Third Report of the Academic Assistance Council (Society for the Protection of Science and Learning, 6 Gordon Square, London, W.C.1). Copies may be obtained gratis on application to the General Secretary of the Society.

their opponents will feel slightly more secure in their opposition, and we shall be spared a repetition of what still remains the most tragic feature of the German disaster, the absence of any stubborn resistance by the universities themselves to the restriction of their freedom.

The report makes it clear that university teachers in several countries will need all possible moral encouragement in face of the widening menace to the security of learning. Realizing this, the Academic Assistance Council has converted itself into a more permanent organization, the Society for the Protection of Science and Learning. The dismissal of university teachers in Germany on 'racial' grounds has seen two main phases—that after the original legislation of 1933 and that after the Nuremberg legislation in the autumn of 1935. Information in the last few weeks suggests that a third phase is beginning; for a considerable number of professors have recently been dismissed merely because they have Jewish wives. Parallel with the series of dismissals on 'racial' grounds there has been a continuing process of dismissals on grounds of 'political unreliability'. The law of January 21, 1935, providing for a 'fundamental reconstruction of the universities' has been used for arbitrary dismissals when the other regulations did not provide so convenient a pretext. The report gives details of the displacement of scholars in other countries on grounds of religious or political opinion; for example, in Italy, Portugal and the U.S.S.R., and of the beginnings of a refugee movement from Spain in consequence of the civil war. The Society considers that its services are even more necessary to-day than when the Academic Assistance Council was founded in May 1933.

It may be asked why Great Britain should take a leading part in this work of salvaging scholarship wrecked by the subjection of universities within the new authoritarian States, and whether the work is worth while. On grounds of principle, there can be little doubt that our tradition of toleration imposes on us a special responsibility, and that it is justifiable in defending principles to protect those who have been victimized by the non-recognition of those principles. Doubts arise, however, not on theoretical grounds but on practical considerations. The Society's report describes fully its methods of work and convincingly answers the possible criticism that the sheltering of the refugees in Great Britain has injured the interests of British university teachers by pointing out that its work

has "protected them from the injury that was threatened in the situation in 1933 when an army of wandering scholars invaded the university world, without guidance or directed distribution and when no new financial resources were available with which the universities could meet the crisis". It is pointed out that, for the future, the efficiency of the work in re-establishing the scholars will make it necessary for almost all to be assisted to re-establishment in over-seas countries without even a period of sojourn here. We must keep a sense of proportion in this matter. There are 228 German *émigré* scholars in Great Britain, and it cannot be seriously claimed that they threaten the professional interests of the 6,000 British university teachers. During the past four years the Council alone has added a sum of £35,000 to the resources of the universities, which has enabled them to bear the additional strain so unexpectedly imposed.

Hospitality is a two-way process, and it is evident how greatly the universities have profited from their guests. One of the German men of science who had found asylum in the United States was urgently invited by Herr Rust to return to Germany, where his ancestry would be forgiven because his services were required in the rearmament programme. He declined the invitation, expressing the hope that Herr Rust would succeed within ten years in benefiting the German universities as much as he had benefited the American universities within one year. It is rumoured that a certain institution not far from Cambridge has considered the advisability of erecting a tablet in gratitude for the benefactions bestowed on it by the results of the new National Socialist régime. The pages of NATURE itself almost each week show how much of the learning and talent that was threatened with extinction in Germany in 1933 has been preserved through the agency of bodies like this Society.

In the gloomy pages of the history of the German universities in the last four years, the work of the Society for the Protection of Science and Learning stands out in happy relief. The Council asks for continued support for its activities and hopes that many will associate themselves with the work by becoming members of the Society. Few subscriptions to societies can show such good profit as a guinea membership subscription to this Society, which is trying to protect science and learning.

Messianic Radiation

Star-Begotten :

a Biological Fantasia. By H. G. Wells. Pp. vii+199. (London: Chatto and Windus, 1937.) 3s. net.

IT is always interesting to see what a scientific fact will look like after Mr. Wells's imagination has been let loose on it. The facts on which this book is based are that particles or photons of high energy provoke mutation, and that such particles and possibly photons are reaching our planet from outside. What if some intelligent extra-terrestrial beings, perhaps on Mars, are treating us as we treat *Drosophila*? If these beings are as benevolent as they are powerful, may we not expect that our mutations will be of a desirable character, and that the mutants will reform the world? So Mr. Wells's characters argue. Two thousand years ago Virgil was writing:

"Iam nova progenies coelo demittitur alto"; and it is widely believed that his prophecy was fulfilled. Wells predicts not a single saviour, but millions of messianic mutations.

It is worth while pointing out why such a theory, even if there were some evidence for it, would be unacceptable. First, as Wells himself remarks, the cosmic radiation is undirected. As a theme for his next story, I offer him the radiation of about 15 metres wave-length which Jansky found to be reaching our planet from the hub of the universe, or rather of our galaxy, in Sagittarius. Secondly, spontaneous mutation has a fairly high temperature coefficient, and therefore cannot well be due to radiation. Muller discovered this fact before he showed that X-rays are more effective than heat in provoking mutation. But radiations are new, and temperature coefficients are not, so the discovery is generally ignored. Finally, cosmic radiation obeys (if one may use such a word) the uncertainty principle, so even a superhuman marksman aiming at particular genes in human nuclei could scarcely expect much success. It is interesting that temperature fluctuations are equally uncontrollable, so that at present we have no method which promises anything better than a random provocation of mutations, most of which are harmful.

Why, we may ask, has our author chosen this particular theme? Many of my younger contemporaries, in Flecker's words,

"Take no more solace from the palm-girt Wells".

I think they are wrong. He still represents an

important tradition, he is a great stylist, and the workings of his mind are most instructive. "Star-begotten", like Stapledon's "Last and First Men" and "Odd John", but unlike his recent "Star-Maker", despairs of existing humanity, and demands beings of innate endowments superior to our own to deal with the present crisis of civilization, which it sketches in brilliant phrases. The author is obviously sceptical of the remedies which he and others have propounded. "Haven't all civilised men nowadays the feeling of being dillettantes on a sinking ship?" asks one of his characters. So with unconquered optimism he puts forward a panacea which he knows to be fantastic.

Some of the undercurrents of Wells's thought are indicative. He is strongly anti-communistic, but he cannot help being influenced by communist ideas. Thus he uses the word ideology, and on p. 165 we find a phrase about mad dogs which perhaps owes something to a speech of Vishinsky's at the first trial of Trotskyists in Moscow. Many of his phrases remain apposite if the letter 'x' is substituted for 't' in Martian. Making this substitution, we read "At the onset of a strange way of living we bristle like dogs at the sight of a strange animal. He hated these Marxians as soon as he thought of them. He could not imagine that their interference with our nice world could be anything but devastating". Another character is more tolerant. "And now these new creatures from outside, these creatures called Marxians, are coming on board our drifting system. With their hard clear minds, and their penetrating unrelenting questions stinging our darknesses as the stars sting the sky. Are they going to salvage us? Shall we let them if they can?"

Whether or not the Marxians have correctly diagnosed the cause of our present distresses, it is clear that evolutionary processes, either natural, or directed by terrestrial or celestial eugenicists, are most unlikely to end them. The time-scale of evolution is altogether longer than that of history; and we probably have not many years, let alone generations, to save our civilization from collapse. If this book encourages a single reader to think, even for one moment, that any natural or super-natural process will take the place of human effort and human thought, then it is a bad book. But if it is read as a record of conversations between rather worried intellectuals, it is not only an excellent piece of writing, but also a valuable historical document.

J. B. S. H.

The Dilemma of Contemporary Linguistics

Infant Speech: a Study of the Beginnings of Language

By M. M. Lewis. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xii+335. (London: Kegan Paul and Co., Ltd., 1936.) 12s. 6d. net.

MR. LEWIS introduces his excellent study of infant speech somewhat dramatically by reminding us how, exactly half a century ago, Max Müller's saying "No thoughts without words" left linguistic studies somewhat in the air. To some, the aphorism went too far; to others not far enough. For the psychologist it was going too far, for obviously symbolic thought without words does occur. Linguistically it did not go far enough, for words mean more than ideas, and in their most important function they are as much a form of human action as any type of bodily behaviour.

To-day, linguists are faced by a similar dilemma. Once we recognize with Mr. Lewis that "language is a form of activity, a mode of human behaviour, perhaps the most important" (p. 5), the question arises: Can we treat language as an independent subject of study? Is there a legitimate science of words alone, of phonetics, grammar and lexicography? Or must all study of speaking lead to sociological investigation, to the treatment of linguistics as a branch of the general science of culture? If the earliest and most fundamental function of speech is pragmatic—to direct, to control and to correlate human activities—then obviously no study of speech except within the "context of situation" is legitimate. The distinction between *language* and *speech*, still supported by such writers as Bühler and Gardiner, but dating back to De Saussure and Wegener, will have to be dropped. Language cannot remain an independent and self-contained subject of study, once we recognize that it is only the general norm of human speech activities. Finally, we shall have to decide whether, with some recent German psychologists, we have to assign three separate functions to speech: the expressive, the evocative, and the representative; or whether we must be satisfied with the admission that speech has only one main function, that of pragmatic control, of co-ordinating human action; while all the other manifold uses and aspects of language are derivative.

The dilemma of contemporary linguistics has important implications. It really means the

decision as to whether the science of language will become primarily an empirical study, carried out on living human beings within the context of their practical activities, or whether it will remain largely confined to deductive arguments, consisting of speculation based on written or printed evidence alone. The first view would insist on drawing the material of linguistics from the observation of infant speech, from the study of pathological phenomena in aphasia, from fieldwork on the actual use of language by the various strata of civilized society, and among so-called primitive peoples.

The grammarian and the lexicologist may have in future to abandon their comfortable, two-dimensional world of parchment and paper, and either go into the field, or else rely on material documented not only by words, but also by those aspects of human life, activity, and social organization by which the use of words is determined. The present reviewer, like most modern anthropologists, would plead for the empirical approach to linguistics, placing living speech in its actual context of situation as the main object of linguistic study.

Mr. Lewis is not too dogmatic in the excellent theoretical introduction to his book. He gives there an impartial summary of most modern theoretical work. He himself, however, takes the empirical view that "the main function of language in human life as the mediator between man and man" must be taken as the guiding principle in any linguistic inquiry.

A cavilling critic might note some omissions in his choice of authorities. The absence of any reference to the work of Philipp Wegener, one of the forerunners of the modern movement; or to the American psychologist, G. H. Mead, who perhaps was the first clearly to formulate the principles of pragmatic symbolism; the relatively small space given to the work of Jespersen and Piaget; and the omission of John Dewey's most important contribution, that is, of Chap. v in "Experience and Nature" (1925), might be remedied in a future edition. On one or two formal matters I should like to suggest also an amendment. Thus to state that "speech is an instrument, a tool" is not, as the author supposes, a useful simile, but, like all analogies, an unnecessary handicap. Speech, obviously, is not a tool, but a habit, a standardized type of activity of the human organism. It is, therefore, not to be classed with the material products of man, but rather with the other modes of active human adjustment to the

nvironment and to the mechanisms of culture. Again, Mr. Lewis speaks of "language as an institution". Whatever meaning be given the word 'institution', the label again brings language as a fixed product into the realm of material achievements and leads us away from the study of speech customs within the living context of human activities.

But these are minor criticisms, and they are found only in the theoretical preliminaries of Mr. Lewis's treatise. When he comes to work, and enters his empirical laboratory, all the minor misconceptions vanish. Throughout, he studies the child's speech habits within the circumstances in which they occur. He conducts, in fact, all his observations, in the only admissible manner: he investigates *speech* and not *language*; and investigates it, not as a detached, purely linguistic transfusion of meaning, but as a means of action on adults by the child and conversely the influence of speech and other activities of the grown-up on the child.

This makes the author recognize that to regard the child's spontaneous utterance as merely 'expressive' in its function is erroneous. In fact, through the whole range of the author's observation, the distinction between 'expressive', 'evocative' and 'representative' falls to the ground. Mr. Lewis's results show that the only correct treatment is to study the total situation: the vocal

act of the child, which is linked up with the circumstances; and the reactions of the adults which respond to the child's pre-linguistic activity. The meaning of such a vocal act can only be defined as the change produced by the child's utterance in mobilizing its social environment, and making the adults obey its wishes. Obviously, an utterance like this is at the same time expressive, in that it corresponds to the child's feelings of discomfort or anxiety; it is representative, in so far as it is linked up with the situation; and it is evocative in so far as it makes the elders respond to the child's utterance. "Throughout all this the child will tend to use his cries more and more as an aid to the rest of his behaviour, and even as a substitute for it. . . ." In other words, from the very beginning, the human being uses his voice in prearticulate and later on in an articulate sense, in order to achieve, through the assistance given him by others, what he cannot do through his own bodily activity.

The work of Mr. Lewis is in many ways a great advance on all previous experimental studies on child speech and a valuable contribution to the theory of language. In his use of older sources, he is judicious, critical and comprehensive. In the setting of his own observations, he has taken his inspiration from the most scientific, that is, the most empirical point of view in modern linguistics.

B. MALINOWSKI

Elementary Chemistry and its Presentation

New Practical Chemistry:

Fundamental Principles applied to Modern Life. By Prof. Newton Henry Black and James Bryant Conant. Pp. xi+621. (New York: The Macmillan Co., 1936.) 7s. 6d.

New Laboratory Experiments in Practical Chemistry

To accompany Black and Conant's 'New Practical Chemistry'. By Prof. Newton Henry Black. Pp. x+193. (New York: The Macmillan Co., 1936.) 5s.

THESE are welcome and important additions to the large number of text-books which deal with the fundamental principles of chemistry and their mode of presentation. Anyone still unconvinced that a knowledge of the fundamental principles of an ever-expanding science and some of their applications may not be a part of a general education might do well to make a detailed study of

these books, one of the authors of which is a distinguished organic chemist, well known in Great Britain, and president of Harvard University.

Much difference of opinion exists among those occupied with the teaching of elementary chemistry concerning the method of presentation. Unlike the authors, some prefer to adhere, so far as possible, to a more or less historical method, and to leave any consideration of the developments of the subject during the last twenty-five or thirty years to a later stage of the student's training. This has the disadvantage that the student who does not continue the more detailed study of the science has little knowledge of the structure of the atom, by which the properties of the elements and the structure and properties of chemical compounds are more adequately explained.

The presentation of the fundamental theories and facts of chemistry by the authors is excellent. Perhaps, at times, it is too didactic, and formulae

of compounds are stated before any description of the compounds is given. This might cause difficulties for the student who reads without the guidance of a teacher. But the books are not intended for home reading. Even the title of the larger volume, dealing with the more theoretical side of the subject, indicates that chemistry is a practical science, and the companion volume gives a comprehensive series of experiments to be carried out *pari passu* with the theoretical instruction. These not only include qualitative and quantitative exercises of the usual type prescribed for the beginner, but also experiments on soil testing, colloids, textile fibres, blue prints, dyeing, paints, food components of milk and identification of simple compounds. An elementary knowledge of such subjects might be frowned upon as being too technical to form part of general education; but it does provide possible stimuli on which later interest, whether for profit or leisure, may depend. It is no mean achievement to give such information without in any way sacrificing the accurate presentation of the essential facts and theories of chemistry.

It is rare to find elementary text-books so stimulating as these, and they would be unique if they were entirely free from faults. Some chemists would not agree with the authors'

explanation of the apparent dual valency phosphorus, and perhaps many teachers would hesitate in the first year of a student's training to give so detailed an account of Bohr's theory of spectra. From the teacher's point of view, however, it is important to realize that the authors show it can be introduced without much difficulty.

The authors state that they have "enriched the treatment by exceeding the factual requirements of the College Examination Board". It is to be hoped that this is the case, because the books are so comprehensive in subject-matter. This ranges from the early history of the science to atomic structure, from the "New Periodic Law" to radioactivity and transmutation of the elements, and from coal and oil to dyes, paints and vitamin. All these are apparently to be studied in one year and presumably the student takes other subjects besides chemistry. Perhaps American students for whom the books are primarily written, work harder than British students. Even if the use of these books is merely a candidate for a college entrance examination, he is fortunate in having the fundamental theories and facts of chemistry and some of their applications presented to him in so fascinating a manner.

CHARLES S. GIBSON

Operational Symbolism in Mathematical Analysis

The Theory of Linear Operators:

from the Standpoint of Differential Equations of Infinite Order. By Harold T. Davis. (Monograph of the Waterman Institute of Indiana University, Contribution No. 72.) Pp. xiv + 628. (Bloomington, Ind.: The Principia Press; London: Williams and Norgate, Ltd., 1936.) 35s. net.

THE modern philosophy of physical science leans strongly to the view, so well expressed by a recent writer, that the concept is synonymous with the corresponding set of operations. The idea of mechanical imagery advocated by Lord Kelvin is thus being replaced by the notion of an operational process which accordingly presupposes the existence of a law of transformation. To mathematicians, this aspect has long been the subject of profound study, but not until comparatively recently has the idea permeated the theoretical domain of science.

The formal theory of operators is generally considered to have originated with Leibniz and Lagrange, whilst in Great Britain the subject was mainly stimulated by George Boole, who clarified

our fundamental ideas in both logic and mathematics. Then came the generatrix calculus which Laplace made the basic method of his "Théorie analytique des Probabilités". A further stage is the development of operational methods arose from researches in electrical communication, out of which came the once-spurned operations calculus of Oliver Heaviside, a self-taught mathematical man of science. Finally, Volterra and Fredholm laid the foundations of the theory of integral equations and, later, the calculus of forms in infinitely many variables out of which, from the modern study of the quantum mechanics and the properties of electrons, has sprung the matrix calculus.

These main divisions of the theory of operators are all discussed with some detail in Chap. I of the volume under review, which was written, as a result of considerable research, to provide an outline of the theory of linear operators and its manifold applications to general types of linear functional equations. The volume is published as a monograph of the Waterman Institute of Indiana University, and surveys the theory of linear

operators from the point of view of the theory of differential equations of infinite order.

The development centres round the generalized differential operator. Several chapters are devoted to the definition and properties of operators, namely, particular operators, operational multiplication and inversion, grades defined by special operators, etc. Some very interesting examples are given in this section illustrating the application of operational processes. These include such important problems as the development of the disturbing function in planetary motion involving Newcomb operators; the propagation of electromagnetic waves in which Silberstein's elegant operational solution is used, and finally the propagation of population by fission, to which the operational method of Rawles is applied. Chapters vi and vii are devoted to differential equations of infinite order with constant coefficients, and linear systems treated by the Heaviside calculus.

Illuminating chapters then follow on the Laplace type of equation of infinite order, in which

the coefficients are polynomials of bounded degree; the generalized Euler equation of infinite order; Fuchsian operators of infinite order, and the Volterra and Fredholm integral equations of infinite order, in which a full description of Lalesco's theory is given. The closing chapter is devoted to the theory of spectra and, after giving some important theorems on matrices concerning transformations, identities and Hermitian, the author proceeds to discuss the equivalence of the theories of quadratic forms and integral equations, and, finally, some general considerations on the continuous spectra of quadratic forms.

Throughout the text, which is very clearly written, many applications to science have been indicated, and an extensive bibliography is provided at the end for further reading. Those interested in the subject will be grateful to have, within one cover, so complete an account of the new operational symbolism which has become one of the important methods of extending the domain of mathematical analysis.

F. G. W. B.

A Text-book of Aerodynamics

Elements of Practical Aerodynamics

By Prof. Bradley Jones. Pp. v + 398. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 18s. 6d. net.

AS the author claims in the preface, this is a student's text-book of American origin, and as such is an admirable exposition of the subject. It gives worked-out examples in the text and further examples for the student at the end of each division. This is a principle that has always been advocated by educationists, but seldom followed by writers of books on aeronautical subjects up to the present day.

The author states, apparently as a recommendation, that he has avoided the use of the calculus except upon two occasions. It is a little surprising to find fear of this branch of mathematics in any modern scientific book, more especially one expressly written for students, who surely must be beyond the study of such elements of it as would have been necessary in such a book before they even reach the stage of studying aerodynamics.

The first few chapters, dealing with the aerodynamics of the aeroplane, are extremely clear and lucid, but they should have been followed by

the chapters on stability, control, etc., so as to read as one continuous argument. One would like to have seen more on skin friction, laminar and turbulent flow, and such matters, treated as lucidly as the rest of the aerodynamics in these chapters.

The chapter on stability infers that lateral stability is less difficult a subject than longitudinal stability, a statement with which few aeroplane designers will agree. The mathematical consideration of it in theoretically undisturbed air may be, but this is only the introduction to the real practical problem with disturbed motion.

The second half of the book is made up of accurate, but quite inadequate, chapters on subjects such as materials, instruments, meteorology, 'avigation' (American for aerial navigation) and aerostatics. These are good, so far as they go, but are very elementary in character, and out of balance with the treatment of the subject-matter of the earlier chapters.

In general, this is a book that should appeal to students in Great Britain, to be taken as additional reading, giving a rather different American outlook on the subject. Now that we have adopted the same units as used in the United States, it will be less confusing to the beginner.

Death from the Skies:

a Study of Gas and Microbial Warfare. By Heinz Liepmann (with the scientific assistance of Dr. H. C. R. Simons.) Translated from the German by Eden and Cedar Paul. Pp. 286. (London: Martin Secker and Warburg, Ltd., 1937.) 6s. net.

THE author of this sensational book claims to have received information from certain authoritative sources which it would be inexpedient for him to acknowledge; but there seems to be nothing new in his disclosures, and all the probable war gases which he lists as "pre-eminently suitable" can be found in any of the books that have been published on this subject. He believes that "hundreds of millions" will perish from gas in the war that is to come. "Just a minute or two of a hideous struggle for air, and then death—lucky, perhaps, if it is over so quickly. In former days men condemned to death were at least given time for a prayer. Not these, not these. They groan, they scream, they suffocate, they die."

We hear again of the same old gas bomb which, falling in Piccadilly Circus, would destroy all life between Regent's Park and the Thames; and amongst the "authorities" on whom he depends he even includes an entry in a record of the German Patent Office. He comes to the conclusion "that there is no protection against poison gas. Anyone who says such protection is possible is a liar." Similarly, there is no defence against bacteria; and, should war break out within the next few months, Germany will wage bacterial warfare, and we may expect glass flasks filled with cultures and contaminated rats dropped from aircraft by means of small parachutes.

The author is mistaken in saying that the British General Headquarters undertook costly chemical experiments before the outbreak of the Great War in the expectation that poison gas would be used. He is also misinformed in supposing that no known gas mask can protect against blue cross gas; and quite wrong in describing the Chemical Warfare Research Committee as a joint Allied organization, and in stating that (the British) General Thuillier succeeded (the French) General Curmer as head of the French State Commission for Gas Service. His description of the present condition of Germany is quite the most interesting part of the book—"a poverty stricken and dangerous land, a focus of unrest for Europe, in imminent danger of exploding—the explosion being prevented only by a reign of terror unexampled in history". Hitler, he thinks, will inevitably embark on expansionist adventures, and a decisive struggle between Britain and Germany must occur.

O. H. F.

The Journal of the Institute of Metals

Vol. 59. Edited by G. Shaw Scott. Pp. 323+22 plates. (London: Institute of Metals, 1936.) 31s. 6d.

In September last year, the Institute of Metals held its autumn meeting in Paris, and this volume includes the sixteen papers presented on that occasion, together with the Autumn Lecture on "The Scientific Organisation of Works" by Prof. Pierre Chevenard, scientific director of the Société de Commentry,

Fourchambault et Decazeville. This lecture is a remarkable and convincing account of the successful application of scientific methods throughout a large industrial concern.

A considerable proportion of the papers published in this volume deal with the alloys of aluminium. M. Gauthier describes the effect on the conductivity of super-purity aluminium of additions of those elements which may occur as impurities in commercial aluminium; Mr. N. D. Pullen presents an account of a new treatment for the production of reflecting surfaces on aluminium, while Prof. Portevin and Dr. Bastien treat the property of forgeability in a fundamental manner.

A lengthy paper by Atkinson and Raper provides up-to-date metallurgical information on the six metals of the platinum group, while Northcott discusses veining and sub-boundary structures in metals. Other papers deal with the creep of tin and tin alloys, fluxes for use in soldering, and the constitution of the alloys of cadmium and tin and of indium and lead.

Statistical Year Book, 1937, of the International Tin Research and Development Council

Pp. 206. (London: International Tin Research and Development Council, 1937.) 6s.

THE International Tin Research and Development Council has carried out a useful task in issuing a comprehensive statistical year book, which deals not only with production and trade but also with the varied aspects of consumption. The use of tin in the automobile industry on one hand (8 per cent of the total world consumption) and in the canning industry on the other (50 per cent of the total) are indications of the widespread importance of this key metal. In spite of this, the production is very localized and about 85 per cent of the output comes now under the control scheme. Of the total world output in 1936 of 179,600 long tons, Malaya produced 66,806; the Netherlands East Indies 31,546; Siam 12,678; Bolivia 24,074; Nigeria 9,529 and China 10,664 tons. The greatest consumer, the United States, had a home production (including Alaska) of 87 tons, and the great European users have similar, tiny supplies only.

L. D. S.

The Technology of Aluminium and its Light Alloys

By Prof. Dr. Alfred von Zeerleder. Translated from the second German edition into English by A. J. Field. Pp. x+301. (Amsterdam: Nordman Publishing Co.; London: Crosby Lockwood and Son, Ltd., 1936.) 21s. net.

THE original German edition of this book was published in 1934, and a second edition was found necessary in less than twelve months. From this second edition Mr. Field has prepared the present translation, and has also brought the text rather more up to date. The book gives in condensed form the essentials of the working of aluminium and its alloys, the object being to bring home the merit and possibilities of aluminium to a wide circle of user and potential users. This purpose it fulfils admirably.

Greenland Culture. (2) The Eskimo*

THREE reports issued recently by the Commission for Scientific Research in Greenland deal with the culture of the Eskimo in East Greenland.

(1) *Kangerdlugssuak District*. An expedition of the Scoresby Sound Committee, of which Einar Eikkelsen was in charge and Magnus Degerbøl responsible for the archaeological investigation, examined the coast from Cape Dalton to Kangerdlugssuak, an area of great interest, as it is situated between the Angmagssalik Settlement in the south and the former Eskimo area of settlement in north-eastern Greenland from Scoresby Sound northwards. Before 1932, this region had been traversed only by the Amdrup expedition of 1900, which found a number of deserted Eskimo habitations, graves, tent-rings, etc., at the mouth of Kangerdlugssuak, but no remains from Kangerdlugssuak to Scoresby Sound, nor north of Cape Dalton to Dunholm, where, however, Eskimo remains existed. The present expedition confirmed this result, and it was only at Miki's Fjord, a few kilometres east of Kangerdlugssuak, that it was possible to prove former habitation. An inference that Irringer's Fjord was once the site of a habitation has later (1935) been proved to be correct.

Miki's Fjord is well suited to habitation. Here a ridge runs north-south, with terraces sloping to the south. A firm rocky ledge affords room for movement and building, with easy access to the sea. The only drawback is an absence of fresh water. On this terrace were five sets of house ruins, at different levels, the lowest being the largest and best preserved, though there is reason to believe that the smaller were parts only of houses originally larger. All the houses, with one exception of indeterminate shape, were rectangular. The objects found in the houses were essentially of the same culture period, and belong to the Inugsuk culture. The number of skeletal remains found in the house, together with the secondarily formed small houses, suggests that the population did not emigrate, but perished in their homes, possibly from malnutrition due to a lack of vegetable food. Animal food was evidently plentiful.

A woman's grave found on a small headland is one of the largest grave finds in Greenland, and contains several objects not known from other finds. An entirely new element, not previously known in Eskimo culture, is eighty-four beads, small white circular disks of mussel shell, while a needle case containing two needles of walrus ivory is the first example of a bone sewing needle from Greenland. An explanation put forward by Th. Mathiasen of the distinctive character of certain of the cultural objects is that the length of occupation gave rise to independent development.

The character of the remains and deposits shows that the occupation was one of considerable length. Immigration probably took place at the end of the fifteenth, or beginning of the sixteenth, century; and occupation, it is thought, may have lasted until so late as the eighteenth century.

(2) *Frederik VI's Coast*. An expedition in 1931-33, of which Knud Rasmussen was leader, made a study of former Eskimo settlements on this coast between Prince Christian Sound on the south and Ikarsuaq, the boundary of the Angmagssalik district, on the north, with the purpose of determining the number and character of the Eskimo settlements which were known to exist, but of which exact information was lacking. As many settlements as possible were inspected, and a few excavations were made. From all sources, including those already in print, as well as from information received, three hundred and eighty-two settlements were recorded in eleven regions. In 1931 Erik Holtved excavated eleven house sites, producing seventy-two artefacts, and in 1932 Th. Mathiasen excavated twenty-one ruins, producing 526 specimens.

The house types fall into the following categories: (1) small, rounded, and much overgrown and flattened-out houses; (2) small, four-sided, partly flattened-out houses; (3) large, four-sided, partly overgrown houses; (4) houses known to have been inhabited in the nineteenth and twentieth centuries.

The most important site investigated was Ruinneset on Skjoldunge Fjord. Here Knud Rasmussen discovered a great house complex. From this site alone 329 specimens were obtained.

In regard to the character and succession of cultures, it would appear that the earliest house ruins on this coast are probably contemporaneous with the earliest houses in Angmagssalik, and belong to the end of the fourteenth, or beginning of the fifteenth, centuries. They are small, round,

* The Scoresby Sound Committee's 2nd East Greenland Expedition in 1933 to King Christian IX's Land—The Former Eskimo Habitation in the Kangerdlugssuak District, East Greenland. By Magnus Degerbøl. (Meddelelser om Grønland, Bind 104, Nr. 10.) Pp. 48+1 plate. 2.50 kr.

6 og 7 Thule-Expedition til Sydøstgrønland 1931-33—The Former Eskimo Settlements on Frederik VI's Coast. By Thorkel Mathiasen. (Meddelelser om Grønland, Bind 109, Nr. 2.) Pp. 68. 2.50 kr.

The Eskimo Archaeology of Julianehaab District, with a Brief Summary of the Prehistory of the Greenlanders. By Thorkel Mathiasen. In collaboration with Erik Holtved. (Meddelelser om Grønland, Bind 118, Nr. 1.) Pp. 141+4 plates. 7.00 kr. (København: C. A. Reitzels Forlag, 1936.)

The first article appeared in NATURE of July 10, p. 52.

and dug down into the ground, with poorly built walls, paved floors, sunk passages and often a cooking extension. Sometimes two or three are built together, forming a clover-leaf shaped complex. Their culture shows evidence of some whaling. There are no glass beads. The culture is of the same type as the Angmagssalik, and belongs to the Inugsuk culture.

The seventeenth-eighteenth century house, of which sixty small, and seventy-seven large, were seen, is distinctly four-sided. At first small; later, in the eighteenth century, it becomes the large common house, which seems to have been introduced by a migration from the west coast, reaching as far as Angmagssalik. Houses of this type were seen at fifty-one settlements. The culture is particularly well displayed in the finds from Ruinasset. It is derived from the contemporary South-west Greenland culture, but with a special south-east coast stamp. This find is given a special character by the many drilled seal jaws.

Fifty-six houses on this coast are known to have been inhabited in the nineteenth century, or later. Records of this period were made on the voyage by W. A. Graah in 1829-30, when 536 Greenlanders lived here in summer. The movement to the west coast had already begun, the last southeasters moving to the southern part of the west coast in 1900. At the present time, it is visited occasionally only for sealing.

(3) *Julianehaab District*. In the course of an expedition sent out by the Commission in 1934 a comprehensive survey was made of the Julianehaab district, the most southerly part of Greenland's west coast, and its most fertile and thickly populated area. It forms a connecting link between East and West Greenland, and was the site of the principal Norse settlement. The main interest of the expedition was the investigation of early Eskimo settlement, of which very little systematic knowledge was previously available.

• It is now known that there are two hundred and forty-six places in the district where there have been Eskimo winter settlements. Of these, one hundred and thirty were visited. Excavation was possible on four sites only. Here fifty-six house ruins, four hundred square metres of midden, and twenty-three graves were examined, producing 1,808 specimens and fifty-seven skeletons. The house types are an early group of round or rounded small houses, sometimes two or three built together with a common passage; two types of the seventeenth-eighteenth century, distinctive, rectangular with a high stone wall and a sunken passage at right angles to the house, large; but the later type small; and fourthly, the nineteenth century house, small, rectangular, with high stone and turf walls and a passage in prolongation of the

longitudinal axis, often with a bend and not sunken, and with a kitchen or storehouse as an offset in the angle. This last is the type now in use, though it is being displaced by wooden houses.

The conditions for the preservation of cultural objects in the Julianehaab district are adverse in the extreme, owing to the succession of frost and thaw and the percolation of water. As a result of this, most of the ruins contained no bones or wood.

In the houses of the earliest type, most of the objects are of the kind known from other sites in Greenland and belonging to the Inugsuk culture. Among the most interesting and important were the lamps, which by their varying form afford a guide to chronology. Those with wick-ledge or knobs are a characteristic type of the culture. A number of objects of Norse origin probably represent spoil from the houses of the Norse settlement, which were deserted when the settlement decayed soon after the first appearance of the Eskimo in 1379. The earliest Eskimo culture of the District may be dated as lying within the period 1350-1650. Early settlement was invariably, so far as observed, half-way up the fjords, the situation most favourable for ice hunting. The principal quarry, as shown by the bones from the sites, was the seal, but the caribou and the whale were of importance.

The finds of cultural objects from the seventeenth-eighteenth century houses do not differ essentially from finds from other parts of Greenland. Glass beads were found in most of the ruins, but in no great numbers. The principal varieties are the large opalescent, the large faceted—blue, yellow and colourless—a large black, a large rather flat dark blue, and a cylindrical bead, red with white longitudinal stripes. Although the culture as a whole compares with that of West Greenland, it has in its harpoon-heads, arrow-heads and lamps an older stamp, as indicative of an out-of-the-way situation. The same old-fashioned types are recognizable at Angmagssalik, the similarity appearing in a relatively large number of objects, such as salmon spear, fish hooks, pendants, etc. The animal bones show that sealing had been the principal occupation; but the inhabitants also hunted whales, caribou, white-whales, bears, foxes and fowl. In certain periods there have been many fish, especially cod. There is also a surprisingly large number of dog bones, but no proof of sledge traction.

The development of the kayak, and the consequent increased utilization of sea locomotion for hunting and fishing, led to a diffusion of settlement, the number of small settlements increasing markedly. In the following period of the nineteenth and twentieth centuries, however, the number of

small settlements declined, and large settlements again prevailed, in order that the population might be near the centres of commerce and industry, which grew up with European settlement. The introduction of wooden houses put a further check on the nomadic habits of the people.

The mummy caves at Querrortut were also investigated. Though much disordered by a previous party of archaeological investigation, remains of desiccated bodies were found, which may be attributed to interment and not to incarceration and death from starvation. The occurrence of grave goods points to the pagan period, and tentatively a sixteenth century date is assigned.

Summarizing his survey of prehistoric Eskimo culture in Greenland, Dr. Mathiasen reconstructs their ethnic history by attributing to them an origin in arctic Canada, whence they came about a thousand years ago, with whale-bone houses and the Thule culture, to settle in the Cape York District. Thence they passed southward over Melville Bay to northern West Greenland, where they remained for several hundred years, encountering the Norsemen travelling northward, and changing the Thule culture into the Inugsuk

culture. In the fourteenth century the growth of population forced them to seek new hunting fields. South Greenland was populated in the course of this century, the Norsemen being overrun. A group of Eskimo wandered around Cape Farewell to the east coast and far to the north along the coast. In the seventeenth century Polar Eskimo migrated north about Greenland and mixed with north-east Greenland's early population. Shortly afterwards, West Greenlanders reached Angmagssalik, while a small remnant of survivors from the first immigration to the east coast at Kangerdlugssuaq died out, as also did the inhabitants of north-east Greenland. In West Greenland, however, the population grew rapidly, helped by Danish settlement; while at Cape York there was still a remnant of the old Thule Eskimo, helped by a new immigration from Baffinland.

On the general Eskimo problem, Dr. Mathiasen expresses the opinion that it cannot be solved in Greenland. He is, however, unable to accept K. Birket-Smith's Caribou Eskimo theory, which makes Eskimo culture a link in a circumpolar inland culture, first created in the central parts of arctic Canada. The Thule culture points to Alaska and possibly Siberia.

The Halle Academy, 1652-1937

THE Kaiserlich Deutsche Akademie der Naturforscher at Halle has recently celebrated the two hundred and fiftieth anniversary of the granting of its charter. In 1652, soon after the end of the Thirty Years' War, there was founded by four physicians, in the Reichsstadt of Schweinfurth, a scientific society under the name of *Academia Naturae Curiosorum*. The principal founder and first president, Johann Lorenz Bausch, had studied in Italy and become acquainted with the local academies of that day, and especially with the Lynceorum Academia, now Accademia Reale dei Lincei; he was also influenced by the writings of Bacon of Verulam. In 1677 the Emperor Leopold I recognized the society as the Academy of the Holy Roman Empire, and ten years later the same prince bestowed upon it considerable privileges and the title of *Sacri Romani Imperii Academia Cæsareo-Leopoldina Naturæ Curiosorum*. Arms were granted, with the motto: "Nunquam otiosus"; the president and the editor of the ephemerides received golden chains of office; they and their successors became counts palatine of the Holy Roman Empire; as such they could legitimize bastards, confirm the liberation of

slaves and perform other legal functions. They could, moreover, confer the titles of doctor, licentiate, master and bachelor, in the faculties of medicine, philosophy and laws; they could even appoint poets laureate. The doctorates so conferred were to secure the same privileges as those given by the universities. The publications of the Academy were exempted from censorship and protected as to copyright.

The Academy has survived the Empire from which its privileges were derived; these privileges were never abolished, but their exercise fell into abeyance. So did the curious custom, recognized in the imperial charter of 1687, of giving 'symbolic' names to its members; thus the first president was known as Jason I, his successor as Argonauta I. Meetings also fell into abeyance, and the activities of the Academy became restricted to the publication of a scientific periodical and to the administration of its library and museum. The location of the latter at first changed with that of the president, until the Academy became definitely established at Halle. Its natural history collections have been dispersed, but its library remains rich in valuable periodicals, of which a recently

published catalogue enumerates some 3,650 items ("Verzeichnis der periodischen Schriften der Bibliothek der Kaiserlich Leopoldinisch-Carolinisch Deutschen Akademie der Naturforscher, Halle (Saale)", 1937). The most important work of the Leopoldine Academy has been the publication of a journal, *Miscellanea curiosa medico-physica Academiae naturae curiosorum sive Ephemerides Germanicae*, started in 1670 and probably the oldest scientific periodical. In the eighteenth century this valuable journal changed its name to *Acta physico-medica* and then to *Nova acta*; in 1932 a new series, *Nova Acta Leopoldina*, was started.

Various scientific funds have been lost as the result of economic upheaval, but a bequest by Christian Andreas Cothenius, the physician of Frederick the Great, is still operative; in accordance with it, a medal is from time to time awarded for scientific research. A second medal and a research fund was more recently instituted in memory of Auguste Henri Forel, the biologist and sociologist.

It will be seen from the above account that in modern times the Casareo-Leopoldina has received no official protection, nor been subject to governmental control. It is one of the oldest of scientific societies; the Royal Society has indeed the older charter, the Lincei Academy the longer history, albeit not so continuous. The present year is the two hundred and fiftieth after the granting of privileges by Leopold I, and this anniversary was celebrated at Halle on May 28-30. The commemoration was attended by representatives of numerous universities, academies and societies, both German and foreign, who were welcomed in the aula of the University by Prof. E. Abder-

halden, the president of the Academy, who has done much to stimulate its activities. His opening address, a historical retrospect, was followed by official congratulations from the rector of the University and the mayor of the city. Then came brief speeches on behalf of the Royal Society of London, the Accademia delle Scienze of Bologna, the Accademia dei Lincei of Rome, the Académie of Vienna, Amsterdam, Copenhagen, Tokyo, the American Academy of Arts and Sciences, at Boston, the Kartell of the German Academies (Berlin, Göttingen, Munich, Leipzig, Heidelberg), etc. It was announced that a sum of 44,000 marks has been collected from numerous donors, to be used henceforth as a research fund.

A very noteworthy lecture was then delivered by Prof. Hans Spemann, of Freiburg, on his recent researches concerning the nature of animal development. Finally, the Cothenius medal, referred to above, was awarded to Profs. Dante de Blas (Rome), Ostertag (Tübingen), Franz Volhard (Frankfurt), G. Barger (Edinburgh), Max le Blanc (Leipzig), Armin Tschermak-Seysenegg (Prague) and Eugen Fischer (Berlin). In the evening there was a banquet with a few speeches. Next day further lectures were given; there was an admirable performance of an operetta in the municipal theatre, and a pleasantly informal reception by the Oberbürgermeister; the third day, Sunday, was devoted to an excursion in the country.

In connexion with this very successful celebration, there have been printed the above-quoted catalogue of periodicals in the Academy's library and a well-illustrated *Festgabe* containing three historical essays and Prof. Spemann's lecture.

International Agreement for the Regulation of Whaling

THE International Agreement for the Regulation of Whaling, which was published on June 23, marks an important stage in the development of whaling regulation. It was the work of a conference at which eleven Governments interested in whaling participated. They met on May 24, and sat almost daily until June 8, when the Agreement was signed. The drastic nature of its provisions are eloquent of the practically world-wide conviction that whaling can be saved from collapse only if it is rationally regulated: while a note under the title "Final Act", which is appended to the Agreement, indicates that the possibility is recognized that actual restriction of

whaling effort may prove necessary if that end is to be achieved.

In the early stages of modern antarctic whaling, the scale on which destruction of the whale stock was wrought made the need of regulation apparent. The Falkland Islands Government, which controlled practically all antarctic land stations, gradually built up a system of regulations and—a feature not yet attempted for whaling as a whole, restriction of the number of whaling vessels—which, while provisional in character owing to lack of information, may be said to have proved adequate until the late 'twenties, when the building of ships capable of working up the whales

in the high seas took the main body of whaling into international waters. The Norwegian Whaling Law of 1929 imposed on Norwegian whaling the provisions of the Falklands regulations except imitation, and added the power to prohibit Norwegian whaling in tropical and subtropical waters.

The Geneva Convention of 1931 followed the lines of the Norwegian law, though without provision for closing areas to whaling. This convention expressed the maximum to which at the time general agreement could be secured. It was recognized that whaling, being mainly outside territorial waters, could be dealt with only by common action, and the inauguration of international treatment was the first object to be attained. The majority of whaling countries adhered to it, and put its provisions into force by legislation which, with the increase of knowledge, tended to go farther and to be more definite than the convention it implemented. Limitation of production was effected by agreements within the industry in several recent seasons: but from various causes these agreements became increasingly difficult to reach, and the International Conference accordingly became necessary.

Space will not permit of any detailed account of the measures taken so far, but it will be useful to summarize the position in the antarctic when the Conference opened, among the countries adhering to the Convention. Only baleen (whalebone) whales were dealt with. Among these Right whales (*Balaena glacialis*), the numbers of which had been reduced almost to disappearance, were protected completely. Protection of other species was partial. It was illegal to kill immature whales, or cow whales with calves, and lengths were laid down below which for the purposes of the regulation Blue (*Balaenoptera musculus*) and Fin (*B. physalus*) whales were to be considered immature. The number of whales killed to afford a given quantity of oil was kept as low as possible by requiring the utmost practicable utilization of each carcass. The pay of gunners had not to depend merely on the number of whales shot. Full records had to be kept of the whales killed and the oil produced. Other provisions, such as the partial protection of the Humpback (*Megaptera nodosa*) in the Falkland Islands Dependencies, were to be found in certain cases.

The agreement now reached affords complete protection to the Grey whale, *Rhachianectes glaucus*, as well as to all Right whales. The lengths below which Blue and Fin whales may not be taken is advanced from 60 ft. to 70 ft. and from 50 ft. to 55 ft. respectively. The mean size of these species in the antarctic at first maturity was determined in the "Discovery" Investigations as

74 ft. 2 in. for male and 77 ft. 9 in. for female Blue whales, and 63 ft. 8 in. for male and 65 ft. 7 in. for female Fin whales. The new limit is thus a marked approach towards the actual mean size at maturity. For the first time, minimal size limits were laid down also for Humpback and Sperm whales (*Physeter catodon*); namely, 35 ft. in each case, this length having a similar relation to the size at first maturity of Humpback and male Sperm whales, according to the best available information and protecting female Sperm whales. Those familiar with the sizes of the whales taken in commercial operations will realize the large body of whales these limits will preserve to reproductive size. It may be noted also that the limits will apply to shore stations.

The seasons for whaling are restricted. Antarctic whaling, that is, whaling south of 40° S., will take place only from December 8 until March 7, though there is a short extension for next season only; and no shore station may operate for more than six months in the year.

Lastly, pelagic whaling is prohibited over enormous tracts of sea. The whole Atlantic and Indian Oceans north of lat. 40° S. are closed to it, as is an extensive equatorial belt of the Pacific. The objects of this provision are the protection of calving grounds and the prevention of the destruction of whales when in their least productive condition. It may be possible in the light of further information more narrowly to define these areas, but their present extent guarantees a valuable protection.

The requirements of furnishing statistics and the regulations as to the payment of gunners are as in the previous practice of Norway and Great Britain.

The Agreement is for the coming season only, but there is provision for its year-to-year extension. It has been signed for the Union of South Africa, the United States of America, the Commonwealth of Australia, Germany, the United Kingdom of Great Britain and Northern Ireland and the Dominions, etc., the Irish Free State, New Zealand and Norway. It is to be hoped that other States will adhere to the Agreement: in particular, the adhesion of Japan would make its operation almost world-wide. The "Final Act," appended to the Agreement shows that the possible desirability of changes and extensions of its terms is fully recognized, and it is recommended indeed that next year, after the experience of a season's working, another conference should be convened to consider the Agreement in these respects. A very welcome recommendation is that Governments should take powers to regulate the methods of killing whales. There is reason to think that this would be in the interests of both economic working and humanitarianism.

J. O. B.

Obituary Notices

The Marchese Marconi

THE death of the Marchese Marconi from heart failure on July 20 deprives us of one who had taken the leading part in the development of world-wide communication. It is difficult to exaggerate the importance of his discoveries and the great effects they will have on the future history of the world. For communication purposes, he took the lead in helping to abolish space; and it is to be hoped that this, in the course of time, may result in the abolition of differences in language and even limitations of race. When sound and television are perfected in broadcasting, the outcome of early experiments in radio, life will surely be made easier for the masses, and Marconi's name will be kept green for hastening the advent of this blessing to humanity.

The early history of a great inventor is instructive; and luckily we have many accounts of Marconi's early life. One of the most interesting is the book by R. N. Vyvyan, formerly engineer-in-chief to Marconi's, entitled "Wireless over Thirty Years". For many years, Vyvyan was in close personal touch with Marconi and took a leading part in the great transatlantic transmission experiments.

Guglielmo Marconi was born in Bologna on April 25, 1874, his father being an Italian country gentleman and his mother the daughter of Mr. Andrew Jamieson, of Daphne Castle, County Wexford, Ireland. He was the younger of two brothers and was privately educated at Bologna, Florence and Leghorn. He attended Prof. Rosa's lectures on physics and studied the works of Prof. Righi. He was familiar with researches that had been made on Hertzian waves. While still a student, he was firmly convinced that just as flashes of light can be used to send signals by means of a heliograph, so, in an analogous way, electric waves could be used for signalling.

Marconi's earliest experiments were made in 1894 before he was twenty-one years of age. He used an induction coil as a Hertz emitter, and, at first, used a ball discharger of the type designed by Righi. It consisted of four brass balls separated by small gaps, immersed in 'Vaseline' oil. He connected one terminal of the secondary of the induction coil to a metal cylinder elevated to the top of a pole, and the other to a metal plate laid in the ground. He thus produced an elevated aerial which discharged across the spark gap to earth. At the receiving end he erected a similar capacity at the top of a pole and connected it to earth through a Branly coherer. He improved the design of this coherer, making it much more sensitive than anything previously made. In 1895 he employed metal cubes, the length of an edge being one foot. With this apparatus he was successful in receiving signals up to a distance of thirty metres. Doubling the height of the poles to four metres, he found that he could transmit to a hundred metres

and quadrupling the height to eight metres, he transmitted to a distance of four hundred metres. He next increased the cubes so that their edges were about 3 ft. 3 in. in length. With this new aerial he was able to record Morse signals up to distances of about one and a half miles. He also tried the effect of concentrating the waves by means of large metal parabolic reflectors. This experiment was the forerunner of the beam aeriels which came into use in later days when short electric waves were proved to be practicable.

In 1896, Marconi came to England and took out a patent, the first ever given for radio-telegraphy. In July of that year, Mr. Campbell Swinton introduced Marconi to Sir William Preece, the engineer-in-chief of the British Post Office. Sir William gave him every facility to carry out his experiments and with the help of the Post Office engineers, his system was successfully operated between the General Post Office and the Thames Embankment. The attention of the general public to the importance of Marconi's experiments was first attracted by the experiments carried out on Salisbury Plain, where reception over a distance of eight miles was demonstrated in the presence of officials of the Navy, Army and Post Office. In June 1897, Sir William Preece, in a lecture to the Royal Institution on "Signalling through Space without Wires", said that "Marconi had produced from known means a new electric eye, more delicate than any known instrument, and a new system of telegraphy which will reach places hitherto inaccessible". He also said that for shipping and lighthouse purposes it was a great and valuable acquisition.

In 1897, 'The Wireless Telegraph and Signal Company, Ltd.' was formed to acquire Marconi's patents. Three years later, the name was changed to 'Marconi's Wireless Telegraph Co. Ltd.' Marconi's next step was to erect a station at Alum Bay and another in Bournemouth. For this communication system he elevated his aeriels to a height of about 120 feet and used a ten-inch spark induction coil. The Isle of Wight station was inspected by Lord Tennyson and Lord Kelvin, the latter paying for two radio messages. One of these, dated June 8, 1898, was to Sir William Preece at the G.P.O., London, and the other to Sir George Stokes.

In 1898, Prof. Slaby, of the Technical High School, at Charlottenburg, wrote an article on the 'new telegraphy' in the *Century* magazine. He pointed out that by a simple, but extraordinarily effective, method Marconi had raised the power of radiation a hundredfold. In collaboration with Count Arco, Prof. Slaby developed the Slaby-Arco system, but the German national wireless system—known as the Telefunken System—was not founded until 1903.

In May 1898, at the request of Lloyds' Corporation, apparatus was installed at Ballycastle and Rathlin Island in the north of Ireland. Uninterrupted

communication was obtained, the lighthouse keepers quickly learning how to use the apparatus. About this period, Marconi greatly increased the range of transmission by inserting the primary winding of a small air core transformer in the aerial, the secondary windings being split by a condenser, the outer ends being brought to the terminals of the coherer. These transformers were called 'jiggers', and their efficiency encouraged Marconi to attempt to communicate across the Channel. The French Government gave permission to erect a mast at Wimereux. A corresponding mast was erected at the South Foreland Lighthouse and Marconi successfully transmitted messages on March 27, 1899. The Wireless Co. had established their works at Chelmsford and had erected a mast 150 feet high. Communication was affected between this station and Wimereux—a distance of 85 miles.

In the year 1900, the technical staff that the Wireless Co. had collected numbered only seventeen. Among them were Eccles, Erskine Murray and Andrew Gray, who was afterwards manager. In 1899, Prof. (now Sir Ambrose) Fleming had been appointed scientific adviser to the Company. The rapid increase in the range of radio communications had convinced Marconi that the curvature of the earth presented no obstacle to the extension of radio communication, and he decided to attempt to telegraph by his system across the Atlantic. In consultation with Fleming it was decided that the station for the transatlantic experiments should be built on the west coast of Cornwall. The site chosen was at Poldhu, on the west coast of the Lizard. In 1900, Marconi obtained his very important patent for 'tuned or syntonie telegraphy'. He used this method in his attempts to send signals across the Atlantic. He erected a station similar to Poldhu at Cape Cod in Mass., U.S.A. Unfortunately, the masts and aerial at Poldhu were wrecked by a storm, and a similar mishap at Cape Cod threatened to delay seriously the experiments. To save time when the Poldhu station was restored he went to Newfoundland and used a balloon to support his aerial. But as this was blown away, he used a kite as the support which, with great difficulty owing to a storm, was kept at a height of about 400 feet. He cabled to Poldhu to begin the pre-arranged programme, consisting of sending the Morse letter S (3 dots in succession) from 3 p.m. to 6 p.m. each day. On December 12, 1901, both he and his assistant repeatedly heard in their telephone the three clicks which proved that the electric waves had traversed the 1,800 miles separating St. John's from Poldhu.

In 1902, the site of a power station was chosen at Glace Bay in Canada, and when completed Marconi left England for Canada in an Italian cruiser, arriving on October 31, 1902. During the whole voyage he was receiving from Poldhu in the night time, but in the daytime he heard nothing after the distance was greater than 500 miles. When transmission was started, the early results were very disappointing. Later on, a site for a new station was found at Clifden, Ireland, and aerials were erected on a new principle Marconi had discovered. The Glace Bay

and Clifden stations were opened for unlimited public service in February 1908. During the Irish rebellion, the Clifden Station was put out of action and a new station at Caernarvon in Wales was used instead.

Prior to 1916 it was generally accepted that for long-distance transmission long waves were essential. But in 1916 Marconi began his wonderful experiments on short-wave transmission, the wave-lengths being only about a hundredth of those usually employed. Erecting a small transmitting station at Poldhu, and fitting a receiver to his yacht *Eletra*, he found in 1923 that with a wave-length of 92 metres excellent reception could be obtained up to about 1,200 miles. The outcome of his work was that the Government accepted the Marconi Company's proposals to use the short-wave beam system for Imperial communications and started building stations capable of working with Canada, South Africa, India and Australia. Later on, in 1931, Marconi turned his attention to the systematic investigation of waves only about one metre in length. Using these waves, a transmission system was put into successful operation between the Vatican City and the papal palace at Castel Gaudolfo.

To the end of his life Marconi retained the vigour of youth. His love for experimenting never waned, and he infected his colleagues with his enthusiasm. He worked hard and was very successful in applying his theories.

Marconi married in 1905 the Hon. Beatrice O'Brien, daughter of Lord Inchiquin, who had been lady-in-waiting to the Queen of Italy. The marriage was dissolved by decree granted at Fiume in 1924. In 1927 he married the Countess Beasi-Scali of Rome. He had one son and two daughters by his first wife and one daughter by his second.

During his lifetime Marconi's achievements brought him many of the highest honours which nations can bestow. His name is a household word all over the world. The patience and equanimity with which he bore the disappointing results obtained by many of his early laborious experiments will be for all time an encouragement to young engineering physicists.

Dr. H. H. Jeffcott

HENRY HOMAN JEFFCOTT, who died on June 29, was born in Co. Donegal in the year 1877. In 1895 he entered Trinity College, Dublin, from the High School, Dublin, and had a very distinguished career there. In 1897 he obtained a senior exhibition at the final freshman examination, and in 1898 he was first mathematical scholar. In 1899 he graduated with a senior moderatorship in experimental science and a junior moderatorship in mathematics and a moderatorship prize. He spent the next year in London, and in 1900 returned to Trinity College and entered the Engineering School, where he obtained his engineering degree in 1902 with honours in all subjects. In the same year he won the McCullagh Prize for a treatise on the theory of elasticity.

Jeffcott spent the next few years in the shops of Armstrong Whitworth and Co., Ltd., and as assistant

engineer with Siemens Brothers, and in 1905 went to the National Physical Laboratory and there became head of the Metrology Department. In 1910 he returned to Dublin as professor of engineering in the Royal College of Science for Ireland. In 1914 he became Dean of the College. During the Great War years his department was organized most successfully for the manufacture of munitions. In 1922 he received the degree of doctor of science of the University of Dublin. From 1918 until 1921 he was secretary to the Water Power Resources of Ireland Sub-Committee and took an active part in collaboration with Sir John P. Griffith, past president of the Institution of Civil Engineers, in the preparation of a scheme for the development of the water-power of the River Liffey. This scheme, though put on one side while the power resources of the Shannon were being developed, is now beginning to take practical shape under the aegis of the Electricity Supply Board.

In 1922 Jeffcott left Dublin for London on his appointment as secretary to the Institution of Civil Engineers, which position he filled until his death. His charming manner endeared him alike to his staff and the members of the Institution. He was very approachable and welcomed members who called on him, especially those home from abroad. His business ability and tact combined to bring to a successful conclusion many important negotiations with Government departments and public authorities. The recent reorganization of the Institution's activities brought much work to Dr. Jeffcott which the state of his health made very onerous. His early death, on June 29 at the age of sixty years, will prove a severe loss to the Institution and an irreparable one to those who had the good fortune to be his friends.

Though of exceptionally fine physique—Jeffcott was well over six feet in height and broad in proportion—he never took an active part in the athletic life of his college, though he thoroughly enjoyed a good game of tennis.

Jeffcott achieved considerable success as an inventor, being best known in this connexion through the Jeffcott direct-reading tachometer. He was the author of papers on the vibrations of loaded shafts published in the *Proceedings of the Royal Society* and *Philosophical Magazine*, and of papers on water resources and other engineering subjects.

Miss Dorothy Sladden

By the tragic death of Miss Sladden in consequence of a motor accident on Saturday, June 20, a severe blow was struck at the science of experimental zoology. Miss Sladden was one of those rare people on whom Nature has bestowed an inborn love of animals and a marvellous skill amounting to genius in keeping them in good health and in inducing them to breed. She had not had a university education, but she was taken to the Imperial College by her parents as an occasional student, because they saw no other outlet for her peculiar abilities which had manifested themselves since she was quite a young girl.

After passing through the regular undergraduate course, at my suggestion Miss Sladden took up the question of the heritability of acquired habit and carried out with indomitable perseverance a series of experiments on this subject which extended over five years. She showed that the stick-insect (*Carausius morosus*) which is a native of southern India but which has been imported into Great Britain and is readily obtainable from dealers, could be induced by a series of periods of semi-starvation to accept a food (ivy) which was at first repugnant to it, and that the offspring of such insects accepted ivy more readily than did their parents, so that after five or six generations, 100 per cent of the insects accepted ivy at the first opportunity. In this species, males occur only at long intervals and the ordinary female is parthenogenetic, so that the complications involved in crossing different stocks are completely avoided. Two of her papers on this subject had already been published by the Royal Society, and a third in which she dealt successfully with objections which had been made to her first two papers, was nearly ready when a cruel fate snatched her away. Fortunately, this paper will be completed by our mutual friend, Mr. H. R. Hewer, who assisted and advised her in statistical matters.

It may be justly said that Miss Sladden has demonstrated beyond reasonable doubt that functional inheritance is a reality; and this is the cardinal question in zoology, indeed in all biology. Once this conviction has gone home, the whole course of evolution becomes clear and doctrines like the recapitulatory theory of evolution which have been fiercely fought over, follow as a matter of course. That functional inheritance must be true is a conclusion which had already been accepted by leading paleontologists and systematists in the British and other great museums, but the distaste for it felt by a certain modern school of biologists is so great that they refused to accept any but direct experimental evidence in its favour. This has now been provided by Miss Sladden, and it is a feat which will make her name live in the annals of zoology.

E. W. MACBRIDE.

We regret to announce the following deaths:

Prof. E. B. Elliott, F.R.S., emeritus professor of pure mathematics in the University of Oxford, on July 21, aged eighty-six years.

Prof. W. T. Mather, professor of physics in the University of Texas, on June 14, aged seventy-two years.

Major Paul Murphy, formerly director of experiments, Chemical Warfare Station, Porton, on July 14.

Prof. S. C. B. Pennington, emeritus professor of agriculture in the University of Reading, on July 19, aged sixty-eight years.

Sir Charles E. Saunders, formerly Dominion cerealist, known for his work on the breeding of wheat in Canada, on July 25, aged seventy years.

Prof. Johannes Walther, emeritus professor of geology and palaeontology in the University of Halle, on May 8, aged seventy-seven years.

News and Views

Sir Denison Ross, C.I.E.

THE retirement of Sir E. Denison Ross from the office of director of the School of Oriental Studies in the University of London, which he has held since the establishment of the School in 1916, has evoked numerous tributes of appreciation of his work as scholar and administrator, as well as of personal regard, which culminated at the dinner at which he was entertained as guest of honour on July 26. The fact that seven thousand students have passed through the School in the twenty-one years of its existence is sufficiently impressive, when it is remembered that before it came into being there were virtually no facilities for oriental studies in London; but these figures give only a very imperfect idea of the importance of the School as an Imperial asset. By adding Africa and its languages to the Orient in the stricter sense of the term, the School not only covers a broader field of scholarship than any other single institution of its kind, but it has also become a much valued, and indeed an essential agency in the training of officials, missionaries and others, whose life-work is, or will be, among the less advanced races of the Empire. This breadth of outlook and sense of public responsibility in the orientation of academic studies is largely due to the qualities and experience which Sir Denison Ross brought to the task of organising and developing the work of the School. After a grounding in the study of oriental languages at Paris and Strasbourg, he travelled extensively in the Near, Middle and Far East, and acquired a knowledge of Asiatic languages and cultures no less extensive. This may be seen in his published works, which range from critical works of scholarship to appreciations of art and literature. Perhaps not the least scientifically interesting is a polyglot list of birds in Turki, Manchu and Chinese. No less important, however, than his gift of tongues was his educational and administrative experience during his thirteen years in Calcutta, which had proved and strengthened his ability to arouse enthusiasm for Oriental scholarship in others.

Prof. C. G. Cullis

At the end of last year, Prof. C. G. Cullis retired from the chair of mining geology which he had held at the Imperial College of Science and Technology, London, since 1930. He became a student demonstrator in the Geological Department of the College so long ago as 1890, and was thus a member of the staff for nearly half a century, having been professor of mineralogy before he was appointed to the chair of mining geology. Prof. Cullis's former colleagues and students, many of whom are scattered over all parts of the world, recently assembled at the College to present an album to him containing their signatures, and to record their appreciation of his work and influence. In this tribute the subscribers say:

"Generations of students will ever remember Professor Cullis as the ideal university lecturer. To few is given the skill to expound with such grace and effect the great truths of geology. We know the labour that is necessary for the attainment of apparent ease and simplicity: and here we see an apt example of *ars est celare artem*. But not only as a teacher will his students remember him: as a wise friend and mentor he was always accessible, and expert alike in directing their studies and in helping them to find their feet in the great world outside the College." In addition to the album, a cheque for the balance of the fund subscribed was presented to Prof. Cullis and a handsome electric clock to Mrs. Cullis and him jointly. Prof. Cullis has presented the cheque to the Governing Body of the College, with the suggestion that the income accruing from it should be used for the benefit of the mining geology department or students at the discretion of the professors of geology and mining geology department with the rector. The Governors have accepted this gift, and have resolved that the name of Prof. Cullis should be associated with the fund.

The Promotion of Peace

A petition to His Majesty's Government has been signed by a large number of distinguished people urging the Government to seek to avert the calamity of war by promoting an international inquiry into the fundamental causes of rivalry and unrest among the nations. The petition urges His Majesty's Ministers to take the initiative in this matter by inviting all other fully self-governing States, Dominions or Colonies to combine with Great Britain on equal terms in setting up expert commissions to ascertain and report upon the basic facts in regard to such questions as access to raw materials, and world markets, colonial development and the problem of surplus populations, foreign loans and credits, trade restrictions and international exchange. The signatories affirm their belief that if Great Britain showed an earnest desire to solve these problems, with full and impartial consideration of all just claims, her example would encourage the establishment of confidence and good will among the peoples of the world.

THE signatories of this petition include many heads of universities and colleges, more than one hundred fellows of the Royal Society, nearly as many distinguished writers as well as the archbishops, bishops and other Church leaders, and a number of members of Parliament. Representatives, individuals of all parties and officials of a large number of important organisations of all kinds throughout the country, have added their signatures, indicating the remarkable and extensive support which a representative body of opinion is prepared to afford the British

Government in the role of world peace-maker. The action already taken by the League of Nations, and approved by the Government, in promoting an inquiry into raw materials is obviously in line with the wishes of the signatories. The first essential step is to establish the facts in these matters beyond dispute, and the wisdom and urgency of this step are the more obvious in view of the refusal of certain countries to participate. If, in spite of such refusal, the British Government resolutely persists in a search for some way of reconciling the conflicting claims of different countries, convincing proof will be afforded of Great Britain's desire to promote peace based on a foundation secure because it is just.

Belfast Meeting of the British Medical Association

THE British Medical Association held its one hundred and fifth annual meeting at Belfast last week under the presidency of Prof. R. J. Johnstone, professor of gynaecology in the Queen's University of Belfast. The main theme of his presidential address, entitled "Some Thoughts on Medical Education", was medical education, undergraduate and post-graduate. As a university teacher and member of the General Medical Council, Prof. Johnstone was able to speak with authority from practical experience. He said that the critic of medical education generally assumes that the teachers should, at the end of the five years curriculum, turn out the general practitioner as a finished product, and blames them if they do not do so, although no one expects a finished surgeon, anatomist or pathologist at the end of this period. The specialist must know almost everything about his subject, the general practitioner must know something about almost every medical subject, and the course the latter has to pursue cannot be less difficult than that needed by the former. Although clinical study must have a considerable place in the education of the undergraduate, it is a fallacy to consider that clinical training is the be-all and end-all of medical education. There must be an adequate background of human anatomy, physiology and pathology provided by medical education. Prof. Johnstone also alluded to the existence of dreary lectures and dull teachers, and suggested that courses of instruction in the art of lecturing might be instituted for those appointed to teaching posts.

Nutritional Requirements of Pregnancy

At a joint meeting of the Sections of Obstetrics and Gynaecology and Nutrition, a discussion took place on the nutritional requirements of pregnancy. Sir Robert McCarrison said that the food essentials needed by the prospective mother are, in order of precedence: (1) milk and milk products; (2) whole or lightly milled cereals, particularly good wholemeal or standard bread, and oatmeal; (3) green and leafy vegetables; (4) root vegetables, particularly potatoes, carrots and onions; (5) fruit, including the tomato; (6) pulses; (7) eggs; (8) meat, including fish, fowl and glandular organs. To these should be added, in Great Britain, a daily teaspoonful dose of cod liver oil; a portion of yeast extract is a wise

precaution. Dame Louise McIlroy also stressed the value of fresh fruit and vegetables, herrings and wholemeal bread. She suggested that lessons and demonstrations in the preparation and storage of food might well form a part of the work of antenatal clinics. Other speakers also emphasized the importance of an adequate supply of vitamins during pregnancy. The incidence of puerperal pyrexia seems to be diminished by these means.

Maiden Castle, Dorchester: Excavations in 1937

EXCAVATIONS have now been resumed at Maiden Castle, Dorchester, under the direction of Dr. R. E. Mortimer Wheeler and Colonel C. D. Drew on behalf of the Society of Antiquaries and the Dorset Natural History and Archaeological Society (*The Times*, July 26). Three areas are to be explored in the coming season. At the eastern entrance, the unexpected discoveries made last autumn towards the close of last season's work will be further examined. These earlier fortifications, partly of masonry and dating from the third century B.C., which were found beneath the earthworks screening the entrance, include two outer gateways, which with the inner gateway constitute a complex plan hitherto unknown in prehistoric fortifications. Outside these are areas in which iron was smelted and burials took place. The latter should afford further evidence of the physical characters of the inhabitants, who according to the skeletons found last year were of a small build. Within the fort, investigations will be directed firstly to the Neolithic trenches found last year near the temple, which may have been part of the inner defensive system of the Neolithic partial occupation of c. 2000 B.C.; and secondly to the original western entrance, which was found in December last, but was not then explored. This last is marked by a gap in the rampart, which shows the original western limit of the castle, and should reveal the plan of the earliest gateway known. The first important discovery of the season is that of approach roads diverging in a north-easterly and south-easterly direction, which were superseded and abandoned in the first century B.C. and are thus among the earliest metalled roads known in Britain.

Evidence of Early Man at Bethlehem

To the antiquities from Tell Duweir on view at the Welloome Research Institution (see *NATURE*, July 17, p. 99) have been added, since the opening of the exhibition, finds from the Bethlehem Bone Beds, which are being excavated by the Welloome Marston Archaeological Research Expedition to the Near East. The work of investigation is being carried out by Miss D. Bate and Miss E. Gardner. The great pit, from the clays of which these finds are derived, appears to be a swallow hole. Rock has been reached on two sides, while on the third side what appears to be only a thin sheet of sloping deposits remains; but until bottom has been reached the exact form cannot be determined. There are indications that the cavity may fork as deposits are followed further. Among the animal remains found in 1937, the most

striking is the hinder part of the carapace of a gigantic tortoise, together with some detached plates and a bone of the same species. By way of contrast is the fossilized bone of a diminutive species of tortoise. There are also shown part of the tooth of an elephant—the first identification of an elephant in Palestine was from this site—the upper cheek-teeth of a rhinoceros and evidence of a very small form of horse, new to the fauna of Bethlehem. Although there has not yet been opportunity to identify the species with certainty, the indications point to a probably Lower Pleistocene horizon, or even possibly Pliocene. With the animal remains are shown flints selected from a larger number which were found in the bone beds and associated with the fossil fauna. Of these, one is apparently a core, while the others are of characteristic Eolithic or pre-Paleolithic forms. Both the character of the flaking and the forms would seem to place their human origin beyond question. Their association with the animal remains in a definite geological horizon constitutes them the earliest evidence of man's existence yet discovered in Palestine. The exhibition will close on August 7.

"Caves and Caving"

THE British Speleological Association, which met for its second annual conference at Bristol on July 23-26, may now be regarded as fully established. It has acquired Cragdale House, Settle, Yorks, for its headquarters—a 'shilling fund' to raise £500 has been initiated for its equipment by the women members—and it has issued the first number of a publication under the title "Caves and Caving" (1s., annual subscription 4s. 6d.), in which speleological studies will be treated scientifically, but in popular form. The first issue opens with Sir Arthur Keith's presidential address "History from Caves", delivered at Buxton last year, fronted by an excellent portrait of the author; Prof. L. S. Palmer follows with an account of the objects of the Association and its work up to the present, the latest undertaking to which he refers being the systematic study of the aquatic fauna to be found in cave streams; Mr. E. Simpson reviews the life-work in speleology of the veteran, M. E. A. Martel, honorary member of the British Speleological Association, and honorary president of the Spéléo Club de France at its foundation in 1930. Mr. A. Leslie Armstrong counsels caution in "Cave Exploration as a Science"; and Dr. Franco Anelli gives an account of the recent descent into La Preta Cavern in the Lessini Mountains of the Veronese, Italy, the deepest known cave in the world, when a depth of 637 metres (approximately 2,090 ft.) was reached. At the recent field meeting of the British Speleological Association at Gaping Ghyll Hole, Ingleborough, Yorks, 356 descents were made and half a mile of new passages were explored. This is Britain's largest cave. The history of its exploration is reviewed by Mr. E. Simpson in a contribution, to be continued. Among other articles is a first instalment of the extremely valuable record of cave finds, arranged under caves, which is being compiled through inquiry by Dr. Wilfrid Jackson.

It will, when complete, show the present location, museum or other, of all animal remains and artefacts of archaeological interest found in British caves, so far as can be ascertained.

New Penguin-breeding Record at Edinburgh

THE Scottish National Zoological Park at Edinburgh has long been famous for its penguins—not only for their number and variety and fine condition but also for the manner in which they have bred there. The king penguin bred first in the Park eighteen years ago, and since that time fifteen king penguin chicks have been bred and reared. The ringed penguin and the rockhopper penguin both bred in the Park two years ago. These were the first occasions on which these three species have bred in Britain, and probably the first time they have bred in captivity anywhere. The latest achievement of this kind is the breeding of the gentoo penguin. The gentoo penguin comes next in size to the king penguin. While the king penguin makes no nest but holds its single egg on its feet during incubation, and the rockhopper penguin and ringed penguin make a rough nest of a heap of pebbles, the gentoo penguin prefers something softer, and collects dead grass, twigs and small sticks which it shapes into a symmetrical nest. It was nearly two months after the beginning of the nest building that the first egg was laid, and a second egg was laid five days after the first. Both parents shared in the work of incubation, and took their turns fairly regularly. The first egg hatched after an incubation period of five weeks and four days, but the second was infertile. The chick has a nestling coat of pale grey on the back and white underneath, and it was observed to feed on the day it hatched. It feeds, as do all 'baby' penguins, by taking partially digested fish from the throat of the parent bird.

Acquisitions at the British Museum (Natural History)

MR. J. L. CHAWORTH-MUSTERS has presented to the Department of Zoology 82 birds belonging to 31 species, and a few field mice, which he collected in the High Atlas Mountains, above Marakesh, in the early part of the year. Included among the birds are examples of the rare crimson-winged finch, an alpine accentor, and local forms of the dipper and shore lark. The Entomological Department has received a welcome gift in the letter-book of Dru Drury, a famous collector and describer of insects (1725-1803). He was a goldsmith living in London who had correspondents in Asia, Africa, America, and Australia. This book contains copies, in his own hand, of letters written by him to his friends, his collectors, and his business connexions during the years 1761-1780, and gives a valuable insight into entomological proceedings during that period. Accompanying this volume, and similarly presented by Mr. Charles Dru Drury, are a copy of the auctioneer's catalogue of Dru Drury's collection (1801), and a small collection of letters addressed to him by Carl Linné the younger, by A. R. Lewin (from Australia), and by other well-known contemporary naturalists.

Accessions in the Department of Geology include a collection of nearly 200 fossil fruits and seeds from the Cromer forest bed, all described and figured by Mrs. E. M. Reid and her late husband Dr. Clement Reid, and now generously presented by Mrs. Reid. The Trustees approved the purchase for the Department of Minerals of a nugget of well-crystallized iridosmine (osmaridium), weighing nearly an ounce, from Adamsfield near the source of the Derwent in Tasmania. There is a larger nugget already in the collection weighing nearly two ounces and reputed to be the second largest nugget of pure iridosmine, but it is less well crystallized than the specimen now acquired. Other important purchases are a slice weighing 1,387 grammes of a rare type of meteorite—a pallasite—from Springwater, Saskatchewan, a fine aurichalcite from Utah, and a fine group of laumontite and a large crystal of adularia from northern Italy.

Televisor, Telegraphy, Telephone

THE word 'Televisor' was coined by Mr. J. L. Baird in 1925 to describe apparatus for television and was registered by him as a trade mark. On account, however, of the general adoption of the word in the United States and elsewhere to denote any kind of television apparatus, Baird Television, Ltd., has decided to abandon its registration as a trade mark, so that in future there will be no restriction upon the use of the word in connexion with television. 'Televisor' may thus be used in future as freely as 'telegraph' and 'telephone'. The word telegraph was first applied by Chappe in France, in 1792, to his invention of the semaphore system of transmitting messages to a distance; and the word telephone was used by Sudré in 1828 for a system of signalling by musical sounds. It was employed in 1844 to describe a powerful wind instrument to convey signals at sea during foggy weather. Philipp Reis, in 1861, called his ingenious instrument a telephone, so that he may be regarded as the inventor of the name of the modern instrument. Alexander Graham Bell adopted the word in 1876 for his "Electrical Speaking Telephone".

The Earl's Court Exhibition Centre

THE new Earl's Court Exhibition building, erected on the site of its predecessor, is approaching completion. It will be the largest permanent exhibition and sports centre in the British Isles. The site covers approximately twenty acres, the new buildings enclosing nine acres. The main arena is unique, as it is the largest concrete building in the country. There are no less than six electric railway tracks running underneath the site of this exhibition. These tracks were covered in by tunnels or bridged without interrupting the railway services. The main hall itself is 250 feet by 350 feet without columns, and has seating accommodation for about 25,000 people. A swimming pool having a capacity of 2½ million gallons of water is provided. An account is given in the *Electrical Times* of July 1 of the problems connected with the heating and lighting of the exhibition. Complete designs and estimates were

got out for all reasonable methods of doing this. The first step taken was to prepare designs and costs for a complete generating power station for the Exhibition and alternatively to use boiler-house plant for heating purposes. This was compared with possible tariffs obtained from the Fulham Power Station for an electric service for lighting power and complete heating of the building by electric thermal storage. The estimates were considered by the Company and its consultants, the conclusion being that electricity for all purposes was the best scheme. The Fulham Borough Council has undertaken to carry out the complete installation of all the electrical plant and services required up to the point of low-tension distribution together with the electric thermal storage plant, and the work is now on the point of completion. A permanent form of fire-fighting equipment is installed at every substation. The heating of the whole of the building is carried out by an electric thermal storage hot water plant which is much the largest plant of this kind in the British Isles.

History of Alchemy

THERE are welcome signs of an awakening interest in the history of science, the study of which has until recently received surprisingly little recognition among the increasing body of scientific workers in Great Britain. The appearance last year of *Annals of Science*, a quarterly journal devoted to the history of post-Renaissance science in general, has been quickly followed by another publication entitled *Ambix*, which is to deal with the specialized study of alchemy and early chemistry. *Ambix* is, indeed, the official journal of the newly founded Society for the Study of Alchemy and Early Chemistry. The first issue is dated May 1937; the second number will appear in November 1937; and thereafter it will be published as a quarterly. At first sight, the subject may appear too restricted to afford material for a quarterly periodical, but this impression is corrected by supplementary glances at Sir Robert Mond's introduction and the later contents of this issue. "Alchemy," writes Sir Robert, "records not only Man's groping for the truth and for the enrichment of his experiences, but at the same time the widening of the Human Mind and the accompanying evolution of thought."

ANOTHER point of view is presented by Prof. J. Ruska in his contribution on "Methods of Research in the History of Chemistry". Here he states that "we continually need new texts, we need summaries of contents, translations and commentaries . . . we need also the application of the keenest critical methods." *Ambix* has already begun to supply material of this kind. Thus, Prof. J. R. Partington contributes a fully documented article entitled "Albertus Magnus on Alchemy"; Dr. F. Sherwood Taylor, the editor, writes upon "The Origins of Greek Alchemy"; Mr. Gerard Heym opens a useful "Introduction to the Bibliography of Alchemy", and also discusses the "*Aurea Catena Homeri*". There are,

in addition, a report of a discussion upon chemical and alchemical symbolism; a translation of "The Visions of Zosimos", by Dr. Taylor; and reviews of four recent books, including notably Prof. Partington's "Origins and Development of Applied Chemistry" and Prof. J. Read's "Prelude to Chemistry". The nature of these two works, differing so widely in scope and treatment, conveys some idea of the ambit of *Ambix*.

Public Health in British India during 1934

THE annual report of the Public Health Commissioner with the Government of India (vol. 1), recently issued, surveys the vital statistics, public health and public health services of British India for the year 1934 (Government of India Press, New Delhi, 1936. Rs. 6 As. 2, or 10s.). The mid-year population is estimated to be 275,753,570, the births were 9,288,897, a rate per 1,000 of 34, and the deaths numbered 6,856,244, a rate per 1,000 of 25. The infant mortality per 1,000 live births was 187. Of the causes of death, malaria heads the list with 1,319,026 deaths, and this figure does not include the mortality caused indirectly by malaria. Deaths from respiratory diseases numbered 488,018, those from dysentery and diarrhoea 285,110 and from cholera 199,708. Smallpox, with 83,928 deaths, caused a greater mortality than plague, with 80,181 deaths. At the Research Institute, Kasauli, a number of cases of snake-bite have been treated with anti-venomous serum with a high percentage of recoveries—25 out of 29 cases of cobra bite, and 12 out of 13 cases of bite by Russell's viper. Lieut.-Colonel Jolly, the Commissioner, believes that the intensive public health propaganda carried out during the last ten or twelve years is beginning to bear fruit, and that interest is increasing in such matters as rural reconstruction, nutrition, child welfare and the prevention of epidemics.

Examinations in the United States

EXAMINATION, as a teacher's tool, has undergone remarkable modification in the past sixteen years in the United States. The search for an instrument of precision for the use of teachers in examining their pupils has engaged the ingenuity of a host of investigators, and the resultant devices, the true-false, the completion, the matching, the multiple-choice, the one-word, the problem and other objective-type tests have, to a large extent, supplanted the essay test. The United States Office of Education has recently issued a report (Bulletin 9/1936, Washington: Supt. of Documents. 10 cents) on testing practices of secondary school teachers of 1,600 schools, as described by themselves. It appears that, when constructing tests, about seventy-four per cent of them make use principally of the objective type, only sixteen per cent rely chiefly on the essay test and ten per cent make equal use of both. The report shows that the new style of tests is popular with teachers. Their simplicity appeals to them. But it is clear that their employment calls for watchful control. A principal advantage claimed for them—that a large

number of items can be answered in a short time and the subject-matter can thus be the more thoroughly sampled—has been unrealized in many cases through not using a sufficient number of questions. Of intelligence tests, the report says that few teachers really use the results.

The Swiss Earthquake Service

THE Swiss Seismological Commission, afterwards the Swiss Earthquake Service, is the oldest committee engaged in the study of earthquakes. For its foundation in 1878, we are indebted to the veteran geologist, Prof. Albert Heim. Two years later, it was followed by the British Association Committee on earthquakes in Japan, which, on Prof. Milne's return to Great Britain in 1895, enlarged its scope as the Seismological Committee. In 1883, shortly after the destructive Iachian earthquake of July 28, a geodynamic section was added to the Central Meteorological Office at Rome, which still carries on its useful work of studying Italian and other earthquakes; and, in 1892, the Imperial Earthquake Investigation Committee began its similar, but more extensive, work in Japan. The Swiss Committee, under the direction of Dr. E. Wanner, has recently issued its *Jahresbericht* for 1935, containing three valuable tables, the first on earthquakes sensible in Switzerland, twenty-seven in number, none of which reached destructive intensity; the second, of eighty earthquakes with origins as a rule less than three hundred miles distant; and the third, of a hundred and fifty earthquakes recorded at the five Swiss stations (Zurich, Chur, Neuchâtel, Basel and Sion), the distances of the origins being not less than six hundred miles.

Discussion on Lubrication and Lubricants

THE Council of the Institution of Mechanical Engineers, with the co-operation of other societies and institutions, has decided to hold a general discussion on lubrication and lubricants on October 13-15, when a series of some 140 papers from leading authorities throughout the world will be presented. The opportunity will be taken to review the present state of knowledge by means of a general discussion among those especially interested and qualified to discuss the major problems of the subject, with objects such as to endeavour to establish a correlation between theory and practice and to show how bearing design can be applied, to relate academic research with trade practice, to obtain current views upon bearing metals, and to review the significance of laboratory tests, including wear and friction tests. An exhibition will be held at the Science Museum, South Kensington, to illustrate the subjects under discussion, and will be devoted to lubricants, bearings and bearing materials, as well as to testing and other apparatus. The exhibition will be open for a fortnight from October 13. Support for the discussion has been given by twenty-nine British societies and technical institutions and by ten over-seas societies and technical bodies. The complete proceedings will be issued as a bound volume. Advance copies of the papers will be available for use at the meetings.

Application forms for tickets of admission and for copies of papers, and further information about the discussion may be obtained from the Secretary, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

A Naked-eye Group of Sunspots

A *very* large group of sunspots, that is likely to develop into the largest group so far recorded during the present eleven-year cycle, came into view at the sun's east limb on July 22 in latitude 31° N. The date of central meridian passage is July 28.5; on August 4, the group will reach the sun's west limb. The group comprises a large leader spot and a follower of composite structure; these, with companion spots, covered no less than 2,000 millionths of the sun's hemisphere on July 24. On July 26 (the date of this report) the two chief component spots could be distinguished separately with the naked eye.

The Night Sky in August

THE moon is new on August 6 at 12.6^h and full on August 22^h at 0.8^h U.T. Conjunction with the planet Venus occurs on August 3 at 9^h, and from the northern part of England and in Scotland an occultation can be seen (see *NATURE*, July 17, p. 103). On August 18 at 23^h, there is a conjunction with Jupiter, and on August 24 at 20^h a conjunction with Saturn. On August 30, the moon occults the 5th magnitude star, α Tauri, the re-appearance at Greenwich taking place at 3^h 20^m at position angle 314° from the moon's north point. From sunset until sunrise during August, four bright planets are visible. Mars sets before midnight; Jupiter is on the meridian at 21^h in the middle of the month, followed by Saturn at 2^h; whilst Venus rises at about 1^h and is a brilliant object in the early morning skies, passing between Procyon and Castor and Pollux towards the end of the month. Uranus is nearly stationary in Aries and may be picked out from the background of stars of similar magnitude (about 6^m) with the help of the map given on p. 57 of the B.A.A. Handbook. At about 21^h the constellations on the meridian offer almost unlimited scope for interesting 'sweeps', which should include double stars such as α Herculis, θ Serpentis, β Cygni, γ Delphini and δ Cephei. The latter star is a notable short-period variable giving its name to a class of variable which, recognisable in the nearer extra-galactic nebulae, enables the distances of these remote systems to be determined. Of the nebulae and star clusters to be viewed with binoculars or a small telescope, the 'ring' nebula in Lyra, the 'dumb-bell' nebula in Vulpecula and the star cluster in Hercules should be easily located by means of a star atlas. The general outline of the Milky Way may also be studied with binoculars, noting the bifurcation near the bright star, Deneb, and the star clouds near the southern horizon. It may be recalled that towards a point at R.A. 18^{h} 4^m: Dec. $+31^{\circ}$ the solar system is moving into space with a speed of 12 miles a second. Between August 10 and 12, in particular, the sky may be watched for meteors of the Perseid stream. An ephemeris for the comet

Grigg-Skjellerup is given on p. 32 of the B.A.A. Handbook and also one for the comet Encke, which may possibly be picked up before long on its return to perihelion due next December. The periodicity of this comet, only 3.3 years—the shortest known period for a comet—was first recognised by Encke in 1819.

Announcements

The Earl of Rothes has accepted the appointment of chairman of the governors of Faraday House Electrical Engineering College, in succession to the late Lord Castletown.

DR. L. J. SPENCER, formerly keeper of minerals in the British Museum, has been elected a corresponding member of the Société Géologique de Belgique.

PROF. L. J. WITTS, professor of medicine in the University of London and physician to St. Bartholomew's Hospital and Prof. G. E. Gask, emeritus professor of surgery in the University of London, have been appointed members of the Medical Research Council, in succession to Sir Thomas Lewis and Sir David P. D. Wilkie, who retire on September 30.

THE Trustees have appointed Dr. S. Ochoa of the University of Madrid as Ray Lankester investigator for 1937, and Dr. Ochoa began his researches at the Marine Biological Association's laboratory in Plymouth on July 1, his subject being the experimental relationship of structure to environment in fishes and other animals. This work is a continuation of previous researches at Madrid and Heidelberg on the same subject.

THE first International Congress of Medical Public Health Officers organised by the syndicate of French medical hygienists under the auspices of the Health Section of the League of Nations will be held in Paris on October 20–21 under the presidency of Prof. J. Pariset. Further information can be obtained from Voyages Duchemin-Exprinter, 26 Avenue de l'Opéra, Paris 16.

THE twenty-ninth Annual Autumn Meeting of the Institute of Metals will be held at Sheffield on September 6–9. On September 6, Dr. D. R. Pye, deputy director of scientific research, Air Ministry, will deliver the sixteenth Autumn Lecture entitled, "Metallurgy and the Aero Engine". Further information can be obtained from the Secretary, Institute of Metals, 36 Victoria Street, London, S.W.1.

THE fourteenth annual conference of the Association of Special Libraries and Information Bureaux (ASLIB) will be held at Gonville and Caius College, Cambridge, on September 24–27, under the presidency of Sir Harry Lindsay, director of the Imperial Institute, who will give an address on "The Interrelation between Science, Agriculture and Industry". Further information can be obtained from the General Secretary, ASLIB, 31, Museum Street, London, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 200.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some New Types of Pleochroic Haloes

EXAMINATION of a large number of biotite specimens from all parts of the world by my students and myself¹ has shown the existence of six distinct types of pleochroic haloes. Two of these, the common type due to uranium and the rarer thorium type, arise from parent radioactive elements of such long periods that α -rays are still being emitted and the darkening of the ring structure is still progressing in these haloes. The remaining four types appear to arise from parents of such short periods that all activity must have long since ceased. The first two types may be referred to as 'active' haloes and the last four as 'extinct' haloes.

To avoid premature implications as to their origin, the extinct types will be designated as *A*, *B*, *C* and *D*. The *A* type is similar to that described by Joly² as "emanation haloes". Types *B*, *C* and *D* are believed to be new. A photomicrograph of a *C* type halo is shown as an example in Fig. 1.



Fig. 1.

The *A* type has one ring, *B* has two rings, *C* three rings and *D* one ring. Certain subsidiary rings, mainly due to the actinium family, are occasionally found. The results of measurements of ring radii with the halo photometer are shown in the accompanying table.

Type	Ring radius in microns	Associated α -particle	Number in group
<i>A</i>	19-80	Po	62
<i>B</i>	24-49	RaC'	24
	20-00	Po	24
<i>C</i>	24-50	RaC'	23
	24-03	RaA	25
	19-85	Po	21
<i>D</i>	16-21	Ra	26

In the third column is shown the α -particle, the range of which agrees with the ring radius within the limit of experimental error and which appears to be the most probable parent of the halo ring in question. The fourth column shows the number of rings actually measured on the photometer records of a limited number of very good haloes mounted on slides and sorted out as to type by visual inspection.

It is to be noted that all six types of haloes may be accounted for by known radioactive elements, and that the ring radii appear to be constant in haloes contained in minerals of all geological ages.

The extinct haloes are fairly common, except type *D*, which is rather rare. All have been observed in more than one biotite specimen. Compound haloes are also found which are due to the superposition of two extinct types, notably *A* and *C*. Extinct haloes are often found arranged along irregular lines the course of which has little relation to the crystal directions. Often a distinct narrow channel is visible, which passes through the centres of the haloes and is sometimes surrounded by a faintly darkened tubulation the radius of which is that of the haloes.

It seems clear that an explanation of the mode of formation of these new types of haloes lies in hydrothermal action, but a detailed consideration is beyond the scope of this letter. A full account of these haloes and a discussion of the mechanism of their formation will be given shortly elsewhere.

G. H. HENDERSON.

Dalhousie University,

Halifax, N.S.

June 12.

¹ *Proc. Roy. Soc., A*, 148, 563, 582 (1934); 158, 199 (1937).

² *Phil. Trans.*, B17, 51 (1917).

Colchicine, 'Phytocarcinomata' and Plant Hormones

COLCHICINE has been shown to produce a bulbous hypertrophy of the root tips and coleoptile of wheat seedlings¹. In these swellings, the appearance of the mitotic figures closely resembles those found in certain organs of animals treated with colchicine, and also in malignant tumours of animals^{2,3}. In this respect, the action of colchicine appears to be similar to that of *B. tumefaciens*, which causes the 'phytocarcinomata'. On the other hand, A. P. Dustin⁴, Amoroso⁵ and Peyron *et al.*⁶ have claimed that colchicine inhibits the growth of malignant tumours in animals.

I have tested the effect of colchicine on the growth of tumours in plants by the following method. Seventy tomato plants (var. Kondyne red), grown in pots, were inoculated on the same day, with a virulent strain of *B. tumefaciens*, five inoculations being made on the main stem of each plant. The plants were then divided into five groups. One group was used as a control; colchicine was tested on another

group; and the other three groups were used for experiments that I shall mention later.

Colchicine in a 1:10,000 aqueous solution was introduced through a cut in the stem, by a method I have previously described¹. On the average, 2.5 mgm. of the substance was absorbed by each plant during the period March 18-May 14, 1937. The accompanying table shows that the effect of this treatment was an inhibition of the growth of the tumours in the inoculated plants.

The other three groups of plants were used in control experiments, designed to test the possibility that hormonal changes in plants influence the growth of plant tumours. An attempt was made to influence the plant hormones by the following three methods:

(1) I excluded light from the terminal buds of one group of plants by capping them with a black cloth², on the grounds that the influence of light on the elaboration and circulation of growth hormones in plants is well known.

(2) In another group I removed the flowers, because this also influences the elaboration and circulation of plant hormones.

(3) I administered palmitic acid to the last group of plants, because palmitic acid, administered to animals simultaneously with sex hormones, increases the effect of the hormones³. The substance was administered to the plants in two successive doses of 10 ml. of a 5:1,000 solution per plant, and the solution was poured directly on to the soil. The experiments were carried out in ordinary greenhouse conditions (the greenhouse was generously put at my disposal by Madame A. Fester, of Antwerp).

Number of plants	15	10	10	5	30
Treatment	Colchicine	Capped terminal buds	Flowers removed	Palmitic acid	Control
Average weight of tumours per plant	1.173 gm.	1.345 gm.	2.063 gm.	1.510 gm.	3.406 gm.
Average weight of one tumour	0.311 gm.	0.206 gm.	0.277 gm.	0.228 gm.	0.444 gm.
Average number of tumours per plant	5.53	6.50	7.50	6.00	6.85

The table shows that all these three types of treatment produced inhibition of the growth of the plant tumours, and it is therefore suggested that inhibition was produced by a hormonal alteration. The possibility therefore cannot be excluded that colchicine inhibits the growth of plant tumours in a similar way, namely, through the intervention of the plant hormones.

LÁSZLÓ HAVAS.

Institute of Pathological Anatomy,
University, Brussels.
June 20.

¹ Havas, L., *NATURE*, 136, 371 (Feb. 27, 1937).

² Dustin, A. P., Havas, L., and Lita, F., *Reunion Assoc. Anatomistes, Marseille*, 1937.

³ Dustin, A. P., *Arch. port. sci. biol.*, 5, 33 (1936).

⁴ Dustin, A. P., *Bull. Acad. roy. méd. de Belgique*, 14, 487 (1934).

⁵ Amoroso, E. O., *NATURE*, 136, 266 (Feb. 10, 1935).

⁶ Peyron, A., Lafay and Kobosloff, *Bull. ass. fr. p. étude du Cancer*, 26, 874 (Déc., 1936).

⁷ Havas, L., *C. R. IIe Congrès intern. hist. sci. contre Cancer, Bruxelles*, 1936.

⁸ Zimmerman, P. W., and Hitchcock, E., *Con. Boyce Thompson Inst.*, 8, 311 (1936).

⁹ Miescher, K. A., Wettstein, and Tschopp, H., *Schweiz. med. Wochenschr.*, 66, 1, 310 (1936).

Interaction of Nuclear Particles

FOLLOWING the results of scattering experiments, the hypothesis is now generally favoured¹ that the interaction forces in nuclei do not depend on the charge of the particles concerned. Then the general interaction potential for two particles 1 and 2, either of which may be a proton or a neutron, can be expressed as:

$$U_{12} = [W + \frac{1}{2}B(1 + (\sigma_1\sigma_2)) - \frac{1}{2}H(1 + (\tau_1\tau_2)) - \frac{1}{2}M(1 + (\sigma_1\sigma_2))(1 + (\tau_1\tau_2))]J(r_{12}) \quad (1)$$

Here σ_i is the spin vector of the particle i and τ_i the formally analogous "isotopic spin vector"²; τ_i has the value $+1$, if i is a proton, and -1 , if i is a neutron; W , B , H and M are four constants. From (1) we obtain $(W + B + H + M)J(r)$ as the potential in the ground state of the deuteron. If $J(r)$ is correspondingly normalized we may put:

$$W + B + H + M = 1 \quad (2)$$

The value of the energy of the singlet state, as derived from scattering experiments, is then accounted for very closely if we put:

$$W - B - H + M = \frac{1}{2} \quad (3)$$

Other relations between the four constants may be obtained from the consideration of heavy nuclei. As Breit and Feenberg³ first showed, the fact that heavy nuclei with extremely large binding energies do not exist is explained if we put:

$$a_1 = 4W + 2B - 2H - M < 0 \quad (i)$$

Further, since heavy nuclei of zero charge are experimentally unknown, we must have:

$$a_2 = 2W + B - 2H - M < 0 \quad (ii)$$

Further considerations by Volz⁴ led him to conclude that a_1 is very nearly zero (which is in agreement with the results of Inglis⁵), and also that a_2 is very nearly equal to 0. Taking $a_1 = a_2 = 0$, the four constants were then completely determined by Volz.

An additional requirement has hitherto apparently been overlooked: all known nuclei show a very large degree of spin-neutralization. Even in the heaviest nuclei, the total spin never exceeds about $10(h/4\pi)$. Heavy nuclei, in which the spin moments

of practically all the particles are parallel, must certainly be unstable. This leads to another condition, namely,

$$a_3 = 2W + 2B - H - M < 0 \quad (iii)$$

This inequality can immediately be deduced by analogy with (ii). One has only to note that (i) is invariant if σ , B and τ , $-H$ are interchanged.

Condition (iii) is not satisfied by the values of the four constants derived by Volz. The assumptions $a_1 = a_2 = a_3 = 0$ lead to equal energies for the triplet and the singlet states of the deuteron, in definite disagreement with experiment. One can satisfy all three conditions (i-iii) only by taking $a_2 < -\frac{1}{2}$. The limiting value $-\frac{1}{2}$ is, however, outside the limits for a_2 inferred by Volz. A negative value for a_1 would not give better agreement.

Note added in proof.

The manuscript of this note was sent to Dr. Volz, who kindly pointed out that the value $a_2 = -\frac{1}{2}$ may be considered as just within the limits of his

estimate. Dr. Volz, however, agrees that the values of the force constants calculated under the assumption $a_1 = a_2 = 0$ are shown by the above considerations to be improbable; the choice $a_1 = a_2 = 0$ should be more accurate.

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June 18.

¹ Brutt, Condon and Present, *Phys. Rev.*, **50**, 825 (1936).

² Oussen and Condon, *Phys. Rev.*, **50**, 846 (1936).

³ Breit and Feenberg, *Phys. Rev.*, **50**, 850 (1936).

⁴ Volz, *Z. Phys.*, **105**, 537 (1937).

⁵ Inglis, *Phys. Rev.*, **51**, 531 (1937).

Infra-red Spectrum and Molecular Structure of Diketopiperazine and Tetramethyldiketopiperazine

SANBORN¹ has concluded from her work on the chemical properties of glycine anhydride (diketopiperazine), that the molecule exists only in the enol-form (I). In view of the importance of the diketopiperazine configuration for the knowledge of the structure of the proteins, it seemed not without interest to look for further means of investigating the molecular structure of this substance. A very suitable method is the analysis of the infra-red spectrum. The absorption bands of diketopiperazine and its tetramethyl derivative were therefore observed with a quartz spectrometer in the region 2.8–3.6 μ . The effective slit-width was 0.02 μ . Each substance was deposited from a suspension in alcohol or ether, respectively, as a crystalline layer on the quartz window of an absorption cell. Following a suggestion of Dr. W. T. Astbury, the cell was then dried *in vacuo* over phosphorus pentoxide for 38 hours, so as to eliminate all traces of water which might have been adsorbed on the surface of the crystals. The cell was kept dry with phosphorus pentoxide throughout the course of the experiments.

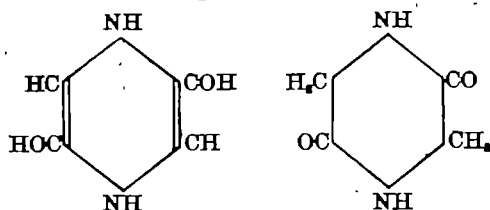


Fig. 1.

The results are given in the accompanying table. The accuracy of the wave-length measurements is $\pm 0.003 \mu$.

ABSORPTION BANDS OF DIKETOPIPERAZINE AND TETRAMETHYLDI-KETOPIPERAZINE

Diketopiperazine (λ in μ)	Tetramethyl- diketopp. (λ in μ)	Assignment of bands to vibra- tions of molecular groups
2.928 } 2.953 }	2.964 } 2.983 }	Valence vibration of C=O groups, first overtone.
3.008	3.013	Valence vibration of N-H groups, fundamental.
3.478 } 3.525 }	3.490 } 3.538 } 3.569 }	Valence vibrations of -CH ₃ (column 1) and -CH ₂ (column 2) groups, fundamental.

The assignment of the bands to the molecular groups given in the table may be understood by

reference to the formulae, of which I shows the enol-form and II the keto-form of diketopiperazine. The presence of an O—H linkage, required by the former structure, would give a band in the region 2.87–2.97 μ , and —CH vibrations at 3.20–3.80 μ should also appear. (If the O—H group were linked to a C—C instead of a C=O valence, as has been suggested, a band at 3.03 μ would appear instead of that at 2.87–2.97 μ .) With the carefully dried specimen, however, no trace could be found of either the —CH vibrations or of a band at 3.03 μ , so that the bands at 2.928–2.953 μ cannot be ascribed to an O—H vibration associated with the enol-form. They are accordingly assigned to the first overtones of the C=O group, which is consistent with the keto-form of the compound. Additional evidence for this form is the presence of —CH bands between 3.4 μ and 3.6 μ , which shows that the diketopiperazine molecule cannot possess any double bonds between carbon atoms. Furthermore, the similarity of the spectrum of the tetramethyl derivative (where no possibility of a keto-enol tautomerism exists) with the spectrum of diketopiperazine confirms the conclusion that in the crystalline state the diketopiperazine occurs in the keto-form (II), free from mixture with the enol-form. It should be remarked, however, that the observations do not preclude the possibility that a certain amount of each substance exists in the lactim-form, in which the hydrogen is linked with the C=O groups instead of with the nitrogen atoms. The result of this transformation is a double bond between the nitrogen atoms and the carbon of the C(OH) groups. It is clear, however, from the occurrence of the NH bands, that the diketopiperazine and the tetramethyl derivative cannot be wholly in this form. A full account of the experiments and a detailed interpretation of the observed bands will be published elsewhere.

I am very much indebted to Prof. A. C. Chibnall and Dr. W. T. Astbury for providing me with the diketopiperazine and the tetramethyldiketopiperazine.

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¹ Sanborn, *J. phys. Chem.*, **38**, 1799 (1932)

Radioactive Isotopes of Element 43

PROF. E. O. LAWRENCE, of the University of California, gave us a plate of molybdenum which had been irradiated with deuterons in the Berkeley cyclotron. The plate showed a strong radioactivity due to more than one body. The half-value periods are of the order of magnitude of some months. A chemical investigation of the activity ruled out any radioactive isotopes of zirconium, niobium, molybdenum or ruthenium, and shows most probably that the activity is due to isotopes of atomic number 43 (masurium of I. and W. Noddack).

Since the chemical properties of this element are practically unknown, we investigated the activity in order to collect some information on the chemistry of 43. This element bears the closest resemblance to rhenium, and shows the same reactions as rhenium with sulphuretted hydrogen, nitron, etc., but it can be separated from rhenium by the method used by Geilmann and Weibke¹ for the separation of molybdenum and rhenium.

We wish to express our thanks to the Radiation Laboratory of the University of California for the gift of molybdenum. A more detailed account will be published in the *Rend. Lincei*.

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June 13.

*Gellmann and Welbke, *Z. anorg. allgem. Chemie*, 199, 120 (1931).

Optical Rotatory Power of Turbid Solutions in an Electric Field

IN a previous note in this journal¹, A. McLean and I published the results of some experiments on the rotation of the plane of polarization of organic compounds dissolved in various solvents under the action of an electric field. These measurements were continued, and the results published in the *Philosophical Magazine*² by J. Kunz and P. H. Babcock.

For some solutions the results could be repeated, but for other solutions the curves obtained were very complicated and could not be repeated, so that the explanation of the phenomenon given became doubtful. These measurements were continued, and we found that the solution of methylester in benzene showed a slight turbidity, due probably to a suspension of naphthalic anhydride; indeed the carefully filtered solution gave no effect, even under the action of alternating fields so high as 15,000 volts per centimetre. Therefore, either some type of compensation is present in this particular solution (such as opposite effects on solvent and ester), or the magnitude of rotation does not depend so much upon the electrical structure as was first assumed. As in the present experiment, the expected effect was not observed, the dipole induced in the given fields may be too small.

When it was found that the rotation was due to a suspension, experiments were carried out using finely grounded calcite, quartz, iron oxide (Fe_2O_3), china clay, sodium chloride, etc., all of which gave an effect. The calcite suspension in benzene was one of particular interest, since it gave rotations from zero to 15° ; in some cases a maximum rotation of 5° was observed at about 3,000 volts per centimetre; then the rotation decreased with increasing fields, reached a minimum and began to increase again. When the field decreased, the curve was either above or below the branch obtained by increasing fields. These features depended upon the platinum electrodes in the polarimeter tube, which were too flexible and were moved upon application of the higher voltages. The difference in the two paths is due to settling or to mixing. The tube was reconstructed by supporting the electrodes in three places, and then the rotation reached a constant value at comparatively low fields.

The optical activity of suspensions is well known; it has received much attention by French and German physicists and chemists³.

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¹NATURE, 136, 705 (1935).

²Phil. Mag., (7), 22, 616 (October 1935).

³See, for example, Stefan Procopiu, *Ann. Phys.*, 1, 113 (1924).

We have been investigating the effect described by Prof. Kunz and R. G. Labaw, first in conjunction with McLean, who, however, had to leave it to take up other work. Although the solutions were apparently quite clear and free from obvious particles, we were led to suspect in some cases that the result might be due to very minute crystals in suspension in the liquid; we have also heard from Prof. Kunz that he has come to the same conclusion. Very careful filtration through selected filter papers removes the optical activity. The conclusion is, then, that the effect is due to dichroism induced in the particles by the electric field, a phenomenon not entirely new, although its accurate quantitative investigation is beset by numerous difficulties.

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Air-drag and the Equilibrium of Whirling Threads

IN the absence of all resistance to motion and assuming perfect flexibility, the differential equations of motion for a thread which carries a small spherical 'bob' and is whirled rapidly about a vertical axis by a horizontal arm give us an approximate solution for small amplitudes a plane sine wave—with reference to moving axes—leading to the well-known formula for plane vibrations¹. This approximate solution throws no light whatever on the stability of whirling threads as observed experimentally in air: these threads show 'necks' of appreciable amplitude in place of point nodes, the necks increasing in diameter the farther they are from the 'bob'. With sufficiently long threads and a large radius of the whirling arm, the sine outline disappears altogether.

I have recently found that if a term be introduced for air-drag—assumed proportional to the square of the linear velocity—the differential equations then admit of an approximate solution which not only gives the outline of the thread with surprising accuracy but also fully explains the limited stability of the system as described by Hall (*loc. cit.*).

For ease in experimental interpretation, the solution is best referred to moving rectangular axes, the vertical axis of whirl being the Z-axis. The form of solution is then:

$$x = R(1 + \frac{1}{2}\mu^2 x^2 + \frac{1}{24}\mu^4 x^4 \dots) \sin \beta x,$$

$$y = R\mu x(1 + \frac{1}{2}\mu^2 x^2 + \frac{1}{24}\mu^4 x^4 \dots) \cos \beta(1 + \frac{1}{2}R^2\beta^2)x;$$

where x is measured from the node of the lowest balloon, R is, effectively, the radius of the lowest balloon, determined by the radius of the whirling arm; β^2 is $m\omega^2/Mg$; m is thread mass per centimetre; ω is angular velocity of whirl; M is mass of 'bob'; g is gravitational constant; μ is $(\gamma/2\beta)(1 - \frac{1}{2}R^2\beta^2)R$; γ is $P\omega^2/Mg$; P is coefficient of air-drag per centimetre of vertical thread.

This solution gives the projection of the spiral thread on two perpendicular vertical planes. The x -values are conveniently referred to as the 'centrifugal wave', the y -values as the 'drag wave'. The period of the drag wave differs from that of the centrifugal wave by the small factor $\frac{1}{2}R^2\beta^2$, so that the positions of minimum amplitude do not coincide exactly with the nodes of the centrifugal wave. This point is clearly shown in photograph *b* of Hall's

note (*loc. cit.*). The accuracy of this solution appears to depend primarily on the magnitude of the expansion coefficient μ and is good, within this limitation, for very large values of the balloon amplitude: we are no longer tied to infinitely small amplitudes.

The value of μ is commonly so small that, with appropriate corrections which will be self-evident from the equations, if r is the radius of the first neck' and R is the radius of the first balloon, then

$$\frac{P}{m} = \frac{2r}{\pi R^2}$$

Measurements of this 'drag ratio' are now in progress, using a coincidence method involving a specially constructed prismatic instrument which eliminates the slight weight inseparable from these whirling systems.

Very fine threads are found to give larger values of the drag ratio than coarse ones in approximately the ratio of their diameters, as might be expected. There appears to be a slight decrease in the drag coefficient with increased whirling speed, which is possibly due to increased air swirl in the system or a departure from the square law.

I hope shortly to give elsewhere a full account of these measurements and the derivation of these equations.

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¹ Hall, H. W., *NATURE*, 136, 972 (Nov. 28, 1936)

Maintenance of the Pulsation in Cepheid Variables

THE oscillations induced in the principal modes of vibration of a star by a free oscillation in one of them, generally of the second order in the corresponding free amplitude, are unimportant unless magnified by resonance; so seems the evidence from Miss H. A. Kluyver's analysis¹. Hence, the motion in a Cepheid variable may be closely approximated to by the superposition of the oscillations of two modes of vibration, a free one and a forced one with half the period.

The damping constant of this composite motion is a weighted mean of the constants referring to the components, the weight factors being proportional to the energies of the separate oscillations. As, excepting exact commensurability, the ratio of these weight-factors is proportional to the square of the free amplitude, the dissipation of the energy of the pulsation depends on this amplitude.

As regards the damping constants of the components of the motion, it is to be remarked that each is the sum of positive and negative terms; the positive terms result from the dissipation of energy in the outer part of the star, hence probably are much larger for the mode of vibration corresponding to the forced oscillation; the negative terms, resulting from the generation of energy, probably are of the same order of magnitude in both cases. Hence the possibility arises that the damping constant belonging to the free oscillation is negative and that

belonging to the mode of vibration in forced oscillation is positive.

If the damping constants in actual stellar conditions have values corresponding to the possibility referred to, then the star may adjust its amplitude in such a way that the damping constant of the composite motion is zero: the pulsation may be maintained indefinitely. If a state of affairs is assumed in which the amplitude is very small, then the negative dissipation of energy of the free oscillation intensifies the motion, until the positive dissipation corresponding to the induced vibration restores the balance: a permanent state of pulsation has been reached.

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¹ *Bulletin of the Astronomical Institute of the Netherlands*, 276.

Photo-decomposition of Aldehydes and Ketones

ALDEHYDES and ketones decompose in the gas phase in two main ways¹. Type I, predominant with short chain compounds, may be represented $RCOR' \rightarrow CO + (RR + RR' + R'R')$. Type II, predominant with long-chain compounds, involves a cracking of the long hydrocarbon chain in a position $\alpha - \beta$ to the carbonyl group, giving a lower carbonyl compound and an olefine.

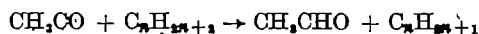
We recently described² certain results obtained in a study of the photo-decompositions of such compounds in paraffinoid solution, in which circumstances both types of decomposition were found to occur, type I being subject to a marked temperature coefficient while type II is not.

These results have now been extended to other carbonyl compounds, and appear to be of general significance. Thus methyl ethyl and diethyl ketones in 10 per cent liquid paraffin solution show no appreciable photolysis at 20° C., but ready decomposition according to type I at 100°.

The products arising from the type I photolysis in all ketones studied in paraffinoid solution are modified in a very simple but profound way, for whereas in the gas phase a mixture of the three hydrocarbons RR , RR' and $R'R'$ together with an approximately equivalent volume of carbon monoxide is obtained, in solution the hydrocarbon products occupy more than double the volume of the carbon monoxide and consist only of the hydrogenated products of the alkyl radicals, RH and $R'H$. None of the RR' and $R'R'$ hydrocarbons, previously found in the gas phase can be detected. It is clear that the free radicals disengaged in the photolysis must mainly react with the molecules of the paraffin solvent rather than combine together, as they do in the vapour. That this is substantially true is shown by the fact that an unsaturation develops in the paraffin solvent which, on removal of the carbonyl compound by distillation *in vacuo*, can be titrated with bromine water, and is equivalent in amount to the unsaturation which would be expected from the volume of the products. This suggests a continuous interchange of hydrogen atoms between paraffinoid free radicals and paraffin molecules, until two such free radicals meeting react to give an olefine and a paraffin by disproportionation.

With methyl ethyl ketone, the ethane produced is in excess of the methane, and this and a deficiency of carbon monoxide with reference to the total hydrocarbon produced has been correlated with the

presence of acetaldehyde which we were able to estimate. These results suggest that the reaction



can occur in paraffinoid solution.

Aldehydes differ from ketones in that photo-decomposition according to type I occurs in solution at room temperatures, and further in that the gaseous products are for the most part the same as those in the gas phase. Thus in the case of acetaldehyde the main products are methane and carbon monoxide, with a slight excess of the former. Butaldehyde and isovaleraldehyde behave similarly giving practically equal volumes of carbon monoxide and saturated hydrocarbon. Both compounds decompose simultaneously according to types I and II, the proportion of each type being approximately the same as in the gas phase, and unchanged in the liquid between 20° and -80° C.

Since with aldehydes less than 2 per cent of hydrogen is found, and but little unsaturation is developed in the solvent, the mode of type I decomposition is strikingly differentiated from that of the ketones. Thus independent evidence is furnished for the conclusion at which we have already arrived*, that the hydrocarbon is produced from aldehydes mainly in one act, namely, $\text{RCHO} \rightarrow \text{RH} + \text{CO}$, whereas in ketones free radicals are first formed. This conclusion can also be shown to be in accord with the fact that, with ketones in solution, the type I decomposition is subject to a marked temperature coefficient, while with aldehydes it is not.

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* Norrish and Appleyard, *J. Chem. Soc.*, 874 (1934). Bamford and Norrish, *J. Chem. Soc.*, 1504 (1935).

* Norrish and Bamford, *NATURE*, 125, 1016 (1935).

* Norrish and Kirkbride, *J. Chem. Soc.*, 1518 (1932). Norrish, *Trans. Farad. Soc.*, 30, 107 (1934); *Acta Physico Chemica URSS*, 3, 171 (1935).

Elementary Cell and Space Group of Ethyl-chlorophyllide

CHLOROPHYLL itself prepared after Stoll¹ is amorphous, giving in X-ray photographs only one broad ring corresponding to a distance of 4.2 Å. However, by replacing the phytol group by the ethyl group, a crystallizable compound can be obtained. Ethyl-chlorophyllide was prepared from leaves of *Heracleum*, following also the method of Stoll. By evaporation from ethereal solutions small crystals, weighing about 2 γ, were obtained in the form of thin equilateral triangles. The crystal form was, as already remarked by Willstätter and Stoll¹, clearly trigonal hemiedric (symmetry class C_3).

X-ray diagrams with copper K α-rays were obtained by oscillation through various angles about the a -axis [1010] and about [1120], the a -axis being parallel to the side of the triangle.

The dimensions of the elementary cell are: $a = 8.90 \pm 0.02$ Å.; $c = 38.4 \pm 0.2$ Å. For the density, the value 1.11 as found for chlorophyll was taken. The number of molecules of $\text{C}_{31}\text{H}_{50}\text{ON}_2\text{Mg} \cdot \text{CO}_2\text{CH}_3 \cdot \text{CO}_2\text{C}_2\text{H}_5 \cdot \text{H}_2\text{O}$ (the crystals were most probably those of the α -component) contained in the

cell was thus found to be 2.7 or approximately 3 so the exact value of the density is 1.24.

The X-ray diagrams confirmed the presence of a threefold axis, with no symmetry plane through the c -axis or at right angles to this axis. So only the symmetry classes C_3 and C_3 are possible, the latter being improbable from the external form of the crystals. As only those reflections 000 l for which $l = 3n$ are found and, further, many of the reflections are inconsistent with a rhombohedral lattice, the space group will be one of the pair of enantiomorphic groups C_3^+ and C_3^- . In these space groups the centres of the molecules, that is, the magnesium atoms, will be arranged in spirals around the c -axis.

A discussion of the observed intensities in relation to the shape of the molecules will be given later. We intend to investigate also the compounds derived from ethyl-chlorophyllide by replacing the magnesium atom by other bivalent metals such as copper and zinc.

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¹ Willstätter, R., and Stoll, A., "Untersuchungen über Chlorophyll" (Berlin, 1912).

Oestrous Reactions, including Mating, Produced by Triphenyl Ethylene

DODDS and his co-workers have described a number of synthetic substances with oestrogenic activity.

We have found that 1.0 mgm. of triphenyl ethylene¹, dissolved in oil, produced full vaginal cornification when injected into ovariectomized mice. A dose of 10 mgm. injected in two doses on two successive days produced cornification lasting for some eight to nine weeks, and partial cornification was present for a further period. The injections also caused oestrous distention of the uterus. Ten ovariectomized mice injected with 10 mgm. of the substance were placed with potent males and five of these have mated, as judged by the finding of vaginal plugs; one of these animals mated twice, namely, 5 and 15 days after the injections.

Oestrous changes in the uterus and in the vulva and also mating have been induced in each of two hypophysectomized rabbits.

Although the oestrogenic activity of triphenyl ethylene, as estimated by vaginal cornification, is only about 1/10,000 that of oestrone, yet it can produce effects of remarkable duration, and its power to produce mating is also noteworthy.

The minimum amount of the substance necessary to produce vaginal cornification when given by mouth in solution of oil is approximately the same as when given subcutaneously. Larger doses given by mouth produce cornification lasting for about a week.

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¹ Klages and Hellmann, *Ber. deutsch. chem. Ges.*, 37, 1455 (1904).

Neural Induction by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*

To investigate the problem concerning the induction of plant tissues in the ectoderm of the gastrula, plant tissues rich in nuclear and plasmatic content were used, such as meristem, cambium, ovaries and others. Fragments of these tissues, living or dead, were implanted into the blastocoel of an early gastrula of *Triton*.

Four series of experiments were carried out. In the first series, fragments of oat root meristem were inserted either in the fresh condition or after subjection to short boiling in water. Thickenings were formed in the ectoderm at the points in contact with the implant. In the second series, pieces of growing shoots of potato shoots were used, fresh or boiled. Greater proliferation of the ectodermal cells in the region of contact took place. In the third series, ash cambium of the birch tree was grated and introduced immediately into the blastocoel of a growing gastrula. Clear instances of inductions of neural plate were obtained, the superficial and deep layers showing a definite differential effect. As might be expected, the cambial layer was the most effective. The reason for this may be that the more tender membranes of the cambium are more easily destroyed by grating. The fourth series forms the control, and shows that the cell membrane is an insurmountable obstacle for inducing substances. Plant subjects such as anthers or whole stamens were implanted with impaired cell membranes. In these cases no induction was obtained.

Our results contradict those of Holtfreter's work with plant material (1934, p. 348)¹, but they suggest an explanation of the negative results of his experiments. Holtfreter used plant objects containing much nutritive material (pieces of banana, dough of wheat flour, potato starch).

The unity of plant and animal tissues thus shown by this corroboration in the biochemical field. Menandt and Jacobi (1933)² extracted folliculin from palm seeds. This folliculin was identical with folliculin $C_{12}H_{22}O_2$. Skarzynski (1933)³ obtained a derivative of follicular hormone from flowers, whereas up to that time this substance had only been obtained from the urine of pregnant women and from the contents.

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Holtfreter, J., *Archiv f. Entwicklungsmechan.*, 122, 225 and 302 (1934).
Menandt, H., and Jacobi, H., *Z. physiol. Chem.*, 218, 104 (1933).
Skarzynski, B., *NATURE*, 131, 766 (1933).

Neural Induction by Fragments of Dead Tissues of Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula

In the springs of 1934 and 1935, experiments were carried out on the influence of pieces of dead tissue (killed organs of desiccation, boiling and treatment with alcohol) on the ectoderm of the gastrula of Anura. Experiments were carried out in which parts of organs of tadpoles and adult Mammalia were implanted into the blastocoel cavity of the gastrula.

Eggs of *Bufo viridis* proved to be the best test material, but eggs of *Rana esculenta* were also used. The results gave positive results. Pieces of the upper

lip of the blastopore were desiccated at 60°, others were boiled in water. Some were fixed in 95 per cent alcohol, and later resoftened.

Fragments of muscle, brain and liver were the most effective of all the organs of anuran tadpoles. Fragments of mammalian organs, especially of liver and of kidneys, showed the highest inductive capacity. Our results confirm the work of Holtfreter (1934)¹, who has shown that mammalian tissues are the most effective in inducing axial organs, and add weight to the view that neural induction is chemical in nature.

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¹ Holtfreter, J., *Archiv Entwicklungsmechan.*, 122, 225 and 302 (1934).

Distribution of the Biting-louse

THE biting-louse, *Heterodoxus longitarsus* (Piaget), is primarily a parasite of certain didelphian mammals (Macropodidae), but it has been found also upon non-didelphian hosts. It has been recorded from domestic dogs, a jackal, a coyote, *Oncifelis salinarum*, and a man; also from the passerine bird *Corone australis*. We have examined the original specimens of most of these records and, in addition, have a number of new records from the dog.

This straggling is of interest from two points of view. First, the parasite has become established upon one of these non-didelphian hosts, the domestic dog and is even the usual dog louse in some localities. Secondly, on this host it appears to have a geographical and local distribution. Of the conditions necessary for the establishment of a louse species on a host other than its 'phylogenetic' host nothing is known, but with the apparent opportunities for transference it is amazing that it has not occurred more often. The earliest date recorded for the occurrence of the parasite on a non-didelphian host is 1902, in Africa.

On examining the locality records, there seems to be a definite geographical distribution such that it occurs only in temperate and tropical areas, roughly confined between lat. 40° N. and lat. 40° S. Thus, we are informed that the parasite is not known from the U.S.S.R., or from Canada; and it does not appear to occur in Europe. The information, from the literature in our records, indicates that within the two parallels of latitude the distribution is localized.

We are indebted to a great number of workers for our data. Accounts of the distribution and of the diagnostic anatomy of the parasite are in preparation.

N. J. B. PLOMERY.

Moltano Institute,
University of Cambridge.

GORDON B. THOMPSON.
British Museum (Natural History),
London, S.W.7.
July 2.

"The Handbook of British Birds"

As many ornithologists are already aware, a new edition of "A Practical Handbook of British Birds" has been for some time in preparation. We should be very grateful to any of your readers who would now send us notes of any omissions or errors in the original work, and of any unpublished observation

which would make the work more accurate and complete. Should secrecy in regard to locality be necessary, this will be rigidly respected.

Since the "Handbook" was completed twelve years ago, such a vast amount of matter relating to distribution, migration, breeding-habits and food has been published, both at home and abroad, that the revision made necessary is a very heavy task involving the rewriting of most of these sections.

Moreover, field characters, habitat, song and 'habits' generally, to which very little space was devoted in the original work, will be greatly expanded, and these new sections are being undertaken by Mr. B. W. Tucker (with Mr. Charles Oldham's kind approbation).

The new work will be very fully illustrated in colour, the aim being to show all the birds in so far as possible all their plumages. Such a series of illus-

trations is not now available to British ornithologists and it is hoped that this new feature will greatly enhance the usefulness of the work, especially observers in the field.

The original "Practical Handbook" will be in fact so much a new work that we consider an alteration of the title to "The Handbook of British Birds" justified.

As it is proposed to publish in five volumes six-monthly intervals, beginning next spring, we shall be glad to have now any notes relating to order Passeres. It would be a convenience if observations concerning breeding habits or food were sent direct to the Rev. F. C. R. Jourdain at Bellevue Road, Southbourne, and all other notes to me at Graciosa Pond Farm, Chobham, Surrey.

H. F. WITHERBY.

July 21.

Points from Foregoing Letters

THREE new types of pleochroic haloes have been found by Prof. G. H. Henderson in the course of an extended examination of biotite specimens. Apparently these are due to certain elements of the uranium family, and are of hydrothermal origin.

A table comparing the ability of colchicine to reduce the size of plant tumours (induced in tomato plants by *B. tumefaciens*) with the effect produced by palmitic acid, by removing the flowers, or covering the terminal buds, is given by L. Havas. The author infers that colchicine, like the other factors mentioned, inhibits the growth through the intervention of plant hormones.

Dr. N. Kemmer gives a condition that must be satisfied by nuclear force-constants in order to account for the fact that nuclei with very large spin do not exist. The force constants previously derived by Volz must be altered to fulfil this condition.

Dr. Lotte Kallner concludes, from infra-red absorption spectrum observations, that in the dry crystalline state the molecules of diketopiperazine and tetramethyldiketopiperazine exist in the keto-form free from mixture with the enol-form.

A radioactive element formed in molybdenum radiated with deuterons has been investigated by Perrier and Prof. E. Segrè. They attribute the radioactivity to isotopes of atomic number 43 (nasurium), and find that their reactions are similar to those of the element rhenium.

Further experiments by Dr. J. Kunz and others show that the rotation of the plane of polarization attributed by J. Kunz and P. H. Babcock to organic compounds dissolved in various solvents, under the influence of an electric field, is in reality due to the dichroism induced in suspended particles by the electric field, a phenomenon already known.

An approximate solution of the differential equations of motion of loaded, flexible threads whirling about a vertical axis and subject to air-drag has been developed by E. R. Goshawk. The solution accounts for the limited stability of such systems and is not materially affected by the amplitude of whirl. A simple method is indicated for measuring the air resistance to the motion of cylindrical threads—rough or smooth—at high whirling speeds.

Dr. J. Woltjer, jun., points out the possibility of the existence of a self-regulating mechanism which would maintain the pulsation of a star, depending on the superposition of the oscillations of two modes of vibration, a free and a forced one.

Two types of decomposition of the methyl-ethyl and diethyl ketones in 10 per cent liquid paraffin solution, are described by Prof. R. G. W. Norrish and C. H. Bamford. They find that solvent molecules react with the radicals liberated by the photolysis.

An X-ray investigation by Dr. J. A. A. Ketelaar and E. A. Hanson of the ethyl derivative of chlorophyll, said to be the first of the chlorophyll derivatives to be examined by the X-rays, indicates that molecules are arranged in spirals.

Three crystalline pigments belonging to the group of carotenoids have been obtained by Dr. G. W. and H. Zussman from extracts of chicken retina. One is purplish red (astaxanthin), another a golden orange xanthophyll, and the third a yellow or yellow-green hydrocarbon. None of these absorbs light in the region 600–700 mμ, and the authors suggest that the chicken, like the pigeon, may be unable to discriminate hue differences in this region.

Curves showing that the maximum sensitivity of photographic plates sensitized with dye-stuffs (thiosin and phloxine) corresponds with maximum absorption by these dyes when absorbed on films of silver bromide (but not with their maximum absorption when in solution) are submitted by Natanson.

Dr. J. Needham and H. Lehmann have investigated the inhibition of embryonic glycolysis by glyceraldehyde—it is due only to *D*-glyceraldehyde. They find that the inhibition is apparently incomplete in the presence of lactic acid formation from glyceraldehyde. This is brought about by its transformation to methylglyoxal, which is then converted to lactate by glyoxalase.

S. Paramasivan reports that the paintings of the temple of Vijayalaya Cholisvaram at Nartham, Pudukottah State (South India) have been examined in a technique which is a combination of fresco and tempera. Lime, carbon, yellow and red ochre, terre verte have been used as pigments.

Research Items

The Quinault Indians, Washington, U.S.A.

THE Indians who speak a Salish dialect lived in a region of the State of Washington, of which the Quinault River, with its valley, was the heart. In addition to the region drained by the river, they also occupied a district along the beach between a point near the mouth of the Raft River and a spot near the present site of the village of Pacific Beach, or the mouth of Joe Creek. In practice, their boundaries were not strictly defined, and the feeling of ownership or exclusive right to this territory was unheard of. The heights above the source of the river were more or less common hunting ground for several neighbouring tribes. The whole region was covered with a luxuriant growth of vegetation. In 1856, they ceded part of their territory to the Government, and since then have lived in the present Quinault Indian Reservation. Between 1925 and 1927 they were visited on three occasions by Mr. Ronald L. Olson under the auspices of the Department of Anthropology, University of Washington, for the purpose of studying the vanishing relics of their tribal culture, of which there has been no systematic description (*Univ. Washington Pub. in Anthropol.*, 6, 1). "Quinault" is a corruption of "kwi'nail", the name of the largest settlement situated at the site of the present village of Taholah. A list of thirty-eight village settlements which had existed along the course of the river was obtained, while some seventy-seven place-names were collected. An approximate estimate for the population at the beginning of the nineteenth century is eight hundred. Their most important economic activity was the taking of salmon, of which the great run began in March or April. During the run, the men virtually lived at the weir, the fish being passed to the women for dressing and curing. After the run, a variety of activities was open. Some might go to the mountains for hunting elk, bear and deer, others might go to the coast to gather clams, while for every household the winter's supply of bark, grass and roots for baskets and clothing had to be gathered.

Daylight Illumination for Clerical Workers

AN interesting investigation into the problem of the daylight illumination which ought to be provided for clerical workers has been described by L. H. McDermott ("Daylight Illumination Necessary for Clerical Work", Dept. Sci. and Indust. Res., Illumination Res. Tech. Paper No. 19. Pp. iv + 14 + 2 plates. London: H.M. Stationary Office, 1937. 6d. net). A mechanical method was devised to ascertain the value of daylight illumination below which workers will make use of artificial light. Briefly, the method employed consisted in photographing a micro-ammeter connected to a photo-electric cell, the motive force for working the camera being derived from the current in the lamp circuit when the subject first switched on the light. The photo-cell was exposed to daylight in a fixed position in one of the office windows, and the reading of the micro-ammeter thus bore a definite relation to the illumination at any particular desk. This relation was determined for each desk occupied by a subject under investi-

gation, and thus it was possible to calculate the daylight illumination at any desk at the moment when the worker made use of the desk light. The results of more than a thousand observations made in a study of seventeen typists are analysed and tabulated. The illuminating value at which the average subject needed artificial light was about 5 foot-candles. Individual subjects varied somewhat in their minimum requirements, but the conclusion that 5 foot-candles is the minimum daylight illumination requirement of the average typist appears to be justified. This result can be applied to determine the average lighting-up time at any season of the year for any given point in a room if the daylight factor for that point is known, and if data concerning the variation of outdoor illumination throughout the day at all times of the year are available. A table is given showing, for positions with various daylight factors, the periods for which natural illumination is sufficient for typists working at desks with specified daylight factors. The figures relate to a non-urban locality in the south of England.

Age and Stock of Blue Whales

THE corpora lutea of whales regress into corpora albicantia, but apparently never become entirely absorbed, so that the ovaries retain a record of the total number of ovulations during the life-history of any female. From material examined in the antarctic, and ovaries extracted and sent to London by whaling factories there, together with date of length, sexual condition, and ankylosis of vertebral epiphyses, Alec H. Laurie has deduced certain important conclusions regarding the antarctic Blue whales (*Discovery Reports*, 15, 223-284, 1937; Camb. Univ. Press, 9s. net). The onset of maturity corresponds with the accumulation of eleven corpora lutea in the ovaries, and a minimum body-length of 86 feet, which is attained at ten to eleven years of age. Breeding may take place every two years at best, and a possible average rate of once in two and a half years is suggested. The oldest females taken, probably about thirty years of age, showed no sign of diminishing fertility. The age distribution of the females points to a progressive fall-off in the rate of recruitment of the stock in recent years, so much so that the author considers it now to be insufficient to compensate for the slaughter of modern intensive whaling. Another suspicious fact bearing upon the same point, is the decrease which (contrary to the analysis made by Hjort, Lie and Rrud) is shown in the average length of females captured. From 82.86 feet in 1930-31, the average length has fallen to 78.99 feet in 1935-36, which means that on an average females are killed before they have even begun to reproduce, and in accordance with this the percentage of immature females captured has risen from 15.16 in 1930-31 to 41.67 in 1935-36. These conclusions point to a serious situation. It would appear that the stock of antarctic Blue whales is steadily being encroached upon, since the annual breeding rate is insufficient to cope with the annual destruction (see also p. 180).

A Pest of the Rhododendron

MR. G. FOX WILSON has directed the attention of gardeners to the appearance in Great Britain of a leaf-hopper, *Graphocephala coccinea*, upon the leaves of species of *Rhododendron* and *Kalmia* (*J. Roy. Hort. Soc.*, 62, Pt. 5, May 1937). The pest normally inhabits the eastern half of the United States. It seems to cause little direct damage to its host, but apparently allows bacteria or fungi to enter the plant tissue, and thus induces secondary infection. Applications of nicotine are recommended where it is necessary to control the activities of the pest.

Chemical Analyses of Rocks and Minerals

BULL. 878 of the Geological Survey of the United States is devoted to a record of analyses of rocks and minerals made in the Laboratory of the U.S. Geological Survey during the years 1914-36. It is supplementary to Bull. 591, which contains the 2,789 analyses made up to January 1, 1914. In the present compilation, for which R. C. Wells, the present chief chemist, is responsible, the details of 1,533 additional analyses are given, including 444 of igneous and crystalline rocks; 303 sedimentary rocks; 115 clays and soils; 156 ores and gangue materials and 515 minerals. Although many of the analyses have already been published, a considerable number have not hitherto been recorded. Moreover, those published are very widely scattered, and some of them would be impossible to find without a great expenditure of time. The Bulletin is therefore likely to be of great value to petrologists and mineralogists. No attempt is made to recalculate the average composition of the earth's crust, but Fersman's figures for the abundance of all the elements—based on the whole of the data available up to 1932—are reproduced from their relatively inaccessible Russian source. Attention is directed to Fersman's new term *clarks* to designate a unit for indicating the relative abundance of an element, either by weight or by number of atoms, in any particular type of rock or in the earth's crust, in honour of F. W. Clarke, who did so much for geochemistry, especially on the statistical side.

Size of Particles Responsible for Ferromagnetism

DIA- and para-magnetism can be explained almost entirely on the basis of the magnetic properties of single atoms; but the phenomena associated with ferromagnetism only appear in aggregates of atoms arranged in a certain manner. These aggregates, it is estimated, should be of ultra-microscopic dimensions. It is therefore to be expected that a study of the structure of aerosols of iron and nickel with the ultra-microscope should yield some information on the size of the elementary magnets of these ferromagnetic substances. Observations by this method are reported by D. Beischer and A. Winkel (*Naturwiss.*, 25, 420; 1937). The nickel and iron aerosols were produced by the thermal decomposition of nickel tetracarbonyl and iron pentacarbonyl, respectively, in nitrogen. Examination of the aerosols under the ultra-microscope showed that the particles were chain-like. This is unusual for this type of sol, which more often forms spherical aggregates, chain-like particles being formed only when some directive force is operative. It is suggested that the force in this case is magnetic. The view is supported by the fact that

the velocity of aggregation is considerably greater than is usual with aerosols, and that if the aggregation takes place at a temperature above the Curie point, no chain-like particles are observed, but aggregation results in the formation of spherical particles. Estimation of the size of the smallest particles of which the chains are composed from the widening of the Debye-Scherrer diagram gives results which are in agreement with the requirements of the Weiss-Heisenberg theory of ferromagnetism. Experiments are also described which indicate that the magnetism of the particles is spontaneous, and not induced by the earth's field.

Polymorphic Changes of the Alkaline-Earth Carbonates

AN interesting application of Hahn's emanation method of investigating changes of structure of solids has been made in the examination of the polymorphic changes of calcium and barium carbonates (K. E. Zimens, *Naturwiss.*, 25, 429; 1937). The curve of amount of emanation evolved against temperature indicates a transition in the case of calcium carbonate from the aragonite to the hexagonal calcite structure at about 500°. The change is monotropic. Barium carbonate shows an enantiotropic change at 800° from the rhombic to the hexagonal form. A further transformation at 982°, which has been reported in the literature, could not be detected.

Mud Fluid for Pressure Drilling Conditions

A HEAVY loaded mud should be used in conjunction with pressure drilling equipment when very high pressures are to be dealt with. Also, it may be convenient to use a mud of this description in circumstances where pressure could be controlled equally effectively either by back pressure or by a loaded mud fluid, for in the event of a formation being encountered where a higher pressure exists such pressure can be immediately controlled by increasing the back pressure applied at surface. Dr. J. T. Evans, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, pointed out that the preparation of loaded muds has two stages: mixing clay or shale with water to give an ordinary rotary mud, and afterwards mixing barytes with this mud until the desired weight is achieved. It is clear that the desired final characteristics of the mud must determine the type of shale or clay to be used, but the clay best suited for a loaded mud base is not necessarily that best suited for an ordinary mud, since if ordinary mud should become viscous at slightly higher weight it would involve heavy expenditure on barytes to produce the final loaded product. This factor and the properties of weight, stability, viscosity and reaction to chemicals used to reduce viscosity should all be taken into consideration when preparing a specification for loaded mud. Then again, conditions are materially altered when the mud is put into service. Pressure, temperature, etc., are liable to have some effect on the characteristics of the mud, and these factors must be borne in mind when assessing the usefulness of a given loaded mud. Finally, it is quite probable that the admixture of drilling mud with formations penetrated and the phenomenon of thixotropy, whereby alternating gel and sol conditions are produced, will alter the characteristics of the loaded fluid in service.

Science and the Conservation of Food*

AGENCIES AFFECTING FOODS

THERE are many agencies, biological, chemical and physical, which may affect foodstuffs, either by spoiling their appearance or rendering them unfit for consumption. Bacteria are most important among the biological factors, but yeasts and moulds, which may either aid or hinder preservation, have also to be considered; and then there are such animal pests as sugar- and cheese-mites, moths, rats and beetles, all of which may damage the raw material used in food manufacture, or attack the finished products.

Food products have also to be protected from heat, dampness, the oxygen of the air and sometimes from light as well. These last two factors, acting in association, produce the bleaching or discoloration which is sometimes seen in bottled fruit, when pieces of the fruit project beyond the syrup into the space at the top of the bottle. Then again, canned food must be protected from the action of acids and salts which might corrode the tin.

There are also substances contained in the foodstuffs themselves which may have a destructive action, namely, the enzymes. These are present in both vegetable and animal cells, but they can exist independently of them. One enzyme having an important bearing on food preservation in connexion with jam-making is pectase, which, if it is allowed to do so, will destroy the pectin which is responsible for the 'setting' property of jam. Jams, in fact, present a number of problems to the manufacturer, and the way he has been helped to solve these is a good example of the assistance which science has rendered to industry.

JAMS

Substances of importance for the keeping quality of jam are held in solution in the water it contains, for example, sugar, acids and salts. The osmotic pressure of these substances, the sugar in particular, can be responsible for protecting the jam from the growth of moulds, because, for germination, a mould spore must first absorb water. If the osmotic pressure of the jam is equal to or greater than that of any spore which falls upon it, either no water will pass from the jam to the spore or the spore will lose water and so dry up and eventually die, and in both these cases its further development will be arrested. The British Food Manufacturers' Research Association has actually determined the minimum percentage of solids necessary to bring about this condition.

There is, however, still a risk of moulds developing in a jam if the relative humidity of the atmosphere to which it is exposed is above 82 per cent.. Then the jam will absorb moisture and so its osmotic pressure becomes lower than that of the mould spores.

Another defect frequently arising in jams is crystallization or granulation of the sugar. In the jam-making process, sucrose is inverted by the boiling acid, and it is necessary that just the right degree

of inversion should take place if no crystallization is to occur. Thus, if the sugar is under-inverted too much sucrose is left and this crystallizes out. If, on the other hand, it is over-inverted, too much dextrose is formed and this crystallizes out. As fruits vary very much in the amount of acid they contain, the manufacturer must be able to discover the degree of inversion taking place, and modify his process accordingly.

The setting property of jam has already been mentioned, and it is important to remember that unless jam is properly set it cannot be transported and handled. It is therefore necessary to make use of the pectin naturally occurring in fruit cells. Pectin is a complex of different substances, and therefore its properties vary from one fruit to another; for this reason the setting properties of some fruit juices are superior to those of others, for example, gooseberry, red currant and apple are good, while strawberry is poor. Now, pectin must be protected from the naturally occurring enzyme, pectase, which destroys it. So long as the cell structure remains intact, the pectase does not attack the pectin, but in fruit which has become damaged by bruising, the pectase appears to get out of control, and in the case of raspberries all the pectin may disappear in twelve hours. In this fact lies the justification for manufacturers using "added fruit juice" or "pectin" in the making of jam.

Pectin may also lose its jellifying powers by the action of prolonged heat. It is therefore necessary to eliminate any over-heating in the manufacturing process, and this is not always easy when large quantities of liquid have to be dealt with.

MEAT PRODUCTS

The processes of jam-making are more familiar to the public than those of meat preservation. An important difference to bear in mind is that meat has no natural acids to assist the preservation process. Meat, if it is to be kept, must be protected from putrefactive bacteria, which though harmless in themselves feed upon animal and vegetable debris, gradually converting them into ammonia and carbon dioxide, etc.

Refrigeration deprives the bacteria of water which is necessary for their growth, the water in the meat tissues being converted into ice. The bacteria are not necessarily killed, but their development is inhibited. Some of the bacteria can grow at temperatures around freezing point, and for this reason chilled meat cannot be kept so long as meat which is frozen at temperatures well below freezing point. The growth of bacteria can also be restrained by certain concentrations of carbon dioxide in the air.

Although the spores of some bacteria are highly resistant to heat, it has been possible to use heat sterilization as a method for meat preservation. It is, of course, necessary for the manufacturer to know the combinations of time and temperature at which all spores likely to be present will be destroyed.

* Substance of a Friday evening discourse delivered at the Royal Institution on April 16, by Mr. T. Macara, director of research of the British Food Manufacturers' Research Association.

Allowance must be made, when the product is packed in a tin, for the penetration of heat to the deepest parts of the package; and the rate of penetration will vary considerably with the density of the contents, being much slower for meat than for a tin of fluid.

FOOD POISONING

A product canned by correct processes is one of the safest articles of diet it is possible to have, and many complaints made to manufacturers that their products have caused illness, have shown on investigation to have no justification. According to Prof. Tanner of Illinois (speaking at the Congress of Microbiology, 1936), in the past cannery and distributors have tried to avoid publicity by settling their claims out of court. Medical practitioners are often unfamiliar with the procedures necessary to establish definitely the causative factors in food poisoning. There is also much prejudice on the part of the public as well as ignorance of the great care generally taken in the manufacture of these products. It has been shown in Great Britain and the United States that by far the largest number of cases of food poisoning are caused by foods which have been prepared in the home or by products sold in a pre-cooked condition, but not sterilized.

TINPLATE CONTAINERS

A difficulty, still not completely solved, is that of producing in commercial quantities the perfect tinplate for the construction of a can, or tin stopper for a glass jar. Then also, the machinery necessary in making the can may break the tin coating and expose the base metal, iron. The iron thus exposed may be attacked by the salt present in meat and

vegetable products. An attempt has been made to produce a lacquer which when applied to the tin plate would prevent this action. Several difficulties have so far prevented the realization of this ideal.

PRESERVATION OF MEAT

The preservation of meat by means of salts has long been practised, but only recently have its scientific principles been studied. The production of colour as well as preservation from putrefaction is brought about by the use of saltpetre. Bacteria action converts the nitrate of the saltpetre into nitrite, which combines with hæmoglobin, and when the meat is boiled the latter is converted into nitro-hæmochromogen, which has the bright red colour characteristic of properly cured silverside. The micrococci responsible for this action can grow in media containing as much as 20 per cent of salt, in which concentrations the putrefactive bacteria cannot exist. Nor can their spores develop in media containing as much as 10 per cent of salt.

CHOCOLATE AND CONFECTIONERY

Changes in atmospheric temperature and humidity are liable to produce changes in chocolate and confectionery. The British Food Manufacturers' Research Association has given manufacturers a great deal of help in determining the conditions necessary for the production and storage of satisfactory chocolate. In the factory, it is generally possible to secure these conditions, but in retail premises it is not so easy. If the manufacturer were able to deliver his goods direct from his warehouse to the consumer, defective products would not be so commonly seen as they are at the present time.

Conduction of Electricity in Solids

CONFERENCE AT BRISTOL

A CONFERENCE on the "Conduction of Electricity in Solids" was held at Bristol on July 13-16 under the joint auspices of the Physical Society and the University of Bristol. The discussions were opened by R. W. Pohl, who gave an account of the fundamental work on electron conductivity and photochemical processes in alkali-halide crystals carried out in his laboratory at Göttingen. The paper was mainly concerned with the properties of crystals which have been coloured either by heating in alkali vapour or in other ways, introducing colour centres called '*F*-centres'. A discussion followed on the exact nature of these *F*-centres, and, although there is as yet no certainty on this point, a hypothesis was proposed which seemed to have a good deal to recommend it, namely that an *F*-centre is an electron localized at a point in the lattice where a negative ion is missing.

Papers on phosphorescence in halide and sulphide crystals were given by R. Hilsch (Göttingen) and J. T. Randall (General Electrical Co., Ltd.) who discussed to what extent this phenomenon is related

to photoconductivity and to the transference of an electron to a large distance from the phosphorescent centre.

J. H. de Boer (Eindhoven) gave a paper by himself and E. J. W. Verwey on semi-conductors with partially filled *3d*-bands. He pointed out that the electron theory of metals in its present form is not applicable to a substance such as nickel monoxide, in which a 'band' of electron states is incompletely filled, and therefore ought to behave like a metallic conductor, but which has in fact a resistance some 10^6 times greater than a metal. Both he and R. Peierls gave indications of the way in which the theory would have to be modified to include these substances.

Subsequent papers dealt with conduction in metals. G. Borelius gave an account of the work carried out at his Institute in Stockholm on the resistance of alloys, and especially of alloys in which the atoms can take up an ordered or disordered arrangement. His own pioneer work on the treatment of this problem from the point of view of thermodynamics

described. W. L. Bragg gave a paper by himself, Sykes and A. J. Bradley on the work carried out at Manchester on the same problem.

C. H. Desch (National Physical Laboratory) gave a paper on age hardening alloys with special reference to their resistance. A. J. Bradley also mentioned his recent work on the crystal structure of the permanent magnets in the iron-nickel-aluminium alloy series, and in consequence of this a very definite model was proposed for the age hardening process, the atoms present in solid solution being supposed to collect together in groups still forming part of the crystal lattice of the original alloy. Such a process sets up intense strain, and hence hardens the alloy.

The final day was devoted to a discussion of the resistance of thin metallic films. After an initial paper by G. I. Finch (Imperial College of Science and Technology) on the structure of these films as revealed

by electron diffraction, E. T. S. Appleyard gave a paper on work carried out in Bristol on their resistance, and A. Féry and M. J. Bernamont followed with papers on work done in Paris. A distinction was drawn between metals such as the alkalis which may form a fairly uniform layer over the surface upon which they are deposited, and metals such as mercury which apparently form islands. The mechanism by which the atoms can wander on a surface and form islands was discussed by J. E. Lennard-Jones. A point upon which no agreement was reached was the negative temperature coefficient of resistance of some films, and whether it is due to occluded gases.

Full reports of the principal papers given at this meeting, together with a summary of the discussions and the main conclusions reached, will be published in September in a special number of the *Proceedings of the Physical Society*.

Beginnings of Western Science in Japan

AT the fellows' dinner held at University College, London, on April 30, Prof. Joji Sakurai, meritis professor in the Imperial University of Tokyo, president of the Imperial Academy and of the National Research Council of Japan, replied to the toast of the new honorary fellow. In the course of his remarks, Prof. Sakurai said:

"If what I have been able to do in my work in Japan is at all creditable, the credit must be traced back to my education in England and, first and most of all, to the scientific training I received in University College during the five years extending from 1876 until 1881. Dr. Alex. W. Williamson, renowned throughout the whole world for his classical investigation on the formation of ethers and renowned also for his remarkably keen insight into the atomic constitution of matter, was then professor of chemistry, and it is needless for me to say how highly I value the scientific training I received from him. I was taught physics by Prof. Carey Foster and Dr. Oliver Lodge, and the knowledge of physics has acquired was a great help to me in following the remarkably rapid development of physical chemistry which was soon to come.

"It was, however, not the scientific training alone that I received in England. The five years of my student life in England were in the latter half of Queen Victoria's reign, a period which is one of the most glorious in the whole history of England. It was a period in which some of the greatest and most illustrious of men and, also, of women were to be met with in almost every field of human activity. As statesman and orators, Lord Beaconsfield and the grand old man—Mr. Gladstone—were shining like stars of first magnitude; Tennyson was being adored as poet laureate, Ruskin as a writer and critic and George Eliot as a feminine novelist of unusual talent; Charles Darwin was enjoying to see his life-long labours bearing fruit, Herbert Spencer was laying a scientific foundation of sociology, whilst Henry Irving and Ellen Terry were, night after night, drawing crowds of enthusiastic audiences to the Lyceum.

"Having had the rare fortune of being in England at such a glorious time, I could not, and would not,

confine myself to scientific studies alone, but wishing to look upon England with more widely opened eyes I studied something of English history, of English literature, of English art and, even, of English drama. At the same time, I had the great good fortune of making some very dear and life-long friends and, through them, of knowing something of English homes and of mixing more or less in English society, all of which combined in enabling me to get a fairly accurate idea of English culture, and it was this—the knowledge of English culture—which has proved to me to be of inestimable value throughout the whole of my later life. If, therefore, my work in Japan is worth mentioning, it is to be wholly attributed to the scientific and cultural training I was able to receive during the five years of my student life in England.

"I should like to make a short reference to an important fact in the recent history of Japan, concerning Anglo-Japanese cultural relations. A few years before the Restoration, that is about seventy-five years ago, a group of five young men from Choshu came over to London in one of the sailing vessels owned by Messrs. Jardine, Matheson & Co. of Yokohama, whose correspondents in London were Messrs. Matheson & Co. The object of these young men was to make a general study and observation of Western civilization and when, after a long voyage round the Cape of Good Hope, they arrived in London they were introduced to an elderly gentleman who took every care of them and helped them in every way in their study and observation. This elderly gentleman was no other than Dr. Williamson of University College under whom, as I said before, I was a student for five years. As to what made him particularly interested in these young men and in Japan I can say nothing, but I remember him often telling me that Japan was England of the East, by which, as it appeared to me, he meant something more than mere geographical likeness of the two island empires.

"Returning to the five young men, two of them went back to Japan in the following year in consequence of important developments at home, and

plunged themselves in the great political turmoil which soon led to the Restoration. One of these two men was Shunsuke Ito—later, Prince Hirobumi Ito—who was generally regarded as the founder of modern Japan, and the other was Bunta Inoue—later, Marquis Kaoru Inoue—who was cabinet minister in the Meiji Government on several occasions. The other three also greatly distinguished themselves and occupied important positions in the new Government. Of these, Yasuke Nomura—later, Viscount Masaru Inoue—who, by the way, was living with Dr. Williamson's family for several years, laid out and ran the first railways in Japan, Yozo Yamao—later, Viscount Yozo Yamao—greatly contributed towards laying the foundation of technical education, and Kinsuke Endo was, if I remember rightly, the first master of the mint.

"Now, the most important item in the policy of the Meiji Government was the transplantation of Western sciences, the elements of which were taught by missionaries. But as time came for higher scientific education, need was felt for teachers properly equipped with the necessary knowledge and ability, and the Government naturally decided to call these teachers from England. Strange as it may appear to-day, these calls were made through the firm of Messrs Jardine, Matheson & Co. in Yokohama, which transmitted them to their correspondents in London, and the latter invariably consulted with

Dr. Williamson or somebody else named by him. The fact that Dr. Williamson intervened in this transaction of this important business was most fortunate for Japan, for the young scientific men recommended by him, either directly or indirectly for the Japanese posts all proved themselves to be most capable teachers of science, among whom the names of William Ayrton, Edward Divers, Alfred Ewing, John Milne and John Perry may especially be mentioned as those who, later, all became fellows of the Royal Society of London. These pioneers of science in Japan taught their students to study science for its own sake, themselves setting example by numerous brilliant researches and thereby greatly stimulating the spirit of original scientific work. I am particularly happy to have been given an opportunity this evening of making reference to this little piece of history, which is almost completely unknown but which shows how much Japan owes to Dr. Williamson and, through him, University College and England for the valuable help given in the early and most important stages of development of modern sciences in Japan.

"Ever since the foundation of Ramsay fellowships in 1920, Japanese Ramsay fellows have, if I remember rightly, without a single exception come to work under Prof. Donnan, with whom the cultural obligations Japan owes University College and England have thus been happily revived".

International Association for European Ethnology and Folklore

CONFERENCE AT EDINBURGH

THE International Association for European Ethnology and Folklore was formed in November, 1935. Its first Congress was held in the New College, Edinburgh, on July 14-21. The Scottish Anthropological and Folklore Society acted as hosts.

Seventy-six delegates registered as members of the Congress, the countries represented being Great Britain and Ireland, Sweden, Norway, Denmark, Finland, Lithuania, Estonia, Holland, Belgium, Switzerland, and the United States.

At the opening of the Congress, the presidential address was delivered by Prof. Herman Geijer, of the University of Uppsala. Thirty-one papers were read. Those dealing with folklore included "Remarks upon Methods of Surveying and Making Distribution Maps in the fields of Dialect and Folklore", by the president; "Scottish and Norwegian Ballads", by Prof. K. Liestøl, Oslo; "Norwegian and Gaelic Folklore", by Dr. R. Th. Christiansen, Oslo; "The Stars in Eskimo Folklore", by Prof. W. Thalbitzer, Copenhagen; "Rites", by Dr. C. W. von Sydow, Lund; and "The Origins of the Ducking-stool", by Prof. J. W. Spargo, Northwestern University, U.S.A.

Papers of technological and museum interest were "Simple Agricultural Implements of England", by Mr. R. U. Sayce, Manchester; "The Early History of Vehicles in Northern Europe", by Dr. G. Berg, Stockholm; "The Irish House", by Dr. Åke Campbell, Uppsala; and "Scandinavian Folk Museums", by Prof. Sigurd Erixon, Stockholm.

On the linguistic side, Dr. W. Grant, Aberdeen dealt with "The Scottish National Dictionary"; Mr J. C. Catford, Edinburgh, with "Scottish Dialect and the Proposed Linguistic Atlas of Scotland"; Dr G. S. Lowman, Brown University, U.S.A., with "The Linguistic Survey in the U.S.A. and Canada". Dr. R. Nordenstreng, Uppsala, made some helpful suggestions as to the solution of an ethnological problem in his paper on "The Riddle of the Finns Frisians, and Fair Broad-heads".

Among papers of particularly Scottish interest was that by Mrs. M. Macleod Banks, president of the Folklore Society, on "The Three Maries and the Mary with the Withy".

During the Congress, a 'ceilidh', arranged by Miss J. Bruce, secretary of Highland Home Industries Ltd., was performed by a group of Gaelic-speaking women; and a display of authentic Scottish country dancing was given at Roslin by a team of 'bondagers' under the supervision of Mr. Ion C. B. Jamieson.

Throughout the congress, there was on view an exhibition of ethnological and folkloristic material, of which the outstanding feature was the display of photographs and drawings of house-types and domestic and agricultural implements selected from the collection of the Irish Folklore Commission. Other exhibits were by the Landsmuseet, Uppsala; the Nordic Museum, Stockholm; H.M. Office of Works; and Highland Home Industries Ltd.

University Events

LONDON.—Sir Robert Pickard, director of the British Cotton Industry Research Association, and member of the Senate since 1926, has been elected vice-chancellor for the remainder of the year 1936-37 and for the year 1937-38. He succeeds Mr. H. L. Mason, who took up his duties as principal on July 1. Prof. J. C. Philip has been appointed deputy vice-chancellor for the year 1937-38.

Dr. William Wardlaw has been appointed to the University chair of physical chemistry tenable at Birkbeck College as from October 1. Since 1918 he has been on the teaching staff of the University of Birmingham and has held the post of senior lecturer in chemistry since 1926.

The title of professor of morbid anatomy in the University has been conferred on Dr. G. R. Cameron (Melbourne), in respect of the post held by him at University College Hospital Medical School, and that of reader in chemistry in the University on Mr. Henry Terrey, in respect of the post held by him at University College.

The degree of D.Sc. has been conferred on the following: G. P. Crowden, university reader at the London School of Hygiene and Tropical Medicine (applied physiology), G. E. R. Deacon (chemistry), I. S. Hartley (chemistry), H. L. Chhibber (geology), Dr. W. F. Whittard (geology), Marion G. Eggleton (physiology), T. H. C. Taylor (entomology), R. A. Fraser (mathematics) and H. O. Bull (zoology).

MANCHESTER.—Among the numerous appointments announced at the end of this session is one of somewhat unusual interest—that of Mr. A. D. Ritchie, at present lecturer in physiological chemistry, to the Sir Samuel Hall chair of philosophy and public administration in succession to the late Prof. J. L. Stocks. Mr. Ritchie took first-class honours in philosophy at St. Andrew's in 1911, and second-class honours in Part I Natural Sciences Tripos at Cambridge in 1914. He was elected fellow of Trinity College, Cambridge and worked on the philosophy of science, and was Tarned Lecturer in 1935. Though for the last twenty-three years he has been professionally engaged as a teacher of physiology, he has published various philosophical works in this period.

The following further appointments have also been announced: Prof. P. M. S. Blackett, professor of physics in Birkbeck College, University of London, to succeed Prof. W. L. Bragg in the Langworthy chair of physics; H. Davenport, P. Du Val and W. W. Sawyer, assistant lecturers in mathematics; G. D. Rochester, assistant lecturer in physics; D. G. Evans, assistant lecturer in chemistry in the Department of Bacteriology; E. L. Patterson, assistant lecturer in anatomy; and Miss Margaret I. Williams, assistant lecturer in applied physiology.

SHEFFIELD.—The following appointments have recently been made: J. W. Watson to be assistant lecturer in geography; Gilbert Forbes to be lecturer in forensic medicine; J. M. Kennedy to be lecturer in infectious diseases; G. A. de Belin to be assistant lecturer and research assistant in the Department of Metallurgy.

ST. ANDREWS.—A lectureship in political science has been instituted in the United College, St. Andrews, and Mr. J. M. Brown of Glasgow has been appointed to the new post. Mr. B. S. Robertson has been appointed lecturer in regional anatomy in University College, Dundee.

Science News a Century Ago

The Diet of Silkworms

At a meeting of the Paris Academy of Sciences on July 31, 1837, reported in the *Gazette Médicale de Paris* of August 5, MM. Moriset, de Clavaison and Durrand recorded the results of an experiment on the feeding of silkworms by substituting for mulberry leaves those of the Spanish *scorsonera*. The silkworms which had been so fed from the time that they had been hatched did not appear to suffer from this diet, and had produced cocoons which were in no way inferior to those of silkworms which had been given mulberry leaves at the same time. Some of the cocoons had been sent to the Academy, but did not appear to competent judges to be the product of healthy silkworms. Similar trials had previously been made at different times with the leaves of *scorsonera*, and had always been abandoned. In any event, what had encouraged the speakers to pursue the experiment was the fact that the silk industry would never acquire a great development in the south of France so long as silkworms were fed exclusively by mulberry leaves, in view of the fact that cultivation of the mulberry tree did not harmonize with the other principal cultivations in the country; whereas cultivation of *scorsonera* did very well and would yield a double profit, the root forming a wholesome food similar if not preferable to salsify root.

Hospitals in Russia

A PAPER in the *British and Foreign Medical Review* of July 1837 on the present state of medicine and medical institutions in Russia by Dr. George Lefevre, late physician to the British Embassy at St. Petersburg, contains the following account of the hospitals in that country: "Although few countries can boast of finer institutions for the sick and infirm than Russia at the present day, it has nevertheless been the work of nearly two centuries to bring them to their actual state of perfection. Commenced by a private individual, whose example was soon followed by Government, they only began to have a character of importance under Peter the Great. . . . As regards the external appearance of the hospitals in Moscow and St. Petersburg, they are splendid in the extreme, resembling more the palaces of princes than the abodes of the sick. But it is of their discipline we have to speak, and many of the regulations of these institutions are worthy of imitation by similar establishments in other parts of Europe. One great advantage they possess over charitable institutions of a similar kind in England is the daily admission of patients, the vacant beds being immediately occupied by the most urgent cases. All applicants are not admitted indiscriminately into the General Hospitals; for there are others devoted to the reception of particular diseases, as eruptive fevers, venereal diseases, etc., and persons labouring under diseases which are considered incurable are not treated in the hospitals but are admitted to almshouses. . . . As regards the internal arrangements there is no cause for complaint. The wards are spacious and lofty, the beds not too much crowded together and cleanliness is carried to a point almost deserving of ridicule. . . . The most decided defect in all these institutions is a thorough disregard of ventilation."

The Botanical Society

At a meeting of the Botanical Society held on August 3, 1937, the secretary read a letter from the Botanical Institution of Brussels requesting it might be admitted into friendly correspondence with the Society. Mr. Dannes then read a paper entitled "Observations on the Structure and Germination of the Reproductive Organs of *Marsilea*". The paper was accompanied by a translation of a memoir on the same subject, made to the Paris Academy of Sciences by MM. Mirbel, Dutrochet and St. Hilaire. In *M. quadrifolia* (which much resembles our common trefoil, excepting in its petals being furnished with an additional leaf) there is apparently a longitudinal membranous partition, containing a number of cells each enclosing an hermaphrodite flower. The stamens of these flowers are stated by Jussieu, who was the first to examine the plant minutely, to be so small, and in such numbers, as to render it impossible to count them: they open transversely, to scatter the grains of the spherical yellow pollen. Convincing proofs were adduced from the researches of Dutrochet and St. Hilaire especially, that germination takes place by the impregnation of the ovules with the antheric dust, although this has been strongly opposed by other botanists, who keep all the species of *Marsilea* in the class Cryptogamia.

The *Athenaeum* and Meteorology

In its issues of August 5 and 12, 1937, the *Athenaeum* devoted several pages to an essay on meteorology, the subject being suggested by a review of two recently published works. The first of these was by Patrick Murphy (1782-1847), and was entitled "Meteorology considered in its Connexion with Astronomy, Climate, and the Geographical Distribution of Animals and Plants". Of the author and this book the *Athenaeum* said: "We state our firm conviction, that nothing but loss can be the result of his publishing such books as the one before us". Of the other book, Graham Hutchison's "Treatise on the Causes and Principles of Meteorological Phenomena" the reviewer remarked: "This is a sensible, well-executed compilation, interspersed with some new views and explanations of meteorological facts". The subject was one in which the *Athenaeum* took a particular interest and at the beginning of the essay it said: "If there be one branch of science, more than another, which we have endeavoured to place prominently before the public, it has been Meteorology, because it appeared to us of great importance and to have been especially neglected".

The London Electrical Society

As a result of a resolution passed at a general meeting of the Electrical Society held on August 5, 1937, the Committee issued a report stating that the object for which the Society was formed, as stated in a resolution of May 16, 1937, would be fully carried into effect. The publication of papers had been deferred, as members had intimated their intention of presenting communications, after the recess, containing new facts in electrical science. Among the communications which had already been received was one from Andrew Croese, of Broomfield, near Taunton, describing some results obtained by him in producing crystals by transferring the electrical energy from the zinc and copper plates to other substances not metallic in contact with them.

Societies and Academies

Paris

Academy of Sciences, May 31 (*C.R.*, 204, 1597-'692).

JULES DRACH: The logical integration of lines differential equations: the reduction of the group

MARCEL DELÉPINE and ALAIN HORNAU: The catalysis of the Cannizzaro reaction by active nickel and platinum. The application to some aldoses. The conversion of an aldehyde into alcohol and acid by alkali (Cannizzaro reaction) is greatly accelerated by the addition of a catalyst, Raney nickel or platinum. Results are given for galactose, glucose and arabinose.

PAUL VINCHENSI: The reconstitution of the ensemble of convex bodies of n dimensional space starting from certain base sub-ensembles.

ARNAUD DINJOY: A theorem of Mandelbrojt.

JOSEPH CHALOM: Reaction pumps with supersonic flow.

ASSÈNE DATCHEFF: The solution of Schrödinger's equation.

JEAN LOUIS DESTOUCHES: The relativistic wave mechanics of systems and the interaction of light and matter.

HENRI MINOUR: Clusters of stars in kinetic equilibrium.

PAUL BOURGEOIS and JACQUES COX: The frequency of the concentrations in extra-galactic nebulae detected by Hubble's tests.

LUIGI D'AZAMBUJA: International co-operation for the continuous observation of the sun, and its first results. A summary of results obtained between July 1, 1935, and December 31, 1936. Study of the connexion between chromospheric eruptions and electrical and magnetic disturbances on the earth.

PIERRE VERNOTTE: How to formulate empirical laws. The exponential development.

HENRI LEMONDÉ: The interpretation of variation of viscosity with concentration in binary liquid mixtures.

RENÉ LUCAS: The thermal waves of liquids.

RENÉ PLANIOL: The application of molecular jet to the production of light ions.

JEAN P. E. DUCLAUX: The anodic polarization of tungsten. Study of the electrolysis of sulphuric acid with tungsten electrodes. The fall of current with time, due to the formation on the anode of a layer possessing a high resistance, depends on the condition of the surface, and is independent of the current.

VITOMIR H. PAVLOVIĆ: A new method for studying subjectively the mixture of colours.

MAURICE PARODI: Study of the transmission of some oxides in the extreme infra-red. Measurement for the oxides of manganese, strontium, cadmium and barium are given. The wave-lengths of the absorption bands plotted against the atomic number fall on a curve resembling a parabola.

HENRI BIZET and BELLING THAI: The magnetic rotatory power of compressed and of liquefied nitric oxide, NO. The experimental results suggest that the molecules of nitric oxide commence to polymerize under high pressure at -80°C . From the Verdet constant at -163°C , it is concluded that 93 per cent of the liquid is in the state of double molecule (NO)₂, and this agrees with the results of Rice, based on the entropy of vaporization.

P. BONNET-MAUBY: The utilization of photo-elements with semi-conducting layer for radioactive measurements. Selenium, or copper photo-cell

radiated with α - or β -rays, give rise to a difference of potential, exactly as with photons; the γ -rays have given no appreciable effect. The local variations of sensibility and the effects of fatigue of the element are more marked with α -rays than with photons.

M^{lle}. JULIETTE GAVOYET: The quantitative study of the adsorption of metallic cations by cellulose. The iso-electric point of cellulose.

M^{lle}. SUZANNE VEIL: The potential gradient of gelatine under electromotive force.

CASIMIR JAUSSEMAN: The anomalies of the dispersion of light by colloidal solutions of silver. Although the heterogeneity of the medium studied produces special optical properties, its refractive index can be calculated utilizing for the dispersed metal the same optical constants as those of the metal in the massive state.

M^{lle}. MARIE THÉODOROSCO: The study by the Raman effect of two molybdotartaric complex compounds in water. The results are in agreement with those found by the rotatory polarization, namely, the existence of two complex compounds, $\text{Na}_2(\text{TH}_2\text{MoO}_4)$ and $\text{Na}_2(2\text{TH}_2\text{MoO}_4)$.

CH. BÉDEL: The determination of the solubility of slightly soluble electrolytes, precipitated and in the presence of their reaction products. Application to silver chloride.

MICHEL CYMBOLISTE: The structure of electrolytic chromium.

PIERRE MASTAGLI: The reducing and condensing action of alkaline benzylates on ketones and aldehydes, and on the α , β unsaturated alcohols.

M^{lle}s. MARTHE MONTAGNE and MARGUERITE LARRY: The action of organo-magnesium compounds in the phenylimino derivatives of benzil.

CHARLES BOUHET: The Raman effect in circularly polarized light in quartz, observed along the optic axis.

LOUIS DUBRETHET: The constitution and genesis of the green Syrian rocks.

DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: The variations of temperature of atmospheric zone according to its origin.

JOSUE HEILMANN HOFFET: The genus *Trigonoides*, a stable genetic mutation of the genus *Trigonia*.

ANDRÉ EICHHORN: Chromosome enumeration and the study of mitosis in two *Crotalaria*.

JEAN TROCHAIN: A new graphical representation of the results of physical and granular analyses of the soil.

M^{lle}s. MARGUERITE COMBES: The probable existence of a higher class, not differing in appearance, forming the true workers in the Formica.

TOHOU SU and CHEN-CHAO-HSI: A new Chinese race of *Acaris megalocephala* (type *trivaleus*).

PIERRE P. GRASSE: Aberrant spermiogenesis of the Metatermitides.

JEAN VILLARD: Geographical variations of the venom of the South American rattlesnake, *Crotalus orificus*.

HENRI BIERBY: Protein sugar and blood proteins in the normal and pathological states.

V. A. KOSTITZIN: A generalization of the biological equations in the case of a population intoxicated by the products of its chemical activity.

JEAN LAVOLLAY and M^{lle}s. FRANÇOISE LABOHEY: The mathematical expression of the development of *Aspergillus niger* as a function of the concentration of magnesium of the nutritive medium.

MARIUS CHADEFAUD: The organization and the richocytes of *Gonyostomum semen*.

HENRI SIMONNET, GUSTAVE GUITTONNEAU, GERMAIN MOOQUOT and ANDRÉ EYRARD: The influence of pasteurization in the absence of air on the nutritive value of milk. The experiments described lead to the conclusion that pasteurization in the absence of air is not incompatible with the preservation of the essential nutritive qualities of milk.

Amsterdam

Royal Academy (Proc., 40, No. 6, June 1937).

L. S. ORNSTEIN: Scattering of neutrons in matter (5). A discussion of the distribution of the directions of motion of neutrons scattered by protons.

J. A. SCHOUTEN: The differential geometry of the groups of contact transformations (3). Infinitesimal doubly homogeneous contact transformations and their applications to mechanics and electrodynamics.

F. M. JÄNGER, J. A. BOTENMA and E. ROSENBOHM: Exact measurement of the specific heats of metals at high temperatures (28). The heat capacity and the electrical resistance of didymium between 300° and 600° C.

F. M. JÄNGER and J. TER BURG: On pterotactic derivatives of bivalent platinum with optically active cyclic trans-1.2 diamines.

A. G. VAN VERN and J. K. BAARS: Constitution of toxoflavin. This substance, produced by the action of *Bacterium cocovenenans*, is a di-imine containing the purine skeleton and is isomeric with methyl-xanthine.

O. POSTHUMUS: Some remarks on the vegetation on the sandy soil of the Pandang Loewai (E. Koetai, E. Borneo).

S. W. VISSER: A period of twenty-seven months in the rainfall throughout the world.

W. B. DEYS and M. J. DIJKMAN: Splitting off of gallic acid from tannin, especially from theotannin by *Aspergillus niger*.

M. J. ADRIANI: Transpiration of some halophytes cultivated in various media in comparison with that of some non-halophytes.

H. J. HARDON: Padang soil, an example of podsol in the tropical lowlands.

G. C. HIRSCH and R. F. J. VAN PULT: Rhythm of the glycogen content of the liver of the white mouse.

M. J. L. DOLS, B. C. P. JANSSEN, G. J. SIZOO and J. DE VRIES: Studies on phosphorus metabolism in normal and rachitic rats with a radioactive phosphorus isotope (see also NATURE, June 19, p. 1068).

J. J. DUYVENÉ DE WIT: Biological evidence of two new hormones by tests on *Rhodosus amarus*.

Cape Town

Royal Society of South Africa, May 19.

K. F. M. BRIGHT: The South African inter-tidal zone and its relation to ocean currents. (2) An area on the southern part of the west coast. (3) An area on the northern part of the west coast.

R. F. LAWRENCE: The odoriferous glands of South African harvest spiders. The external appearance of the odoriferous glands in some South African harvest spiders is described, as well as the colour, volatility, and smell of the secretion of the glands. The activity of the glands is considerably more marked in the large group of Laniatores, some members of which expel the secretion in the form of a fine jet. The ejection of an evil-smelling substance is most probably a defence reflex in this group of Arachnida.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN ZOOLOGY in the University College of North Wales, Bangor—The Registrar (August 7).

TEACHER OF ENGINEERING in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77, George Street, Oxford (August 14).

LECTURER IN MECHANICAL ENGINEERING in the Coventry Technical College—The Director of Education, Council House, Coventry (August 23).

JUNIOR METALLURGIST for the British Non-Ferrous Metals Research Association—The Secretary, Regent Buildings, Weston Street, N.W.1.

Official Publications Received

Great Britain and Ireland

Report on the Progress of the Discovery Committee's Investigations. Pp. 53+11 plates. (London: Colonial Office.) 3s. 6d. net. [116]

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March 1936. Pp. viii+136+9 plates. (London: H.M. Stationery Office.) 2s. 6d. net. [146]

Forestry Commission. Bulletin No. 18: Spring Frosts, with Special Reference to the Frosts of May 1936. Pp. 181+12 plates. (London: H.M. Stationery Office.) 2s. 6d. net. [146]

Carnegie United Kingdom Trust. Twenty-third Annual Report, January-December 1936, approved by the Trustees at their General Meeting held on Friday, March 6th, 1937. Pp. vi+105+18 plates. (Dunfermline: Carnegie United Kingdom Trust.) [146]

Nutrition and Health. (Gabrielle Howard Memorial Lecture.) By Sir Robert McCarrison. Pp. 26. (London and Ashford: Headley Bros.) 6 copies, 1s. [156]

University of Oxford: Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 9 (Dissertations accepted during 1936). Pp. v+272. (Oxford: Clarendon Press; London: Oxford University Press.) 3s. net. [156]

The Animal Year Book. Vol. 4. Edited by Dr. H. M. Bergmann. Pp. vi+174+10 plates. (London: University of Animal Welfare Society.) 2s. 6d. [156]

Secondary School Examinations and the Curricula of Secondary Schools, with Suggestions for Reform. An Address delivered to the Higher Education Meeting at the Portsmouth Conference of the N.U.T., 1937, by Sir Philip Hartog. Pp. 34. (London: National Union of Teachers.) Free. [166]

Proceedings of the Royal Society of Edinburgh, Session 1936-1937. Vol. 57, Part 2, No. 14: The Genetical and Mechanical Properties of Sex Chromosomes. 3: Man. By Dr. P. C. Koller. Pp. 194-214+2 plates. 2: 2d. Vol. 57, Part 3, Nos. 15, 16: Quantitative Heredity. 2: Composite Dp-ages in relation to Time; 3: Dp-ages of Gramineae. By Prof. James Small. Pp. 215-227. 1s. Vol. 57, Part 3, No. 17: Tests for Randomness in a Series of Numerical Observations. By Dr. W. O. Kermack and Lieut.-Col. A. G. McKendrick. Pp. 228-240. 1s. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [166]

List of 16 mm. Science Films. Pp. 26. 4s. List of 16 mm. Geography Teaching and Travel Films. Pp. 38. 6d. List of 16 mm. History Films. Pp. 6. Free. Supplementary Catalogue of British Medical Films of Technical Interest to Medical Practitioners and Students, Jan. 1936-Jan. 1937. Pp. 16. 6d. (London: British Film Institute.) [17]

Technical Publications of the International Tin Research and Development Council. Series B, No. 4: The Decoration of Tinplate by Printing and Varnishing. By W. H. Hoare. Pp. 24+3 plates. (London: International Tin Research and Development Council.) Free. [27]

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 7: Modern Equipment for the Poultry Farm. By Alexander Hay and D. F. C. Voiser. Pp. 11+14. (London: Rubber Growers' Association.) Free. [27]

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 48: Report of the Irish Radium Committee for the Year 1936, including Reports from St. Anne's Hospital, Dublin, and by Oliver Chance and Oswald J. Murphy. Pp. 641-665. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. [27]

Board of Education. Educational Pamphlets, No. 109: Physical Education in Germany. Pp. 80. (London: H.M. Stationery Office.) 1s. net. [27]

The Strangeways Research Laboratory, Cambridge. Report for 1936. Pp. 24. (Cambridge: Strangeways Research Laboratory.) [27]

British Wood Preserving Association. Circular No. 1: The Preservative Treatment of Estate and Farm Timber. By R. C. B. Gardner. Second edition. Pp. 36+2 plates. (London: British Wood Preserving Association.) 6d. [27]

Royal Society for the Protection of Birds. Forty-sixth Annual Report, January 1st to December 31st, 1936; with Proceedings of Annual Meeting, 1937. Pp. 116. (London: Royal Society for the Protection of Birds.) 1s. [27]

Come to Crook. Pp. 16. (Crook: Crook Development Committee.) [27]

Other Countries

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Systematics in Relation to General Biology

THE classification of living things is of prime importance, and fundamental to any biological research. Taxonomy, the law of order, is not only one of the oldest branches of biology, but also remains one that is basic to such more recently developed branches as cytology, ecology, and genetics. This fact cannot be too much stressed. It is somewhat unfortunate that a really satisfactory history of plant and animal taxonomy remains unwritten. The philosophical and logical principles underlying classification have also not received the consideration they deserve, and taxonomists themselves are often ignorant of the real implications of the working hypotheses they adopt. They are often also none too clear as to exactly what is implied by certain words and phrases, such as 'phylogeny' and 'a natural system', which have perhaps assumed a 'blessedness' they scarcely deserve.

Text-books of systematic biology, with very few exceptions, still define the aim of a natural classification as the reconstruction of the course of evolution, and seem to envisage the possibility of eventually producing a schematic tree on which each group hangs on its appropriate branchlet. That this conception rests on a confusion of thought has been suggested by many biologists, and its continued unqualified statement in taxonomic text-books is to be regretted. Perhaps the fullest discussion of the difficulties of equating a natural with a phylogenetic classification is contained in the late Dr. F. A. Bather's presidential address to the Geological Society in 1927, and the same point was stressed recently by Mr. J. S. L. Gilmour in his article "A Taxonomic Problem" in *NATURE* of June 19, p. 1040. Clear thinking on this fundamental issue is one of the most urgent needs

for the future progress of taxonomic work. The older, 'orthodox', taxonomy is based mainly on morphology (including, especially for some groups, anatomy) and with the supplementary use of geographical data, notably in higher animals. This use of morphological criteria as the basis of classification has yielded remarkably valuable results, of which taxonomists may well be proud. There is also no doubt that much yet remains to be done along the well-recognized lines of morphological description and classification, especially in many groups of invertebrates and lower cryptogams and among the faunas and floras of relatively little-explored parts of the world. It will further be generally allowed by taxonomists that there is still room for improvement in their methods of comparative description, terminology, and details of classification without involving far-reaching changes.

Within the last two decades, however, there has not only been an almost startling advance in cytology, ecology, genetics, and other sub-sciences of biology, but it has also become increasingly recognized that many discoveries classified under these heads have a bearing on orthodox taxonomy. This impact of newer methods on the still essentially morphological systems of naming and arranging animals and plants can no longer be ignored. It concerns all biologists, whatever may be their particular fields of research. There is no general agreement as to whether new subsidiary systems, with their own terminology and symbolism, should be developed as independently as possible of existing taxonomy, or whether the latter can be so expanded as to include those data of cytology, ecology, genetics, etc., that can be used as 'characters' for arranging organisms into groups.

Orthodox taxonomy has developed International Rules of Nomenclature. The use of these within their proper field is not disputed, but they may, in their present form, prove a hindrance if rigidly applied to an expanded taxonomy. The possibility and desirability of developing an all-inclusive taxonomy towards an ideal state of perfection needs full investigation.

Existing taxonomy is based on grouping animals and plants into taxonomic units termed varieties, subspecies, species, genera, families, etc. There is, however, considerable disagreement, even among specialists within one group, as to the limits of the units. A general survey of the systematic categories in different groups, a classification of the criteria used, and a careful consideration of recently discovered cytological and genetical facts might well lead to obtaining greater precision, more logical arrangement, and greater uniformity in taxonomy.

Taxonomic literature is very large, scattered in many periodicals, and very diverse in presentation and contents. Museums, herbaria and other institutions contain quantities of material and data, available to the biologist, but often not in a readily accessible form for any particular piece of research. There is, indeed, an almost unrealizable mass of material and of known facts which would yield results of the greatest biological importance if only they were collated and correlated with the rest of biology. It is to be anticipated that new generalizations of considerable importance will emerge in the process. Some of the preliminary analysis has been done, but the results are scattered and uncorrelated; the synthesis would seem to await another Darwin. The task, however, is now beyond the physical powers of any one individual.

- While taxonomy is at present based mainly on morphology, its history shows that attempts have been made from time to time to incorporate new ideas.* Thus, though taxonomy long antedates the general acceptance of the evolutionary principle, this had in time considerable effects on taxonomic theory and practice. Similarly, especially at the species level, peculiarities of distribution have been utilized in drawing limits between groups.

Of recent years, it has become increasingly evident that speciation is neither invariably a simple, clear-cut phenomenon nor due to any one cause or series of causes: rather, a number of factors, internal and external, operate in producing speciation and other evolutionary processes. Their relative importance in different groups needs

intensive and extensive investigation. Again, many relevant facts have been published, but until the scattered data have been extracted, correlated and classified, it is impossible to tell along what line and with what material new research is most likely to throw light on those questions of equal importance to the taxonomist, cytologist, ecologist, and geneticist. It is certain, however, that a great deal of new research is necessary before the problems even of speciation can be solved. The development of biology along synthetic lines does not mean the abandonment of analytical methods in special research. It means rather their intensification, but with a co-ordination at present largely lacking. The collection of material for the eventual publication of a British Fauna and a British Flora on uniform and broad biological lines should serve as a stimulus to research and as a focus for co-ordination.

Many kinds of biological research involve the recording and interpretation of large masses of facts. With proper help and advice, valuable work can be done by local societies, amateurs, schools and colleges. Such research, properly conducted, can have a twofold value: observations or experiments can be made over a wide area or for a long period of time; and they are of very considerable educational value to the persons making them.

Taxonomists, and indeed other biologists, frequently complain that their subject is not well taught in universities and schools. There is much truth in this complaint, and the modification of teaching methods and syllabuses is an urgent need. Students not infrequently know much about the anatomy of a plant or animal without knowing anything about it as a living organism or its relationships to other organisms. The revivification of taxonomy by expanding its scope to include data from other branches of biology and the realization of what they can gain from taxonomy would in itself tend to encourage greater attention to its careful teaching.

That the time is ripe for increased co-operation between workers in different branches of biology will, it is hoped, be acknowledged. In this connexion the recent formation of an "Association for the Study of Systematics in Relation to General Biology", an account of which was published in *NATURE* of July 24, p. 163, is of special interest. The work of the Association should do much to stimulate interest and co-operation in the various aspects of the impact of modern biological thought on the problems of taxonomy.

Indian Ethnography

The Khārīās

By Sarat Chandra Roy and Ramesh Chandra Roy. Vol. 1. Pp. xv+306+27 plates. Vol. 2. Pp. i+307-530+lviii+13 plates. (Ranchi: "Man in India" Office, 1937.) 11 rupees.

STUDENTS of tribe and caste in India are well acquainted with Sarat Chandra Roy's excellent studies of the wild tribes of Orissa and the Central Provinces, of which the results are contained in his works on the Mundas, Oraons, Birhors and Bhuiyas. We are now given two interesting volumes on the Khārīās, who are to be found in Orissa and the eastern portion of the Central Provinces. Following the established order of such works, particulars are given of the origin, migration, physical traits, culture, social organization, birth, marriage and death rites, festivals and superstitions. Dr. Marett gives the work a short introduction, and there are numerous illustrations.

There are three branches of these primitive people, the Erenga or Hill Khārīās, the more civilized Dudh Khārīās, and the Delki or Dhelki Khārīās. The Hill section of this tribe still live by a system of cultivation known as *Jhum* in the eastern and *Kumri* in the western provinces of India. This consists in burning down large tracts of forest and sowing scanty crops in the ashes. As the forest is destroyed by this process, the population moves to fresh areas for a source of livelihood. The other divisions of the tribe have adopted more settled forms of agriculture.

The two large volumes containing the fruits of Sarat Chandra Roy's research offer, as was to be expected, much resemblance to the accounts of similar tribal units in other parts of India. We find traces of totemism, a system of ancestor worship, the belief in and propitiation of evil spirits, a form of medicinal treatment based partly on the use of vegetable products and partly on spirit scaring, and a firm belief in omens and witchcraft. The totem section among the Khārīās is known as *Kili* or *Khili*, corresponding to the *devak*, *bedagu* or *bali* of western India. The author gives the name of many totem divisions which apparently bear close resemblance to those of similar tribes in other parts of the country; but here, it may be noted, identification is rendered difficult by lack of adequate description of the tree or animal referred to. The vernacular names are an inadequate guide, particularly in the case of trees which bear many vernacular names in different areas.

In this connexion, special interest is attached to the list contained on pp. 458-460 in vol. 2. The author is here giving his reader the names of a number of trees of which the products are used for medicinal purposes. It will be at once discovered that the botanical names are those of well-known totems of other parts of India, as for example, *Lausonia alba*, *Phyllanthus emblica*, *Achyranthes aspera*, *Artocarpus Lakoocha*, *Bombax malabaricum*, *Eugenia Jambolana* and the well-known *Calotropis gigantea*.

The importance of this list lies in the fact that it has been often assumed that there is a close connexion between the medicinal value of certain trees and their adoption as the totem of an exogamous unit. Significance, therefore, is attached to the fact that among the Khārīās, a very primitive tribe, such value is found in the very same trees that the Marāthas and allied castes hold in totemistic relationship on the other side of India.

Russell, in his "Tribes and Castes of the Central Provinces", pp. 445 *et seq.*, describes the Khārīās as a primitive Kolarian tribe which appear to be allied to the Mundas and Savars. He considers them to be an elder branch of the Mundas. He describes them as very dirty in their persons, with features of a low character, not unlike the Bhumij, but with an absence of any strongly marked type.

In the "Linguistic Survey of India", the Khārīā language has been declared to be closely allied to Savara, and to resemble Korku and Juang. It has ceased to be a typical Munda language, according to Sir George Grierson. Sarat Chandra Roy, as was to be expected from the results of similar investigation in other areas, finds evidence that the first spirits to be personified and deified were those of ancestors. He writes:

"This is why we find among all sections of the Munda tribes, the worship of ancestor spirits. One's parents and other near relatives whom the Khārīā loved and honoured when they were living cannot fail to be regarded with love and reverence after they were dead. Spirits of ancestors who were revered and looked up to as *Sins* or village elders during their life-time are especially remembered and honoured after death" (p. 315).

The late Sir James Campbell, in his notes on the spirit basis of "Belief and Custom" published in the *Indian Antiquary*, held a similar theory, and proceeded to show by numerous examples collected in western India how the original practice

of spirit soaring by various well-known rites developed into a system of spirit 'squaring', whereby suitable propitiation was made to the spirit and a lodging found for him where he would be content to dwell without further troubling the helpless victims of his attention. This process of propitiation for the *Dubo* or ill-disposed spirits is described by Sarat Chandra Roy. In addition to ancestral spirits, as might be expected, Khārīās worship a host of minor deities, of which details will be found in Chapter xi. Above them all is the supreme spirit known as Poromosor, an obvious corruption of the Hindu title of Parameshwar.

We must close this short notice of Sarat Chandra

Roy's valuable work by an acknowledgment of the assistance such studies are to those interested in the Ethnographic Survey of India, now represented by a constantly increasing flow of works of this description. If a word of criticism may be permitted, it would take the form of a regret that so many misprints are allowed to disfigure these pages. They are quite unusually numerous, and, strangely enough, we have a consistent wrong spelling of the well-known name of the author of "Tribes and Castes of the Central Provinces". The illustrations, mostly reproductions of photographs, are greatly lacking in clearness of outline, and thus lose much of their value.

R. E. ENTHOVEN.

Afforestation in the Lake District

Afforestation in the Lake District:

a Reply to the Forestry Commission's White Paper of 28th August, 1936. By H. H. Symonds. Pp. xxi + 97 + 4 plates. (London: J. M. Dent and Sons, Ltd., 1936.) 2s. net.

IT is well known there has been considerable controversy over the afforestation work which has been and is being undertaken by the Forestry Commission. Mr. Symonds has written a small book dealing with the Lake District in this connexion, and Lord Howard of Penrith contributes a foreword. A joint informal committee of the Forest Commission and the Council for the Preservation of Rural England was appointed. The author details the various results of the meetings, the questions asked in Parliament and comments in the Press on the Forestry Commission's proposals.

Opposition to the proposals to afforest parts of the Lake District is based in part on the monotony of scenery introduced by commercial afforestation. "The sitka spruce and Norway spruce—the staple diet of waterlogged ground—Douglas fir, Corsican pine—how they repeat themselves; ages ago they learnt their lesson, and the 'damnable iteration' of them is an offence: they have the air of mass production, the efficiency of the machine." The author states that his book is not an argument against afforestation or conifers. But he points out that while conifer stands, after first youth, may look magnificent on the Alps, Jura or the Rockies, they are out of place in the fells of Cumberland which are on so small a scale that they "depend for their grandeur on a system of

natural proportions which you can spoil, but not alter". As Lord Ullswater has said, the problem is one "of taste, discretion and degree".

If one of the reasons for planting in the Lake District was to give work to the unemployed, it would seem a pity that the Forestry Commission did not avoid controversy, for the work of the forester is exposed to many dangers on an antagonistic countryside, by agreeing to plant broad-leaved trees only, and mixed woodland, as suggested by the author. Some valuable experience would have been obtained on the subject as to the elevation to which some of these species can be taken, and amenity would have been safeguarded; since the forester who knows his job should have been able to adapt his plantings to harmonize with, and not spoil, a piece of countryside the beauty of which has for long been a household word in Great Britain, even amongst many who have never seen it. It would be an interesting piece of work demanding skill and considerable knowledge; a different type of work, it may be admitted, from the monotonous planting of young conifers on a more or less uniform pattern. The question of the longer period the nation would have to wait for a return in money does not appear to be of so great importance in the Lake District, where other advantages are already being reaped.

The author puts up a strong plea for the preservation of the sheep farming and the Herdwick strain, both of which must disappear with any considerable afforestation in the Lake District owing to the fact that of necessity all the lower ground would be planted up, and thus the sheep disturbance would be complete. The Forestry Commission

planting proposals will involve the displacement of more than 5,000 of this local breed of sheep.

Mr. Symonds also deals categorically with the question of the extra unemployed that the scheme would provide for and the question of small holdings. On both these subjects he displays ample local knowledge, and his remarks on the subject of the prospects before the small holder, especially of one unacquainted with the locality, merit consideration.

Mr. Symonds' little book appears to sum up the present position. To many, the Lake District is a thing apart; and when the total area involved and the comparative small size of the conifer woodlands to be established is taken into account, it would appear that the Forestry Commissioners here have the chance of justifying the useful position they have taken in the country by leaving the beauty spots alone, and planting, where planting must be, with hardwoods.

Insect and Allied Pests of Fruits

The Pests of Fruits and Hops

By Dr. A. M. Massee. (Agricultural and Horticultural Handbooks.) Pp. 294 + 27 plates. (London: Crosby Lockwood and Son, Ltd., 1937.) 15s. net.

THE production of profitable fruit crops is dependent upon a variety of factors, some beyond the control of the grower, others being within his control. The factor of pest incidence in an orchard or plantation is one of extreme importance, for while the occurrence of some species—resident pests—are within the plantman's control, others—migratory pests—are to an extent beyond control, and the presence of the latter group are frequently undetected until irreparable damage is committed.

Great advances in fruit culture have been made during the past twenty years, and an increasing number of scientific investigators are engaged upon the elucidation of problems connected with this important industry. Entomologically speaking, the changes have been great both as regards new and troublesome pests, namely, capsid bugs, fruit tree red spider mite, and tarsonemid mites; the appreciation of virus infection and the part played by insects in their transmission; the measures for controlling pests by the introduction of tar-distillate egg-killing washes, petroleum oils, and *Derris* and *Pyrethrum* preparations; and the evolution of high-powered machinery for the application of insecticidal and fungicidal washes and dusts.

It may appear strange that this much-needed volume is only the third standard work dealing with the pests of fruit which has appeared in forty years. To those, however, who are familiar with Miss Ormerod's "Handbook of Insects Injurious to Orchard and Bush Fruits", published in 1898, and with the monumental work of Prof. Theobald, published in 1909, it is less curious, for these

authors produced works which were classics in their particular line.

The present author, while purposely omitting technical descriptions of insects, has attempted to place before fruit-growers and students a simple and brief account of some of the more important insect and allied pests that occur on top and soft fruits and on hops. Simplicity of expression is a matter of degree, and while the specialist may consider the account of the several pests to be simple, the layman may think otherwise.

Technicalities are wisely omitted, but the inclusion of some information relative to the more important orders of insects and allied animals would have allowed the lay reader to appreciate the varied life-cycles, feeding habits, and metamorphoses of the several groups of arthropods mentioned in the text. Again, the inclusion of a simple key, with figures, to the larval stages of insects, would enable the practical man to differentiate between the larvae of the Endopterygota without seeking for such information in the body of the work.

The volume is well illustrated with more than a hundred photographs taken by Mr. R. M. Greenalade, who is Dr. Massee's colleague at the East Malling Research Station. An author would prefer to have the illustrations placed near the description of the pest, and it is unfortunate that publishers frequently fail to attain this desirable end. One example will suffice, namely Plate iv (facing p. 36) illustrates bark beetles and shot hole borers and the damage committed by them, but these pests are described on pp. 181-183—an unfortunate misplacement.

To illustrate insect species without descriptive matter is of little value either to the specialist or to the fruit-grower, for while the former is taught not to depend on an illustration for purposes of

identification the latter is tempted to make his specimen fit the figure. For example, Plate viii illustrates eight species of tortricid moths, but one fails to find any description of the several species on pp. 60-66.

Careful proof-reading has reduced the number of errors to a negligible quantity, and the inclusion of three indexes—scientific, popular, and author—is of immense value both to those who read and to those who scan a textbook.

The author is not hopeful of the standardization of scientific names of insects. The laws of priority must of necessity be obeyed, and as such the standardizing of generic and specific names will take time. The applied entomologist is not blameless in this respect, for he, too, has the habit of changing names; for example, the coccid, *Lecanium corni* Bouché, though long known as the 'peach scale' following its appellation the 'brown scale', is now termed the 'European fruit scale'!

Of the fifteen chapters, eleven deal with fruit pests arranged under their respective hosts, which are arranged alphabetically, and one chapter (xii) is devoted to a review of the pests of hops. Chapter xiii discusses beneficial and harmless insects, while the penultimate chapter deals with insecticides. The final chapter, entitled "Spraying Equipment and Methods", has been written by Mr. J. Turnbull, the Ministry of Agriculture's specialist on the subject.

A limited number of references conclude the

note on each pest described, but the omission of references in the case of Chapter xiv requires to be rectified in a second edition. It is apparent both in the notes on control measures and more especially in the chapter on spraying equipment and methods that the book is written primarily for the fruit-grower rather than for the owner of smaller establishments. This is unfortunate, for the earlier works of Miss Ormerod and Prof. Theobald are examples worthy of assimilation, in that these authors never failed to appreciate the difficulties both of the owner of large plantations and of the amateur gardener.

It is strange to read the author's statement (p. 233) that the 'cauliflower' disease of strawberry is probably due to virus infection, for the work of Dr. Margaret Lacey indicates that a bacterial organism is concerned with this malformation.

Notwithstanding these several criticisms, Dr. Massee, who is recognized as the foremost pomological entomologist in Great Britain, has produced a work of outstanding merit which will long remain a classic. It will be welcomed by the fruit-growing community, the biologist, the student, and by all who are interested in fruit culture. The author has not sought to embellish his story with scientific jargon; the simplicity of phrase, though worthy of emulation, is rare; and Dr. Massee shines despite of it, thereby showing his eminence in the field of biology.

G. FOX-WILSON.

Experimental Optics

Introduction to Optics

By Dr. G. B. Deodhar. Pp. xii + 614 + 21 plates. (Allahabad: The Indian Press, Ltd., 1936.)

THE term 'Introduction' applied to a text-book on a branch of physics gives little idea of the standard and scope of the work. Those who are familiar with the customary method of teaching optics will understand what is implied in this case from the fact that the work is based upon the author's lectures delivered to degree students in the University of Allahabad. It is assumed that the reader is familiar with the elementary principles of physics, such as are taught to pupils during their last school year, or to students during the first year at a university. In Great Britain the work would be regarded as suitable for an ordinary degree course in optics but as falling short of the standard required in an honours course.

The author tells us that he is especially con-

cerned in keeping the experimental side of the subject in the foreground and that the treatment is chiefly non-mathematical in character. The first six chapters are devoted to geometrical optics and the remaining thirteen chapters to physical optics. The book is large, consisting of some six hundred pages, and the syllabus of subjects is complete and adequate.

In the treatment of geometrical optics, the author adopts the Abbé sign convention, which chooses oppositely directed axial directions for the location of object and image. He thus falls in with a custom which is becoming more and more widely adopted. His convention with regard to angles is confusing, and is not necessary. He introduces the reader to the 'principal points' in a simple and interesting manner; but he ought to have elaborated the brief explanation of his points in this connexion. He ought also to have given a fuller account of telescopic systems.

Many practical questions on the investigation of lens systems are treated, and this is certain to be helpful to the student reader. In the treatment of interference, diffraction and polarization, the author keeps very closely to the methods of some well-known writers on the subject of physical optics, and makes use of familiar diagrams. He makes some improvement in the presentation of the formula for the resolving power of the microscope, but again errs by being too sparing in the discussion. The last few chapters are concerned with Bohr's theory of spectra, with colour, photography and the ether experiments.

A work of this kind must be judged to some extent on the basis of the purpose for which it is written, but some general criticisms arise in connection with it. There are several well-known standard text-books on this subject, and a new one ought not merely to add to their number. It must either introduce new matter or present the old in a novel and better way. The present volume does not justify itself on these grounds;

indeed the author accepts the old subjects and methods.

There is also the question as to what the nature of an introduction should be. Is it to introduce the reader to a very wide range of subjects, with the sacrifice of thorough study in the case of most of them, or should it treat a more limited range in which the principles are well illustrated and in which superficiality can be avoided? In this book, with its brief references to subjects not always well moulded into the general plan, the author creates the impression that he is afraid of leaving something out. It would appear that he favours the introduction to a wide range. But at the present time, when all branches of physics are becoming more and more bewildering in detail and extent, students require guidance to those parts of the subject where principles can be soundly grasped. Depth of study is an urgent need, and it is suggested that this book will be improved as an introduction to optics if the author will consider this point in modifying future editions.

Advanced Dynamics

Dynamics

Part 2. By A. S. Ramsey. Pp. xi+344. (Cambridge: At the University Press, 1937.) 15s.

THE publication in 1929 of Mr. Ramsey's excellent dynamics for the use of higher divisions in schools and for first-year students at universities has called forth many requests for similar treatment of the more advanced parts of the subject. The present volume has therefore been written as a continuation of the course so well laid out in the earlier book. It amplifies both the dynamics of the particle and of rigid bodies, and extends the discussion to three dimensions sufficiently far to meet the requirements of an honours degree. It also includes the use of generalized co-ordinates, motion under no forces and the motion of tops and gyrostats. The author has had the advantage of drawing freely from the late Dr. Besant's "Treatise on Dynamics" which was a model of conciseness and lucid exposition, and which, although revised by Mr. Ramsey some twenty years ago, is now out of print.

The plan of the book has been skilfully devised so that the inherent difficulties of the subject may be intelligently surmounted by the average student. There are twelve interesting chapters,

abundantly illustrated by seventy fully worked-out examples, most of which are taken from recent examination papers. This is done to represent the kind of knowledge which is expected of present-day students, but it is apt to confine the subject-matter within somewhat artificial boundaries, especially if the syllabus to be covered is traditionally academic. This, however, is not the fault of any author who sets out to deal with a specific syllabus, and, whilst the content of the present volume is undoubtedly academic, the treatment is thoroughly fresh and stimulating. Practical topics, such as longitude, gyrostats, gyrostatic compasses, etc., are touched upon, though mainly from a theoretical point of view.

The book closes with an appendix on vectors and their applications, for the author does not wholly approve of the principle of establishing the fundamental equations of dynamics by vectorial methods, which he rightly regards as a modern fashion not designed to become permanent.

There is an abundant supply of examples for the use of the student, and each set is roughly divided into two groups, one of easier problems and the other of a more difficult character. The book will undoubtedly be of great value to all students who are training to become mathematical specialists.

F. G. W. B.

The Ancient Burial-Mounds of England

By L. V. Grinsell. Pp. xiii+240+24 plates. (London: Methuen and Co., Ltd., 1936.) 12s. 6d. net.

MR. GRINSELL is an enthusiast about his subject; and although he does not profess to be a scientifically trained archaeologist, if he fails to inspire the reader with his own enthusiasm, it will not be the fault of his excellent descriptions of the barrows of England. He includes all that the amateur will desire to know of the history of the study of barrows, of their types and chronology, of burial customs, of their folk-lore and of their local names. He describes the methods of study in field-work and by excavation. Finally, he gives a detailed topographical list of these monuments, of which the only criticism to be made is that it is more complete for the south of England than it is for the north. The illustrations are good, though small. Brief bibliographies are given for the benefit of those who wish to carry their studies further.

Handbuch der biologischen Arbeitsmethoden

Herausgegeben von Prof. Dr. Emil Abderhalden. Lief. 460. Abt. V: Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus, Teil 10, Heft 6. Allgemeine und vergleichende Physiologie. Eine Verstärkeranordnung zur Registrierung gehirnelektrischer Spannungen, von Rudolf Ottenthal; Neue kataphoretische Verfahren, von Hugo Theorell; Lichtelektrische Zellen und ihre Anwendung für wissenschaftliche Messungen, von Marie Wreschner. Pp. 1075-1234. (Berlin und Wien: Urban und Schwarzenberg, 1936.) 9 gold marks.

THE first paper describes an amplifier designed to work an oscillograph for recording electrical changes in the intact brain. The arrangement consists of a three-stage resistance capacity amplifier containing two pentode valves followed by a triode. The values of the various condensers and resistances are chosen to give a long time-constant, and the author claims an undistorted amplification of 70,500, constant over a frequency range of 10-500 cycles per second.

An interesting application is described in which two amplifiers are simultaneously led off from the same cranial electrodes, thereby giving two oscillograms on the same photographic paper. One instrument responds normally over the complete frequency range, while the other, by means of large capacity condensers arranged in parallel with the anode resistances of the first two stages, amplifies efficiently only at frequencies of 1-10 cycles per second. From the two simultaneous oscillograms an approximate curve analysis is obtained.

The second paper describes an improved type of kataphoresis apparatus in which it is possible to maintain the solution at a constant pH value. Several examples of its application for the investigation of biochemical material are quoted, such as references to work on flavin, Warburg's respiratory co-enzyme, cytochrome c, blood serum, and the anti-pernicious anaemia principle of liver.

In a larger type of apparatus suitable for the purifica-

tion of various substances, the cell has a greater cross sectional area, and parchment paper diaphragms are employed to separate the intermediate buffer solution.

The third paper commences with a fairly comprehensive survey of present-day knowledge of photo-electric phenomena, and includes a number of useful references. This section is followed by detailed descriptions of different types of photo-electric cell and their characteristics. The remainder of the paper is devoted to descriptions of numerous applications including microphotometry, spectrophotometry, colorimetry, nephelometry, pyrometry and polarimetry.

Die mathematischen Hilfsmittel des Physikers:

Von Prof. Dr. Erwin Madelung. Unter Mitarbeit von Dr. Karl Boehle und Dr. Siegfried Flugge. (D Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, herausgegeben von R. Courant Band 4.) Dritte vermehrte und verbesserte Auflage. Pp. xiii+381. (Berlin: Julius Springer, 1936) 28.80 gold marks.

THIS book falls into two distinct parts: mathematics and physics. The third edition differs from the second (published about twelve years ago) in respect of a more systematic handling of the subjects, the introduction of much new matter, including a chapter on group theory, and a complete rewriting of the chapter on quantum theory. The author's object is to provide for physicists a précis of those parts of mathematics which shall be of direct use and which could only be otherwise obtained by consulting a large variety of text-books. In the second part of the book the equations of mathematical physics are formulated.

The result is excellent as a piece of clever condensation, but one cannot help feeling that to make any adequate use of matter in such concise form—practically no proofs or illustrations are given—the reader will have to consult the text-book after all. For the mathematician or physicist, however, the work affords admirable and useful summaries in their respective subjects.

Faithful Rebels:

A Study in Jewish Speculative Thought. By Dr. Israel Levine. Pp. viii+146. (London: The Soncino Press, 1936.) 6s. net.

IN this work Dr. Israel Levine, the head of the Philosophy Department, University College, Exeter discusses the outstanding contributions to philosophy by Jewish thinkers from biblical times down to the present day. In the oldest writings of Hebrew culture as represented by the Book of Job and Ecclesiastes and the works of Philo and Maimonides little philosophy is to be found, and it is not until the middle of the seventeenth century that Jewish philosophy begins with Spinoza, while in the nineteenth and present centuries Marx represents economic science and Bergson metaphysics. Dr. Levine comes to the conclusion that science and philosophy are not really native to the Hebrew genius, but require for their development the stimulus of alien culture and the raw material of alien contact.

The Natural Philosophy of Paintings

By F. Ian G. Rawlins

IN his inaugural lecture in 1936 as Tait professor of natural philosophy in the University of Edinburgh, Prof. Max Born referred to an essential difference between science and art. Mathematical and physical theories deserve well if they meet the intellectual needs of their period, whereas the creations of great artists are for all time. It might appear from this that mankind is obliged to reckon with continuous change in his scientific concepts, and can hope to find rest unto his soul only in the static nature of art. However this may be, it is no purpose of the present article to insist upon such a distinction, but on the contrary, rather to inquire into the conditions which exist (or may exist) tending to bring the worker in the exact sciences into contact with the world of art and its problems.

One such opening is obvious enough—the task of applied physics and chemistry in assisting the curator in the conservation of paintings, both by a knowledge of materials as such and by devising methods of improving the environment in which objects of supreme value are housed. Progress along these directions is not difficult to trace. There are laboratories specially equipped for such studies at the Fogg Art Museum in the United States, at the Louvre in Paris, the National Museum in Lisbon, and three in London—at the British Museum, the Courtauld Institute (Norman Wilkinson Foundation) and the National Gallery. Much has been learnt at all these places; but it is clear that basic questions relating to the behaviour of paintings in certain circumstances remain unanswered, and that a fair amount of the data so far collected is little more than empirical.

In Great Britain, co-operation with specialist institutions under the Department of Scientific and Industrial Research has proved both interesting and effective. The experiments needed are so many-sided that no one laboratory could expect to cope with more than a fraction of them.

There is another way in which physics and chemistry may help. This is in the prosecution of systematic studies relating to the technique of the old masters: the search for forgeries and their possible establishment are notoriously difficult tasks, but if and when such results are possible, it is not infrequently as a by-product of the careful investigation of painters' methods in general. There is much to be said for the regular use of X-ray analysis to assist the student of art history

in his researches, and as a check upon the conclusions which he may reach on stylistic grounds. It is no part of scientific method to attempt to do what only 'an eye for a picture' can, in the end, accomplish; nevertheless, investigators will not refuse objective evidence when it can be forthcoming. Fortunately, favourable cases do arise.

Yet another possibility can be visualized, difficult as it is. In much the same way as physics and philosophy are to some extent conterminous, so a detailed study of art history leads naturally to the necessity of exploring the mind of the artist, and consequently the outlook of his time. Thus art history and psychology tend to share common ground. Doubtless, a large number of pictures were commissioned and executed according to rigid conditions prevailing in the ideas of the period, yet here and there examples appear which seem to indicate that the work in question was brought into being in the subconscious mind of the artist and is thus a document of the deepest significance. It is a far cry to the day when anything of this nature might conceivably be demonstrable experimentally; what is important at the moment is the infiltration of scientific method into the attempt to effect a closer synthesis between our appreciation of works of art as they are, and the mental and cultural background which produced them. A work of art is an organized whole, possessing shape as well as tone; above all, it is no mere accident, and in its fashioning the artist may be presumed to have given of his best. These conditions approximate to the law of *prägnanz* in the psychology of Gestalt. It may be here that, in the last resort, a natural philosophy of paintings may be found.

The immediate problem is the application of scientific principles to paintings in the matter of conservation, restoration, environment and in the systematic study of technique. A major consideration is that of safety. No risks can be entertained for a moment, and therefore much may have to be learnt upon models, or (by the artificial reproduction of conditions. The essential characteristic of a painting—mural or panel—is its stratified structure. In order, there are (a) the support or carrier, for example, plaster or wood, (b) the ground, (c) the paint film, (d) the surface or varnish film. According to the varying methods of different schools, modifications of this sequence

may arise; but it represents the normal state of affairs, and the one with which the scientific investigator usually has to deal. Clearly, of the four, the paint film is of the greatest interest to the beholder, for it is in fact 'the picture', as generally understood.

From this arrangement the scope of physical and chemical investigations can be gauged. First comes the need for accurate knowledge of the physico-chemical properties of plaster and wood. Secondly, the ground is perhaps composed of 'gesso', a water paint containing lime as its main constituent, and often the seat of an involved system of cracks, which may influence the layer above. Thirdly, the paint film is a most complicated phase, comprising pigment plus binding medium. Fourthly, the varnish film is not an exact chemical entity, and its properties change considerably with time. All these layers react to some extent upon one another, more especially with regard to relative flexibility. Chemical reactions in the paint film sometimes generate fissures akin to geological phenomena on a minute scale.

In general, the paint film may be constructed in a variety of ways. The pigments may be embedded in a previously prepared surface, or they may be powdered with a suitable medium (as in ordinary oil painting), or again they may be applied to a dry surface and afterwards fixed by some kind of spraying.

As in other branches of science, physical methods may be preferable to chemical ones in that no sampling or removal of minute fragments of material is required. When, however, it is necessary to know for certain the composition of a pigment, then it has long been the custom to detach a microscopic amount from some inconspicuous part of a picture (under the rabbet of the frame for example) and to subject it to chemical or spectroscopic analysis. In very favourable cases, observation with a polarizing microscope will give a clue to the nature of a pigment *in situ*, by reference to crystallographic properties, colour and index of refraction. An extremely illuminating method—when conditions allow—is to use a micro-borer, and so to obtain, in the form of a minute cylinder, samples of all the different strata. Microscopical examination of the core, at a magnification of about one hundred diameters, reveals the constituents clearly.

The possibilities of X-ray work are considerable, and at several institutions systematic use is being made of them. The whole process, so far as pictures are concerned, depends for its success upon the particular pigments and technique in question. It is by no means of universal application. Exceedingly thin films of paint, such as

those sometimes used by the Venetians, are frequently too transparent to offer any appreciable resistance, except perhaps to the very softest radiation. However, areas containing much lead or mercury, in the neighbourhood of compounds like the lakes, composed of elements of low atomic weight, make excellent subjects, and a wealth of detail is often revealed. Sometimes the experienced eye can perceive the presence of an outline under the visible paint layer: X-ray photographs supply the objective proof. The uses to which such photographs can be put are several. If it is proposed to remove over-paint, the extent of the original picture left can be determined before any action is taken. Again, a previous version of a composition may be discovered or, as has happened lately, the work of two artists can be distinguished.

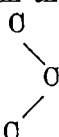
It remains now to discuss some external factors which influence the condition of paintings, and to which it is possible to apply scientific methods. For many years there has been an increasing movement for the abolition of the glasses from pictures in the national collections. From the students' point of view such a course would have everything to recommend it. In practice, however, difficulties are encountered. Experiments have shown that the surface of a canvas, if unglazed, is usually cooler than the air of the gallery, and consequently condensation of moisture sets in, forming a thin wet film over the varnish. Dust and smoke particles settle on this film, and create in time a dull, dirty layer, easily removable in some cases, but by no means in all without risk to the varnish. The cure, theoretically, is a complete air-conditioning and filtering plant. Observations in the National Gallery have demonstrated that for every pound of carbonaceous material per million cubic yards of atmosphere in the immediate neighbourhood of the gallery, 0.7 lb. is present within the building. This is an average figure for the interior as a whole, and seems to represent a fairly constant quantity. In any event, there is a strong argument for air-conditioning in museums and galleries if objects of art are to be seen at their best.

Perhaps the greatest need of all, as indicated already, is a closer understanding between the outlook of the student of art history and that of the scientific investigator. Co-operation for practical ends like conservation and protection there must obviously be. But the ultimate aim is a more intimate fusion of the two ways of thinking, such as would lead to the appreciation of a work of art as an object of the profoundest symbolism. Some of the great masters were intellectuals of a high order, as well as supreme craftsmen. To know them better is to broaden our concept of natural philosophy.

Agricultural Products as Raw Materials for Industry*

TO what extent is agriculture likely in the future to supply the raw materials for industry in addition to food and textiles, her main customers to-day? The answer to this question involves a forecast of both demand and supply: whether the nature of the demands will alter, and whether in meeting them materials or manufacturing methods will change fundamentally. Biochemistry and biotechnology are of great significance for the future of industry, but their value will be judged largely by their power to save expenditure of material and energy. For more than a century, organic chemists have been investigating the atomic structure of the products of organic life, and the new weapons, X-rays and electron diffraction, have been of great service.

Although we still know very little of the mechanism used by Nature in synthesizing these complex substances, it is clear that they are built up on comparatively simple models. Starch, cellulose, hemicellulose, and the pectins appear to be built up from hexose units like glucose, though possibly the primary unit is a triose, like glycerin, containing three carbon atoms, since the units $C_3 - C_3$ and $C_3 - C_3 - C_3$ occur frequently in plant products and the transformation $2C_3 = C_6$ presents no difficulty to Nature. Vegetable oils, fats and waxes are built up of long chains from units of six carbon atoms. Essential oils, resin and rubber are built up from the unit C_5H_8 with

a branched carbon skeleton  $C - C - C$, which

may be regarded as their parent substance; and from the same unit the plant can construct the terpenes and diterpenes, which have ring structures. The resins are more complex, containing twenty or more atoms, but of similar type.

Proteins are derived from the union of ammonia with carbon-chain units; amino-acids are formed, and their molecules combine to make long chains, like fibroin, the chief protein constituent of natural silk. Long chains similar to these, but folded into rings, are the structural units of the vegetable proteins found in many seeds and tubers. Many alkaloids also can be regarded as built up in the plant through the medium of amino-acids.

The mode of formation of chlorophyll—the key substance in the living world—is obscure; it presents us with the old problem of the hen and

the egg, for chlorophyll is essential for the synthesis of carbohydrates, but carbohydrates are required to make chlorophyll. Many natural flavouring substances, for example, eugenol, are built up upon a $C_6 - C_3$ skeleton, and this group may be doubled to give constituents of many resins, or with the addition of a C_2 group to give the catechins, found in the tannins, and in anthocyanins, the colouring matter of many plants.

Although Nature synthesizes her complex products from simple units with an ease and certainty that tantalizes the chemist, by elucidating their structure, he has succeeded in synthesizing many of them artificially. Nevertheless Nature has proved to be a cheaper producer than the factory, and is likely to remain so. Many so-called synthetic substances, for example, camphor and ionone (the perfume of violets), are made from vegetable products in which the carbon skeleton has already been formed by the plant, and they are thus the result of chemical processing.

Of greater significance from the point of view of displacement of plant products, is the use of cracked oil gas and natural gas in the United States as starting-points for the manufacture of organic chemicals, and also their production from water gas by catalytic processes, and from calcium carbide made in the electric furnace. Here there is direct competition with the products of the fermentation industry and of wood distillation. Synthetic 'rubber' made from cracked oil gas is another example of this competition. On the other hand, the more detailed knowledge of plant products has led to great developments in their extraction and utilization, for example, the process of fat-hardening, the conversion of molasses into alcohol, glycerin, acetone and other solvents, and the production of furfural from cereal wastes for use as a solvent or as a constituent of plastics. Research has also opened up completely new fields, such as the cellulose products and synthetic resins or plastics, in which agricultural materials like casein, glycerin, soya bean are finding fresh outlets. The possibilities of plastics are great; at present they are handicapped by high cost, moulding powder costing £75 to £100 a ton, and the great pressures required for moulding thermo-plastics are expensive to apply to large articles.

The present percentage utilization of agricultural produce in the world is, on a value basis, roughly: food 86-88, textiles 9-8, and other industries 5-4, so that the consumption by industry is at most only 12-15 per cent of the total production, and

* Based upon the Mather Lecture given by Sir Harold Hartley to the Textile Institute on June 11.

of this textiles account for about two thirds. On this basis it is estimated that the value of farm, field and forest products used in industry now amounts to about one half that of mineral products, that is, to one third of the whole value of industrial raw materials.

The extent to which agricultural materials may replace minerals and metals will depend on physical properties and cost. Some plastics are suitable for replacing metals; the use of synthetic resins as adhesives, and the improvements in the manufacture of laminated wood already make it a successful rival to metal in many fields, for the new products possess such advantages as absence of fatigue, high ratio of strength to weight, and resistance to corrosion, whilst the defects of wood due to local weakness are eliminated by the laminated structure. Rubber is also supplanting metal in fields where its elasticity, freedom from abrasion, and value in reducing noise are required. Laminated wood is finding many applications in building construction owing to its strength, lightness and low cost; and the substitution of nitrocellulose and synthetic resins for the older natural resins, and that of the new solvents and plasticizers for the older and cruder materials of the forest-produced type, all in the main involve the use of processed agricultural products. The cost of producing fermentation alcohol from molasses, at 2d. a gallon, is estimated at 9d. a gallon; and from maize at 2s. a bushel, at 1s. 3d. a gallon; but the cost of petrol at the refinery without tax is 3d. a gallon; its use to-day as motor fuel is only justifiable on strategic grounds, but when petroleum supplies begin to contract, alcohol will be in a better competitive position. There has been a very great development in the use of new packing materials, made of wood, textiles, cellulose, Cellophane, etc., but mineral oils have been replacing vegetable oils for lubrication, although the total consumption of the latter has not declined.

In the United States, the Farm Chemurgic Council is working strenuously to promote the use of American farm products; and the Department of Agriculture, with its numerous associations, is admirably equipped for research and development work in this connexion; as also in the wider field of finding new crops like soya bean, tung oil and southern pine, to replace products now imported. Success will depend on the co-operation of industry in providing factories for processing the raw materials and the research necessary to find new and cheaper methods of using them. The utilization of farm wastes and by-products is being investigated; already cull citrus fruits in California are being processed for producing citric acid, citrus oils and pectin, but an economic method for using waste farm cellulose for paper, strawboard,

insulating material or packing has yet to be found. Within the last decade, the soya bean has become a major crop in the United States. One ton of it yields about 250 lb. of oil and 1,600 lb. of meal. The oil is used in edible products and in making paints, enamels, varnishes, linoleum, soap, glycerol and printing inks. The meal is mainly used in foodstuffs, but a good deal goes to the manufacture of protein glues, paper sizes, washable wall-papers and protein plastics. Mr. Henry Ford has been one of the pioneers of this new crop. It is estimated that the annual output of a million Ford cars involves the consumption of the following quantities of farm produce: cotton 80 million lb., maize 500,000 bushels, linseed oil 2.4 million lb., molasses 2.5 million gals., wool 3.2 million lb., leather 1.5 million sq. ft., hogs 20,000 (to supply lard for lubricants, oleic acid and bristles for brushes), mohair 350,000 lb., and soya bean oil 2 million lb. (for making enamel).

The discovery of new uses for established crops is well exemplified by research on cotton, which has disclosed the effect of fibre fineness on the strength of cotton yarns. Extensive breeding and selection are showing how to improve this characteristic in American cottons. Strength and durability are needed in cotton used for making bags and bagging, and a fresh outlet here is the development of duplex open and close-mesh fabric bags for packing fruits and vegetables, millions of which have been sold. The use of cotton fabric for reinforcing tarred roads has been investigated and with seeming success. After the road bed has been levelled and primed with tar, the cotton fabric is laid down and then covered with alternate dressings of asphalt, road metal and chips, which are consolidated with a heavy roller. Strenuous efforts are being made to find new uses for maize. In the Middle West about 7 per cent of the maize crop is processed for industrial purposes, the main products being starch, dextrin, corn syrup, dextrine, corn oil and cake. Finally, sugar or starch derived from second-grade maize or other grain, sugar-beet, and molasses is being converted into industrial solvents.

The energy and skill with which all these investigations are being pursued is beyond praise. The answer to the question posed in the first sentence cannot be definite. The use of carbon compounds is certainly being extended, and perhaps we are approaching a cellulose-plastic age. But the chemist cannot vie with Nature in the cheap production of complex organic molecules: and the future lies in closer association between them. Such a development of the use of agricultural products would be most fortunate in view of the gradual exhaustion of our capital assets, coal and oil.

New Zealand Fish Oils

By F. B. Shorland

ALTHOUGH the fish life of New Zealand waters offers many interesting and unusual features, the study of the fish oils has, until quite recently, been practically neglected. The earlier work included an analysis of sting-ray liver oil by Donovan¹ and more extensive researches on the food values of New Zealand fish initiated by Malcolm in 1920. During the course of these investigations the oil content of the flesh from various fish was examined^{2,3} and the fats of red

A. australis, have received considerable attention. It was found that the body oil (comprising so much as 20 per cent of the total weight of the fish) had a vitamin A potency approaching that of cod liver oil, while the traces of oil in the liver were extremely rich in this vitamin^{2,3}. McIntosh and Shorland⁴ established a general similarity between the composition of the component fatty acids of *A. aucklandii* and that of typical freshwater fats of the northern hemisphere analysed by Lovern¹⁰,

CHARACTERISTICS OF SOME NEW ZEALAND AND OTHER FISH LIVER OILS

Species	Body weight	Liver weight	% Oil	Iodine value	Saponification value	% Unsat. matter	% Vitamin A (Elem. 328 mg) 10	
New Zealand	Ling (<i>Gerypterius blacodes</i>)	20 lb.	1 lb 7 oz	35	137-153	183-189	2-4	0.6-0.7 (usually)
	English hake (<i>Merluccius gayi</i>)	18 lb	1 lb. 6 oz	35	132-143	185-187	2-4	0.3-0.8
	Groper (<i>Polyprion oxygeneios</i>)	10 lb.	6 oz	5-10 (usually)	82-122	176-197	3-15	0.5-5.0
	Bass (<i>Polyprion americanus</i>)	somewhat heavier than groper	8 oz.	5-10	78-131	175-191	4-16	1.0-4.5
North Sea	Cod* (<i>Gadus morhua</i>)	17 lb.	14 oz	60-70	140-180	180-190	1	0.01-0.05
	Halibut* (<i>Hippoglossus vulgaris</i>)	60 lb	1 lb	20	111-171	150-175	8-22	0.2-1.0 (usually 1-1.5)
	Hake (<i>Merluccius merluccius</i>)	—	—	—	140-159	184-186	0.9-1.7	similar to cod liver oil
Chilean	¹⁴ (<i>Merluccius gayi</i>)	—	—	—	185	176	2.0	similar to cod liver oil
	¹⁴ <i>Gerypterius blacodes</i> and <i>G. chilensis</i>	—	—	—	160	188	0.2	somewhat stronger than cod liver oil.

* Typical values from the results of various investigations.

cod (*Physiculus bachus*) in relation to its food were studied. The fat content was less in winter than in summer, indicating a depletion of reserves during the scanty winter feeding⁴. Although tarakihi (*Dactylopagrus macropterus*) flesh was found⁵ to contain appreciable amounts of vitamin A, none could be detected either in the ether extract of this flesh or in the ether extracts from the flesh and liver of red cod⁴.

Denz and Shorland⁷ discovered in 1934 that the larger edible fish of Cook Strait, including ling, English hake and in particular groper and bass, yielded liver oils of much higher vitamin A potency than had generally been recorded in the case of North Sea fish. In contrast with the fish which had hitherto been examined by other investigators, the vitamin A content of ling liver was not found to exhibit any marked seasonal variation⁸.

Lately, New Zealand freshwater eels, of which there are two species, *Anguilla aucklandii* and

thus confirming the difference between the marine and freshwater types of fat. An examination of the C₁₈ unsaturated acids showed the presence of oleic and stearidonic acids. Neither linoleic nor linolenic acid could, however, be detected⁹. Edisbury, Lovern and Morton¹¹ showed that the ratio of non-liver vitamin A to liver vitamin A of *A. aucklandii* tended to increase with age, while the increased vitamin content of the body oil in the older fish was correlated with the oil content of the tissue.

In many instances, fish oils of high vitamin A potency are also good sources of vitamin D. Cunningham¹² reported vitamin D values of 2,250 and 500 for groper and ling liver oils respectively, as compared with 100 international units per gram for good cod liver oil. Skate (*Raja nasuta*) liver oil and the body oil of freshwater eel gave, respectively, the lower values of 15 and 47.

The deep-sea fishing industry of Cook Strait, which provides the commercial liver oils, is rather

limited on account of the small area of the banks. About 8,000 cwt. of groper and 2,000-4,000 cwt. of ling are caught annually, together with smaller quantities of English hake and bass. In other large centres such as Auckland, smaller fish, including snapper, tarakihi and flounders, predominate, and although some of these yield a small proportion of vitamin-rich oil the livers invariably weigh less than 2 oz.

Cook Strait elasmobranch liver oils are not rich in vitamin A. Skate (*Raja nasuta*) liver oil, for example, is less potent than cod liver oil. Oils from individual livers are sometimes exceptionally potent. That from a bass contained 10 per cent vitamin A, while a swordfish from North Auckland yielded a liver oil with some 14 per cent of this vitamin.

An examination of the properties of the liver oils given in the accompanying table for the same or similar species inhabiting different waters suggests that the composition and vitamin A content are sometimes determined more by environment than by biological considerations of species.

Observations on the properties of groper liver oils, which will be published in detail elsewhere, show that the winter oils, especially during July and August, approach the upper limit given in the table as regards vitamin A content, iodine value, and percentage of unsaponifiable matter. During the intensive feeding of October and November, these values approach the lower limit and the livers become softer owing to the infiltration of fat, which in some instances increases the oil content to 20 per cent of the liver weight. The oil from *Sardinia neopilcharda*, a source of food at this time, gave no reaction for vitamin A. Seasonal changes in the properties of groper liver oils thus appear to be associated with alternate intensive feeding and relative starvation. The North Sea halibut affords an interesting contrast with groper in that the potency of the liver oil is lowest in winter but rises to a maximum during the seasonal increase of diatomaceous food in the spring¹. Winter groper liver oil is exceptional in containing as much as 20 per cent phosphatide. An analysis of the component fatty acids of these oils is being made under the direction of Prof. T. P. Hilditch, of the University of Liverpool. Examination of other fat depots including the roe, head and stomach failed to reveal the presence of vitamin A except in the stomach oil.

Further work on ling liver oil at present in progress substantiates the lack of marked seasonal variation of vitamin A content or in yield of oil as determined by ether extraction. Of the total fat present in the fish, more than 96 per cent is concentrated in the liver, and during spawning

less than 0.5 per cent of this fat is transferred to the roe. The ether extract from the ova gave no Carr-Price test, while that from the stomach showed a value of 800. Lack of seasonal variation in the vitamin A content during spawning seems to be explained by the fact that the production of ova requires an insignificant drain on the liver oil. Both cod and halibut appear to derive their vitamin-rich liver oils from food relatively deficient in this vitamin by a process of intensive storage^{12,14}. In these circumstances, it is not surprising to find that the livers from the older fish contain a higher concentration of vitamin A^{15,17}. In the case of Cook Strait ling, however, the chief food is whiptail^{18,19}, which is rich in vitamin A (a specimen taken from a ling stomach, for example, yielded an oil giving a Carr-Price value of 75), so that relatively little storage is necessary to produce a vitamin-rich liver. In confirmation of this observation, the larger livers from the older fish have not been found to yield a more potent oil than the smaller livers.

Ling liver oil is distinguished from typical liver oils of the North Sea by the higher content of C₁, unsaturated acids (35-40 per cent as compared with 27-30 per cent) and the low proportions of palmitoleic acid (7-10 per cent as compared with 15-18 per cent). The ether extract from the roe contains about 56 per cent phosphatide. As in the case of animal fats, the phosphatide fraction is richer in C₁ and C₂, highly unsaturated acids than the glyceride fraction. The relative proportions of C₁, C₂, acids in the liver, viscera, roe glyceride and roe phosphatide may be given approximately as 35, 45, 40 and 50 per cent respectively.

I wish to record my sincere appreciation and thanks to the directors of the British Drug Houses, Ltd., London, for generously placing their analytical laboratories at my disposal. Thanks are also due to Mr. T. T. Cooking of that laboratory for valuable advice, to Prof. T. P. Hilditch for his continued interest and to the Department of Scientific and Industrial Research, New Zealand, for a scholarship.

¹ Donovan, *Trans. N.S. Inst.*, 58, 59 (1920).

² Johnson, *ibid.*, 58, 30 (1920).

³ Johnson, *ibid.*, 58, 472 (1921).

⁴ Carter and Malcolm, *ibid.*, 58, 647 (1920).

⁵ Malcolm, *ibid.*, 57, 879 (1919).

⁶ Malcolm, *ibid.*, 58, 650 (1920).

⁷ Dens and Shortland, *N.S. J. Sci. Tech.*, 15, 327 (1934).

⁸ Shortland, *ibid.*, 15, 313 (1935).

⁹ Shortland and McIntosh, *Biochem. J.*, 30, 1775 (1936).

¹⁰ Lovern, *ibid.*, 28, 1978 (1933).

¹¹ Edisbury, Lovern and Morton, *ibid.*, 31, 416 (1937).

¹² Cunningham, *N.S. J. Sci. Tech.*, 17, 503 (1935).

¹³ Drummond and Hilditch, *Empire Marketing Board Rep.* No. 35 (1930).

¹⁴ Pfister, *Pharm. Z.*, 31, 933 (1936); *Chem. Abstr.*, 30, 7887 (1936).

¹⁵ Lovern, Edisbury and Morton, *Biochem. J.*, 27, 1461 (1933).

¹⁶ Lovern and Sharp, *ibid.*, 27, 1470 (1933).

¹⁷ Macpherson, *NATURE*, 128, 35 (1932).

¹⁸ Phillips, *Trans. N.S. Inst.*, 58, 525 (1920).

Obituary Notices

Dr. J. W. Capstick

JOHN WALTON CAPSTICK, who took a prominent part in the work of the Cavendish Laboratory from 1891 to 1898, and in the administration of Trinity College from 1895 until 1910, was born at Lancaster on August 31, 1858, and educated at the 'Friends School' in that town. In 1880 he went to Owens College, Manchester, which was then a part of Victoria University; he won at Owens the senior Dalton mathematical scholarship in 1882 and took first class honours in mathematics at the examination for the B.A. degree at the University of London in 1883. He then took a teaching post in the University of Dundee, saved some money, and entered Trinity College, Cambridge, as a sub-sizar in 1888. He was elected to a sizarship in 1889 and to a scholarship in 1890. He took a first class in Part I of the Natural Sciences Tripos in 1890, and one in Part II, with distinction in both physics and chemistry, in 1891.

In that year, Capstick began original research at the Cavendish Laboratory on the values of the ratio of the specific heats in gaseous compounds of various types. He was a very good experimenter, a skilful manipulator, and very persevering, and was never content until he always got consistent results. These researches, which gave valuable additions to our knowledge, were published in two papers in the *Philosophical Transactions of the Royal Society* for 1894 and 1895. They had much to do with his election to the Courts Trotter scholarship in 1892 and to a Trinity fellowship in 1893. His next research was on the relation between the 'cathode fall of potential' in compound gases of different types; he was, however, unable to get consistent results; we know now that a mere trace of impurity produces a great effect on the cathode fall, and to remove these traces requires methods of producing high vacua which had not been invented at that time.

In 1895 Capstick was appointed lecturer in natural sciences in Trinity College in succession to Glazebrook, who had been appointed senior bursar; he gave lectures at the laboratory to candidates for the Natural Sciences Tripos, and in 1898 he took over the lectures for medical students which Glazebrook had given for many years. He was appointed to the very arduous post of junior bursar at Trinity College in 1910, and though he still continued to give some lectures at the Laboratory he had no time for research. He was a very successful junior bursar; he liked the work and did it very well.

Capstick had an exceptionally wide range of interests and activities. He took an interest in motoring from its very early stages, and kept in touch with its development. Thus, he was one of the first to drive a motor-tricycle, then he tried a steam car; he must have tried about half a dozen types of cars in his time and was always convinced that the new one was much better than the last. He turned his skill as a driver to good purpose during the Great War; he volunteered for the Red Cross, and for a

year drove a motor ambulance for the French Army. He was always anxious to help other people. When at the very beginning of the War the Cloisters in Nevilles Court in Trinity College were used for a military hospital, he visited the hospital regularly and often after talking to a patient he would take his photograph and give him copies to send home to his friends. He was an expert photographer, but it required more than photography to think of doing a deed like this.

Capstick had a great love for music, and it was one of the chief interests of his life. For many years he took the leading part in teaching acoustics to the candidates for musical degrees. He was not merely a good lecturer on music but was also a good musician and a good player of that exceedingly difficult instrument the French horn. For years a regular attendant and valued member of the orchestra of the Cambridge University Musical Society.

Capstick's health broke down suddenly about five years ago, and for the rest of his days he had to live the life of an invalid; he died at his house in Cambridge on April 27. His old friends cherish the memory of the help, the kindness and the good companionship they received from him. J. J. T.

Prof. S. Pennington

PROF. SYDNEY PENNINGTON, who died at Newport, Salop, on July 19, was born in 1869 and received his early education at Giggleswick School under the headmastership of the Rev. George Style. After leaving school in 1888 he had four years experience of practical agriculture in Shropshire. The next three years he spent in study at the Royal (Dick) Veterinary College, Edinburgh, and the Royal Veterinary College, London, obtaining the diploma of M.R.C.V.S. in 1895. After this he again returned to farming until 1902, when he decided to enter upon another course of study. Consequently, at an age considerably beyond that at which men now commence their academic career, and with a very thorough knowledge of farming practice, he proceeded to the University of Edinburgh, whence he graduated with the degree of B.Sc. in Agriculture in 1905. His first teaching appointment was as lecturer in veterinary hygiene in the School of Agriculture at Ghizeh in Egypt. In 1908 he returned home, and was in that year appointed lecturer in agriculture at what was then University College, Reading. In recognition of his work he was elected the first professor of agriculture at Reading in 1920. After twenty-five years service to the University of Reading, he retired in 1933, and was accorded the title of emeritus professor.

Pennington will be remembered best as a great teacher by the many agricultural students who passed through his classes. He was himself so full of enthusiasm for his subject that he readily infected others and especially young minds. This was even more marked in his farm classes, where he drew so largely from his personal experiences. He had the secret

of making his students feel they were listening to one who spoke from living contact with a living world. In addition to his teaching duties, Prof. Pennington had charge of the University Farm. When he commenced his work at Reading in 1908 he set himself the task of grading up a herd of dairy shorthorn cattle that would be eligible for registration in Coates' herd book, and at the same time of establishing a herd of cows on the University Farm free from tuberculosis and of good milking type. This he accomplished several years before his retirement, and the herd remains as a record of achievement on the present University Farm. The herd of dairy shorthorns at the National Institute for Research in Dairying was founded largely on cattle of Pennington's breeding.

Though neither an orator nor debater, Prof. Pennington spoke with a sincerity of conviction and a directness of purpose that commanded attention. He loved what was best in literature and art, and gathered together a surprising amount of knowledge and information on many and varied subjects. He was absolutely devoid of pretentiousness or seeking after effect. Pennington carried into everyday life a dignity of thought and conduct that unconsciously raised the tone of those about him.

J. S. L. WALDIE.

Count Robert de Montessus de Ballore

ROBERT FERNAND BERNARD DE MONTESSUS DE BALLORE, whose death occurred towards the end of 1936, was born at Lyons on May 20, 1870. He belonged to one of the oldest families of Burgundy. His mother was a great-granddaughter of Philibert de Commerson, the botanist of the Bougainville expedition, his uncle Ferdinand de Montessus was known as an ornithologist, and his elder brother Fernand was a distinguished seismologist who founded an observatory at Santiago in Chile. For a time Robert de Montessus contemplated a military career, but in his late twenties he made up his mind that such a life was incompatible with a streak of independence in his character, and he began to study mathematics at the Sorbonne. In 1903, while still preparing a dissertation for his doctorate, he was invited to Lille by his friend Robert d'Adhémar, himself a distinguished mathematician, and there he was appointed professor of general mathematics in the Faculty of Science.

Robert de Montessus worked in many fields. Algebra owes to him a fundamental simplification in the use of Sturm's theorem, based on the method of successive approximations; his process is one for evaluating, to an arbitrary degree of accuracy, the real roots of numerical equations, transcendental as well as algebraic. The theory of elliptic functions attracted his attention, and he was stimulated by Halphen's pioneering work to obtain beautiful theorems on the representation, the singularities, and the classification, of algebraic skew curves; he studied carefully the twisted quartic of the first kind, that is, the curve of intersection of two quadrics, showing in detail as Halphen had shown in general terms that the current co-ordinates on this curve are expressible as elliptic functions of a single parameter.

In an important memoir on algebraic continued fractions, which was crowned by the Academy of Sciences, de Montessus presented a body of results constituting great advances in this difficult theory. Starting from a certain fraction which is convergent throughout the whole plane, except possibly on the rectilinear segment joining two points if the function represented by the fraction has two singularities, he deduced that analytic continuation by means of a continued fraction is not impeded by poles, or by algebraic or logarithmic singularities.

In his later years, de Montessus devoted much attention to the theory of probability, which he proposed to found on Bernoulli's theorem, regarded as an experimental fact. He tried also to find a satisfactory theory of correlation which should be applicable when the number of observations is small, and he developed some ingenious ideas on weighted probabilities.

About twenty years ago, de Montessus undertook the publication of the "Index Generalis", an annual reference work now well known throughout the scientific world and of inestimable value to every investigator. It is hard to conjecture the number of practical difficulties which de Montessus had to overcome in organizing this immense mass of data on the universities and learned societies of the world; the scientific qualities of which he had given evidence elsewhere came to his aid here.

In 1931, during a mission to Central Europe on behalf of the French Government, de Montessus gave courses of lectures on various branches of mathematics in Warsaw, Cracow, Lwow, Budapest, Vienna and other universities.

Robert de Montessus, has left the memory of a modest and conscientious scholar, an upright man, and a firm friend.

HENRI VILLAT.

We are indebted to Mr. E. Mather for the information that the early training of his father, Prof. Mather, was that of an engineer, not that of a carpenter as stated in the obituary notice in *NATURE* of July 17. Prof. Mather came from a family of engineers. We also learn that, during the Great War, Prof. Mather devoted much time to the invention and development of a device for giving warning of the approach of enemy aircraft.

We regret to announce the following deaths:

Prof. P. E. Brown, head of the Department of Agronomy in the Iowa State College, known for his work in soil science, on July 8, aged fifty-one years.

Lieut.-Colonel E. G. Ffrench, known for his researches in tropical medicine, especially dermatology, on July 25.

Prof. D. M. Lewis, emeritus professor of physics in the University College of Wales, Aberystwyth, on July 28, aged eighty-five years.

Prof. J. Wilhelm Michaelsen, head of the Department of Natural History in the Hamburg Museum, an authority on the Oligochaeta, on February 18, aged seventy-six years.

News and Views

Prof. R. A. Sampson, F.R.S.

THE retirement of Prof. R. A. Sampson from the position of Astronomer Royal for Scotland has been recently announced, and will shortly take effect. He has held this office, which is associated with the professorship of astronomy in the University of Edinburgh, since 1910 when he succeeded Sir Frank Dyson on the appointment of the latter as Astronomer Royal at Greenwich. Prof. Sampson's career has been long, varied and distinguished. His earlier years were spent in posts mainly mathematical, and it was only comparatively late in life that he was able to devote all his time, during the twenty-seven years at Edinburgh, to the pursuit of astronomy. But much of his astronomical work had already been done in the earlier period. Happily, this is not the occasion—may it be long distant—when it is necessary to give biographical details or to assess the value of scientific achievements. But it is interesting to recall that Prof. Sampson was the first product of the Isaac Newton studentships (1891–3), then lately founded by Mr. F. McClean, for he gained this prize a year after his election to a fellowship at St. John's College, Cambridge, where his mathematical career had been eminently successful. Between 1893 and 1910 he held a mathematical professorship first at the Durham College of Science, Newcastle-upon-Tyne, and after 1896 at the University of Durham, where (after 1908) he was also professor of astronomy.

PROF. SAMPSON'S first work on a large scale was the editing of the astronomical papers of J. C. Adams, which demanded critical qualities of no common kind. But the work with which Sampson's name will always be associated is that on the four great satellites of Jupiter. This fell into three main phases, all involving immense labour. The first was the reduction of the photometric observations of eclipses of the satellites made at Harvard, the second was the subsequent production of "Tables of Jupiter's Four Great Satellites". These were carried out at Durham. The third phase was a memoir (1921) containing the theory of the four great satellites of Jupiter. The whole of this work constitutes a monument of industry and power. Much else of Prof. Sampson's work in the domain of optics, solar physics, time-keeping and other subjects are of value, but need no more than mention here. The recent history of the Edinburgh Observatory, with the provision of a 36-in. reflector, is too familiar to call for description. Born in 1866, Prof. Sampson has seen the revolutionary change which has influenced the development of the science to which his life's work has been devoted. A sincere hope may be expressed that he will for many years to come have the happiness of seeing the progress of astronomy continue in the manner he has himself so clearly appreciated. (See also p. 229.)

Prof. J. H. Burn

PROF. J. H. BURN has been appointed to the chair of pharmacology in the University of Oxford. At Cambridge, Burn was president of the Union. After serving as a temporary lieutenant in the Royal Engineers he obtained his M.B. degree in 1920, and joined the staff of the National Institute for Medical Research under Sir Henry Dale. In 1925, he was appointed director of the Pharmacological Department of the College of the Pharmaceutical Society of Great Britain. Later he became Dean of the College, and was given the title of professor of pharmacology in the University of London. During the last twelve years he has been responsible for thousands of pharmacological tests carried out on behalf of manufacturing firms. This work has given him an unrivalled experience of the fundamental scientific work upon which a great industry depends. Through his own work, and that of his colleagues, he has devised new tests and improved old ones for a large number of hormones, vitamins, synthetic chemotherapeutic agents, and plant extracts. Besides all this, he has found time to do fundamental pharmacological work, particularly on vasoconstrictor and vasodilator nerves, and to write several books. He has built up a department which is not only famous for its contributions to knowledge, but has also had a direct effect in raising the standard of pharmaceutical products in Great Britain. With the appointment of Prof. Burn, Oxford should look forward to a period of great activity in her Department of Pharmacology.

Dr. H. S. Harrison

IN October next, Dr. H. S. Harrison will retire from the staff of the Horniman Museum, Forest Hill, London, S.E., after thirty-three years service. Dr. Harrison was appointed curator in succession to R. Quick in 1904, not long after the Museum had been transferred to the London County Council by the late Mr. E. J. Horniman. Dr. Harrison re-organized and extended the collections, and the Museum became, and continued to be, under his direction an important centre for lectures on subjects illustrated in the collections, more especially in connexion with the County Council's scheme of lectures for the teachers of the London schools. The value of the collections for the general public was much enhanced by the series of small popular guides written by Dr. Harrison, more especially those on technology, of which "From Stone to Steel" is now in its third edition. Dr. Harrison was formerly honorary secretary of the Royal Anthropological Institute, edited its *Journal* for some years after he relinquished that office, and was president of the Institute in 1935–37. In 1930 he presided over the Anthropological Section at the Bristol meeting of the British Association, when his presidential address, which dealt with the diffusion

of culture, aroused no little interest both in Great Britain and, more especially, in the United States by his well-balanced handling of the subject. Dr. Harrison will be succeeded at the Horniman Museum by Dr. L. W. G. Malcolm, who since 1935 had been a member of the inspectorate of the London County Council, and has been engaged in organizing arrangements for the further utilization of the resources of the museum collections of London by the pupils of London schools as part of the educational curriculum. Dr. Malcolm, on coming to England from Australia, was trained as an anthropologist at Cambridge by Dr. Haddon and in Germany. He was formerly curator of the ethnographical collections in the Bristol Municipal Museum and later conservator of the Wellcome Historical Medical Museum.

British Pharmaceutical Conference at Liverpool

THE seventy-fourth British Pharmaceutical Conference was held on July 26-30 at Liverpool, this being the fourth occasion upon which Liverpool has given hospitality to the Conference. Mr. T. E. Leecher delivered his presidential address entitled "Pharmacy Today—Its Responsibilities" the main theme of which was the contrast between the important contribution made by pharmaceutical research to the national well-being and the lack of official recognition of this service. Many painstaking chemical, pharmaceutical and biological investigations, said Mr. Leecher, have resulted in placing the treatment of disease increasingly on a scientific basis by the discovery of specific remedies which remove the cause of disease rather than alleviate its symptoms and, of almost equal importance, have, where necessary, enabled these remedies to be taken in a form which does not cause the patient to rebel against them. In view of such achievements, it is surprising that the pharmacist has not received the recognition which his work and responsibilities deserve and which his Continental confrère enjoys. The present system of allowing anyone to handle the majority of drugs and medicines on payment of a five-shilling licence annually encourages the exploitation of the public by the distribution of 'cure-alls' without the slightest guarantee of any knowledge of their properties on the part of the vendor. The official attitude in its latest form is seen in the report of the Select Committee on Medicine Stamp Duties, which recommends what is in effect a sales tax on medicines if claimed to be beneficial to health. It is almost unbelievable that a body of public men should suggest that the State is justified in taxing medical substances used in ill-health.

Julaber's Grave, Kent

THE mound or barrow known as Julaber's Grave or Julliebarrie, at Chilham, near Canterbury, has long been an object of interest to archaeologists and others, mainly perhaps on account of the lack of precise evidence of its character and age. It is thought to be neolithic, dating from about 2000 B.C. Its excavation has been undertaken by Mr. R. F. Jessup,

the author of the volume on Kent in the County Archaeology series, on behalf of Sir Edmund Davis of Chilham Castle. The barrow is 144 ft. long, by 45 ft. wide. In the initial operations, which were carried out last year, the course was traced of the ditch running round the mound, from which its material was taken. In the investigations of the present season, a longitudinal section has been cut, following the ditch, which has revealed the construction of the barrow above the original chalk surface. This shows a darker section where the original turves form a core and a loose rubble of chalk from the ditch. A particularly interesting find is recorded (*The Times*, July 31). This is a large circular burial in the side of the mound, probably of Roman date. It shows the cutting through the neolithic layer and the careful replacement of the mixed soil. This is held to support the view that the barrow is the burial place of Laberius Durus, one of Caesar's generals of the second invasion, of whose name, "Julaber" is thought to be a local corruption. Another interesting find is that of three skeletons at the edge of the ditch at the south end of the mound, three feet below the surface. These have been ascribed to Romans of the third century of our era. They are the remains of a large, well-developed man, a child and a girl. The child's bones were extremely fragile and disintegrated at once, but the small drinking vessel, a platter of rough coarse black ware, and the fibula, which had held the shroud together, were recovered. The girl's remains were fairly well preserved, but those of the man were in an excellent state of preservation.

Angmering Roman Villa

AN appeal is issued for funds for the excavation of the extensive Roman villa site near the old village of Angmering, Sussex. The site is situated in the flat meadows which lie between the downs and the sea, beside a Roman road, still to be traced with probability as a farm track between Lyminster and Poling, and as the footpath from Poling to Angmering across the Black Ditch. The site first attracted the attention of archaeologists in 1819, when a Roman bath was discovered, with hypocaust, sudarium and sewers. This bath was rediscovered at the beginning of the present year, and the whole bath building is now being uncovered by Mr. R. C. Sherrif and the Littlehampton Archaeological Society, with the co-operation of the Sussex Archaeological Society, under the direction of Miss Leslie Scott with Dr. R. E. Mortimer Wheeler acting as advisory director. The bath building comprises a dozen or more rooms, some with hypocausts, grouped around a cold-water tank. The building appears to stand by itself, surrounded by a beaten chalk causeway, flanked on the west side by a ditch. It was built in the latter part of the first century, and is interesting both on account of its early date and for the richness of its internal decoration. Beside the usual painted wall plaster and window glass, common on such sites, there is evidence that some walls were faced with slabs of different coloured stones. The bath building was destroyed in the middle of the second century;

out whether it was rebuilt can only be decided by excavation. The villa appears to lie to the west. With so rich a bath house, it should be a fine example of an early Romano-British country house. The cost of the complete excavation will be £500, of which £150 is required to finish the present season's work. The appeal is issued by a Committee of which Mr. E. W. Hulme is the chairman and Mr. E. J. F. Hearne the hon. secretary. Donations should be addressed to Mr. D. Crawford, Hon. Treasurer, Angmering Roman Villa Excavation Fund, Barclay's Bank, Littlehampton, Sussex.

Roman Leicester

Excavations, which have now been resumed on the Jewry Wall site at Leicester, have brought to light a remarkable example of the Roman bath, where the Roman forum and basilica were discovered by previous excavations (*The Times*, July 31). The bath is situated in the middle of the open space in the centre of the forum. It is probable that this bath was the largest built in Britain by the Romans. It is on an enormous scale, and comparable to the Imperial baths at Rome. It has one suite for men and one for women, with hot, cold and warm rooms. Miss Kathleen Kenyon, who is again in charge of the excavation, is of the opinion that it was built at the beginning of the fourth century A.D. about two hundred years after the erection of the forum.

Mass-Observation

At a meeting of the Engineers' Study Group on Economics on July 23, Mr. Charles Madge, joint organizer of "Mass-Observation" (6 Grotes Buildings, Blackheath, London, S.E.3), gave a preliminary account of some of the results already obtained. "Mass-Observation" was begun at the end of 1936 to find out more about everybody's everyday normal life and habits. There are now voluntary observers at work all over the world, and special surveys have been made of the life of the community on certain days. It was found that observers' references to people fall mainly into three categories: (a) people one knows or one has met already; (b) strangers—people one meets in the street, or for the first time; (c) celebrities, one hears of, or reads about in the newspapers. Most reports dealt with the unusual happenings of the day, and the observers had, generally, to be reminded not to overlook the routine happenings. Mr. Madge pointed out that the movement uses both trained and untrained observers, and he stressed the great value of having so many observers who have voluntarily offered to supply information of their immediate surroundings. Although many of them are untrained for this special work, nevertheless, much material of value is being gathered. The chairman (Mr. Alexander Farquharson, secretary of the Institute of Sociology) remarked on the useful relationship that the work carried out by "Mass-Observation" had to that of the sociologist, in supplying raw material not always easily obtainable.

Utilization of Leisure

At a subsequent meeting of the Engineers' Study Group on July 30, Mr. M. M. Bruce, secretary of the London Council of Social Service (7 Bayley Street, W.C.2) outlined the results of a survey undertaken in co-operation with other bodies (L.C.C. Education Department, Y.M.C.A., Young Communist League, trade unions, co-operative societies, Workers Educational Association) to determine how young people between the ages of fourteen and twenty-five years spend their leisure. Some 5,000 answers—an admittedly insufficient sample—were received, which gave an indication of the wide variety of interests. The largest proportion of predilections expressed for any one type of recreation goes, with young men to outdoor sports (11 per cent) and with girls to dancing (30 per cent). The influence of the cinema was very evident in the choice of girls' fashions and hair-dressing styles. A tendency away from organized sports (football, etc.) towards the more individual type (rambles) was also noticeable. The investigation is being continued by a smaller committee, which is looking further into these particular aspects. The survey acquires a particular significance in view of the fact that the Government will, in the autumn, begin a campaign to improve both the physical and the mental abilities of the people of Great Britain.

Annual Report of the Astronomer Royal for Scotland

THE forty-seventh annual report of the Astronomer Royal for Scotland records the work done at the Royal Observatory, Edinburgh, for the year ending March 31, 1937. The daily time service for the city of Edinburgh was maintained without change. The transit circle was used exclusively to determine time. An apparatus installed during the year by H.M. Office of Works enables the mains supply to be used as the electrical power maintaining the winding of the clocks. Provision is made automatically for a temporary breakdown in the mains supply, by means of a secondary battery which is kept fully charged by a trickle from the mains. The 6-inch photo-visual refractor has been fitted with a synchronous drive. The solar spectroscope is being used to obtain spectra of the east and west limbs of the sun's disk to determine the solar rotation from the measured Doppler effect. The seismograph provides daily records which are available to other workers in this field. Observations with the 36-inch reflector were interrupted in order to have the great mirror aluminized by a reputable firm. Unfortunately the aluminium coating was not a success, and the mirror was then resilvered at the Observatory. A number of plates were taken with the 10-inch triplet as part of a programme for a search for variable stars near the Selected Areas centred around declination $+75^\circ$ and $+60^\circ$, the plates being examined with a blink comparator. Among the meteorological observations, it may be noted that the maximum shade temperature was 75°F. on August 28 and the minimum of 24°F. on December 7 and February 11. The deep rock thermometers at a depth of 250 inches on Calton Hill gave a minimum temperature on June 8 of 46.3°

and a maximum of 48.3° on December 14, thus showing, as usual, a greatly reduced annual amplitude and almost a complete reversal of seasons at this depth. (See also p. 227.)

The Treub Foundation of Buitenzorg, Java

DR. K. W. DAMMERMAN, director of the Botanic Gardens, Buitenzorg, has sent us a copy of the first report of the Treub Foundation (Treub-Stichting), which was established at the end of last year for the administration and application of the Treub Fund collected in Netherlands India. When, in 1933, the Government of Netherlands India had, for reasons of economy, to make substantial reductions in the grants to the biological establishments at Buitenzorg, a committee was formed to collect donations for this Fund; and the Government gave permission for any sums received from the sale of surplus plants to be added to the Fund. The Treub Foundation has now been legally constituted to take over and administer this Fund.

THE object of the Foundation is to co-operate in maintaining, and, if possible, in extending the scope of, the scientific institutions united under the name of the 'Government Botanic Gardens', namely, the Botanic Gardens at Buitenzorg and Tjibodas, the Treub Laboratory, the Herbarium, and the Zoological Museum and Laboratory at Buitenzorg, and the Marine Investigation Laboratory at Batavia. The Foundation distinguishes donors, patrons, subscribers and corresponding members. Donors are corporations which contribute one sum of at least Fl. 1,000 and persons who contribute one sum of at least Fl. 500; and patrons those who contribute one sum of at least Fl. 100; subscribers contribute at least Fl. 10 annually. Persons who, because of their interest in the Government Botanic Gardens or in scientific research in the Dutch East Indies, are appointed corresponding members will not be obliged to pay any subscription, but, in their own countries, will look after the interests of the Buitenzorg Institutions in co-operation and in concert with the Foundation. The chairman of the Foundation is Mr. J. H. B. Kuneman, member of the Council of Netherlands India; the secretary is the director of the Government Botanic Gardens, and the treasurer, the president-director of the Java Bank. The capital of the Foundation amounted to about Fl. 20,000 on December 31, 1936. Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, has accepted an invitation to act as a corresponding member of the Foundation in Great Britain, and Dr. David Fairchild, Prof. Elmer D. Merrill and Dr. Thomas Barbour have been appointed corresponding members in the United States.

Phenology of 1936

THE Phenological Report for 1936, recently issued by the Royal Meteorological Society, contains the usual mass of statistics, maps, graphs, etc. of the relations between fauna, flora and the weather. It is the forty-sixth report, compiled mainly by Ivan D. Margary, from 477 reporters. The year was remark-

able for its sunlessness generally, for wetness in England and Wales, and a cool winter, so that plants generally flowered late—all in the Midlands, nearly all England, south-east, south-west, and south Ireland, but were earlier in Scotland, especially the west. Insects nearly all appeared late in England, and save for Scotland, spring migrants were generally late because of the cool April; the autumn migrants were mostly early in moving. As in 1934, the lesser celandine was very late, but by early April vegetation had made up the lost ground; late frosts damaged potatoes, beans and most tender growths; fungi were scarce after August, although flowers were especially fine in the dry, sunny late summer and autumn; trees often remained green late, and wind, more often than frost, caused the leaf-fall. A considerable amount of second flowering was noted in autumn on elder, laburnum, dog-rose and apple. Wild fruits did not do so well as cultivated ones, where bumper crops of apples, plums and raspberries were obtained. Garden crops did good, cereals bad, and hay was ruined by rain. After a record early wave of migrants in March, the long April frost caused a marked hold-up until the sunny third week. Bird song was less in the May drought and cold early June; redwings and fieldfares were scarce in the mild winter. An increase in red squirrels was noted in south-west England; but grey squirrels hold their own in the south-east.

An Extra Receiver for the Telephone

BEFORE the introduction of the modern form of hand micro-telephone instrument and before thermionic amplifiers were introduced on trunk telephone lines, the extra receiver was considered a useful means of improving reception. In modern times the popularity of this receiver has greatly declined. At first sight it would look as if when listening with both ears to a long distance call or when in a noisy room it would be a great improvement; but this is rarely the case owing to what is called side-tone, that is, the reproduction by the receiver of room-noise falling on the microphone at the same station. It is far more difficult to sort out the wanted from the unwanted sounds when both are entering both ears, than when one ear alone is used. In the Engineering Supplement to the *Siemens Magazine* of April a new type of the extra receiver is described. It is pointed out that in certain circumstances it is very useful to have an additional receiver. It enables a third person to listen to the conversation and, if necessary, make notes. As this facility is only required occasionally, and if this receiver were always left in circuit it would permanently 'degrade' the hearing, a switch actuated only when the 'watch' receiver is pressed against the ear is introduced in the circuit. Incidentally, this receiver enables the user to know when he is using sufficient pressure. It is not sufficiently recognized that in everyday use, pressing the telephone too lightly against the ear distorts sounds communicated. In the new table pattern 'neophone' telephone, the extra watch receiver is hung up by a hook. When lifted off and pressed against the user's ear, it is immediately available.

Hebrew University of Jerusalem

THE Hebrew University of Jerusalem, now entering its thirteenth year, is making a special appeal to the Anglo-Jewish community for increased financial support. A pamphlet issued by its "Friends" (199 Piccadilly, London) gives some account of the University's growth and present status. In grounds covering sixty acres on Mount Scopus, its buildings already include institutes of chemistry, physics, mathematics and meteorology, a library containing more than 300,000 books and an open-air theatre. A hospital and graduates' medical school and nurses' home are under construction, and plans have been prepared for a building for Jewish studies and the humanities. A department of radiology and experimental pathology, at present housed in the Straus Health Centre in Jerusalem, is engaged in cancer research, financed by a special endowment of £40,000. In a letter, reproduced in the pamphlet, signed by Lord Rutherford, Prof. Albert Einstein, Sir F. Gowland Hopkins, Sir William Bragg and others, it is pointed out that the University is the only one throughout the Near and Middle East in which scientific and scholarly research is a principal activity, and that some of the widely recognized work of its scientific institutes has been of immediate value to the whole population of Palestine. The director of its department of parasitology, engaged in the study of Mediterranean diseases, was chosen by the Royal Society to carry out investigations. Its department of hygiene and bacteriology maintains a malaria research station and has received subventions for its work from the Health Organisation of the League of Nations and the Government of Palestine. Jews in the United States contribute nearly half towards the annual budget of £80,000. Apart from endowments for two chairs and several scholarships, the Jewish community in England has hitherto borne an insignificant part.

Universities of Poland

POLAND'S universities are described in a bulletin recently published by the United States Government Printing Office, Washington (pp. 160. 25 cents). It is one of a series of studies undertaken at the request of the American Association of Collegiate Registrars by the Comparative Education Branch of the United States Office of Education. The institutions of higher education in existence in November 1918 within the boundaries of the new State then constituted reflected the influences, German, Austrian and Russian, of the Governments in whose territory they had been located, but have since been brought, along with a larger number of new institutions, into an organized scheme of training on university levels, all under the strict control of the Ministry of Public Instruction. The total number of regular students is 56,000, being one to 589 of the total population, a high proportion in comparison with those obtaining in other countries. The pressure for admission to many of the institutions such as the polytechnics, academy of mines and the medical schools of the universities, is so great that selection is made by competitive examination from

among the qualified candidates. In the small Free Polish University of Warsaw has lately been instituted an ingenious scheme under the name "Universitas Rediviva" for equipping aspirants to a liberal culture with a knowledge of things in general. The name refers to the medieval ideal of a university.

Science in Australia and New Zealand

THE Australian and New Zealand Association for the Advancement of Science is taking steps to give effect to the resolutions passed at the Auckland Meeting last January amending the constitution and by-laws relating to membership. Hitherto, ordinary members have paid a subscription of one guinea for each biennial session of Association; but it has been decided now to institute annual membership (one guinea per annum) and an elected fellowship (two guineas per annum). The fellows resident in Australia will constitute a committee to be known as the Australian National Research Council, which will have at its disposal for research and other purposes a sum not exceeding one half of the subscriptions of fellows and annual members resident in the Commonwealth. The Council will take over all the assets and responsibilities of the existing body of the same name which was brought into being early in the post-War period as the Australian member of the International Research Council. It is anticipated that one of its activities will be the institution of a periodical for the encouragement and dissemination of scientific knowledge among members of the general public.

The Brisbane Seismological Station

AN important and very welcome addition has recently been made to the chain of Australian seismological stations at Sydney, Melbourne, Adelaide and Perth. As an aid to the study of earthquakes in the south-west Pacific region, a station farther to the north was greatly needed. Interest in the foundation of one in Queensland was aroused by the occurrence of a tremor at Gayndah in April 1935, and a former student in the University of Brisbane offered to provide a Milne-Shaw seismograph. Later, the Council for Scientific and Industrial Research added a second instrument, so that both north-south and east-west components can now be recorded. According to an account given in the *Courier-Mail* (Brisbane) of June 2, the instruments are installed in the basement of the University's new library block. They were placed temporarily on their foundations about midday on May 31, and at 3.30 the next morning recorded an earthquake with its origin about 1,450 miles from Brisbane. The new station has been placed under the direction of Dr. W. H. Bryan, lecturer in geology in the University.

The American Chemical Society

THE ninety-fourth meeting of the American Chemical Society will be held in Rochester, New York, on September 6-10, under the chairmanship of Mr. M. H. Eisenhart, president of the Bausch and Lomb Optical Co. Seventeen professional divisions of the Society and the Microchemical Section will

hold sessions. Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, will deliver the annual presidential address of the Society on September 7. At the twenty-three symposia, the following subjects will be discussed: developments affecting industry, nutrition, public health, pure science, and education; artificial radioactivity and its chemical uses, studies of the chemistry of the earth's crust, low temperature methods and research, chemical microscopy, quantitative spectroscopic analysis, and photography; chemistry and physics of electrical insulation; medicinal patents, vitamins, and the chemistry and metabolism of fats; cellulose derivatives; organic plastics; 'unit processes' and 'automatic control'; characteristic properties and chemical utilization of hydrocarbons; 'gaseous combustion'; investigations dealing with sugar, rubber, water, sewage, and sanitation, micro-chemistry, organic chemistry, fertilizers, and colloids.

The Selborne By-Pass

THE Selborne Society, which for fifty-two years has cherished the memory of Gilbert White, invites admirers of his life and work to make a copy of the following protest and send it signed to the Secretary of the Selborne Society, The Hermitage, Hanwell, London, W.7, so that it may be forwarded to the proper authority with the Society's own: "Understanding that powers are to be sought to drive a road, in the future, through the grounds of The Wakes at Selborne between the house and the Hanger which Gilbert White loved so well, I wish to protest against what would be an offence to the memory of a very great Englishman who made his village famous throughout the world and to urge that an alternative scheme, if necessary, be adopted.

Indian Institute of Science, Bangalore.

It is reported in *The Statesman* (India) of July 21, that, at a meeting of the Governing Council of the Indian Institute of Science, Bangalore, held on the previous day, Sir C. V. Raman accepted the appointment of professor of physics at the Institute at a monthly salary of 2,500 rupees (£187). The Council has appointed an interim director on a monthly salary of 1,000 rupees for one year, in addition to a registrar on 1,250 rupees. Rao Bahadur B. Venkatesachar, a member of the Council, has taken over charge of the directorship from Sir C. V. Raman and the latter has thus been relieved of all administrative duties, including the secretaryship of the Governing Council. The registrar is Mr. C. E. W. Jones, formerly director of public instruction, Central Provinces, who took up his new duties on July 31. (See also *NATURE* of June 26, p. 1102.)

'Vaseline' Products

THE manager of the Cheesbrough Manufacturing Co., Victoria Road, Willemsden, London, N.W.10, writes to point out that the word 'vaseline' is wrongly used in a letter by Mr. L. Bellingham in *NATURE* of July 10, and in the summary of the letter. The word is not a common designation, but

"is the trade mark or brand name used to distinguish the particular products marketed by this Company". The manager asks that the word 'vaseline' should not be used "unless in conjunction with and as the brand name applied to one of our products, such as 'Vaseline' Petroleum Jelly".

A History of Chemistry

AN interesting handbook issued by the Science Museum, London, S.W.7, entitled "Chemistry, a Brief Outline of its History and Development", by A. Barclay, gives an account of the history of chemistry, and is well illustrated, in some cases with representations of historical apparatus in the Museum. Apparatus used by Davy, Faraday, Graham, etc., is included. There are a good index and a bibliography. The subject is dealt with from the earliest period to modern times, the last section being on atomic structure. The handbook forms a useful and interesting supplement to text-books on chemistry. The price is 1s. 6d., post paid 1s. 8d., from the Museum or the sales offices of H.M. Stationery Office.

Announcements

THE Baly Medal for 1937 of the Royal College of Physicians has been awarded to Prof. E. L. Kennaway, professor of experimental pathology in the University of London and director of the Research Institute of the Cancer Hospital (Free), London. The award is made in recognition of Prof. Kennaway's biochemical investigations, which have led to the identification of a group of substances provoking malignant growth of tissues and having significant relations in structure to certain hormones and vitamins.

THE Warren Research Fund Committee of the Royal Society has appointed G. S. Hartley, of University College, London, and J. T. Randall, of the General Electric Co., Ltd., to Warren research fellowships, each to be held for four years in the first instance. Mr. Hartley proposes to carry out research on oil drops, films and solutions, and Mr. Randall will undertake a research on the mechanism of fluorescence in pure and impure solids.

THE Ministry of Health has approved the application of the Birmingham Corporation for sanction to a loan of £8,505 for the provision of a forensic science laboratory for the detection of crime.

THE publishers of *NATURE* have in stock a certain number of bound volumes for which space can no longer be found. The volumes extend from vol. 1 to vol. 91, with the exception of the following: vols. 3, 8, 15, 17, 19, 22, 23, 24, 25, 51, 53, 74, 76, 77, 79, 80, 83, 84, 85, 86. Librarians and others wishing to complete their sets of *NATURE* can be supplied with any of the volumes in stock, so long as the stock lasts, at the price of 2s. 6d. per volume, carriage paid. Application, with remittance, should be addressed to *NATURE* Office, St. Martin's Street, London, W.C.2. Volumes which are not applied for by the end of this year will be destroyed.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 242.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Differences in the Chromogenic Properties of Fresh-water and Marine Fish Liver Oils

WHEN vitamin A concentrates from marine fish livers are treated with antimony trichloride the blue solution normally exhibits an absorption maximum near 620 m μ with a subsidiary masked maximum near 693 m μ (displaced to 606 m μ and 572 m μ

We have also found, in addition, that the ultra-violet absorption spectra of the liver oils of fresh-water fish are differentiated from those of marine fish, in that the maximum is displaced from 328 m μ to 345-350 m μ (with, frequently, the appearance of another band at 280-285 m μ). The 340-350 m μ maximum thus appears to be associated with the 693 m μ antimony chloride chromogen, just as the 328 m μ band is associated with the 620 m μ chromogen.

Although most fresh-water fish liver oils show only one band near 693 m μ in chloroformic antimony trichloride, the absorption near 620 m μ is always appreciable. Thus the 693:620 intensity ratio seems to average 2:1, whereas for marine fish it is usually less than 0.2:1 (cf. Table 1 for the spectroscopic data on a few typical oils and concentrates).

The chromogenic properties of the two classes of liver oils reported here are closely parallel with those recently observed by Wald* when examining the retinas of

marine and freshwater fish respectively. It appears possible to us that the 693 m μ chromogen may be a second vitamin A with some degree of specificity for freshwater fish, and in this connexion an alcohol with six conjugated ethenoid linkages is obviously suggested as a possibility by the spectrographic data. We are at present engaged in an attempt to isolate the compound, and we also have the biological aspect of the question under test. It should, however, be noted that, until both biological and spectrographic data have been accumulated and examined, the accurate determination of the vitamin A content of liver oils of freshwater fish, by physico-chemical methods, is not possible.

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respectively in oils of low potency). In exceptional cases, however, additional maxima at 635, 645, 656, 680 and 690-695 m μ have been recorded¹. The '693 chromogen' appears to be the most important of these extra chromogenic substances and follows the vitamin A during concentration into the richest fractions. When this chromogen has been recorded previously, in halibut oils, the intensity has usually been about one tenth of that due to the 620 chromogen². Recently, however, liver oils from certain Russian freshwater fish have been reported that gave antimony trichloride solutions exhibiting clear maxima at 645 or 690 m μ and only a weak band near 620 m μ ³.

We have since examined liver oils and concentrates from various freshwater fish by quantitative spectrophotometric methods and have consistently found them to be abnormal in exhibiting an absorption band in antimony trichloride solution at 690-697 m μ , or less commonly at 645 m μ , having an intensity greater than that of the 620 band. Up to twenty catches of each of the species quoted in the table were examined, the fish being obtained from the Volga or Don, or rivers in the Leningrad region.

TABLE 1.

Species	Liver oil or concentrate	Ultra-violet absorption		Antimony chloride blue test		Ratio of intensities 693/620
		Maxima† m μ	E 1% 1 cm.	Maxima† m μ	E 1% 1 cm.	
Catfish (<i>Silurus glanis</i>)	O	343 (281)	203 102	606 (620)	560 292	1.92
Pike (<i>Esox Lucius</i>)	O	345 (280)	187 124	606 (620)	445 240	1.85
Pike-perch (<i>Luciopeca Luciopeca</i>)	Oil	348 (283)	4.0 3.0	603 (606)	8.1 3.45	2.35
Bream (<i>Abreus brumus</i>)	O	340 280	53.5 36	607 (620)	97 58	1.67
Sturgeon (<i>Acipenser Stellatus</i>)	Oil	334	3.5	605 617	5.8 4.4	1.32
Sturgeon (<i>Acipenser Gulianostatus</i>)	Oil	330 (280)	2.3 2.1	605 620	3.6 2.7	1.33
Salmon (<i>Salmo Salar</i>)	Oil	349 292	14.2 11.8	605 (617)	33.9 14.2	2.38
Salmon (<i>Oncorhynchus latus</i>)	O	327 (280)	73 53	606 620	51.5 125	0.41
Halibut* (<i>Hippoglossus Hippoglossus</i>)	Oil	323	71.5	607 620	30 170	0.17

* This is a typical marine fish liver oil.

† Values in brackets indicate only ill-defined bands.

¹ Hellbron, Gillam and Morton, *Biochem. J.*, **25**, 1252 (1931).

² Hellbron, Healop, Morton, Webster, Ros and Drummond, *Biochem. J.*, **25**, 1178 (1933).

³ Lederer and Rosanova, *Biochimica*, **2**, 293 (1937).

* Wald, *NATURE*, **126**, 1017 (1937).

A Possible Vitamin A₂

THE antimony trichloride colour test for vitamin A is associated with a maximum absorption at 620 mμ. We have, since 1929, repeatedly encountered an additional band near 693 mμ, but further characterization of the chromogen has been hindered by the presence of excessive amounts of vitamin A. Thus, in halibut liver oils the relative intensities 620 mμ/693 mμ are c. 6:1, and in halibut visceral oils 10:1. The 693 mμ chromogen is rarely detectable in cod liver oils and never in our experience in whale liver oils.

It is frequently absent from the vitamin A fraction of eyes, but one of us (J.R.E.) has observed the 693 mμ band in extracts from goldfish eyes, the ratio 620 mμ/693 mμ being c. 1:1.5. Experiments on brown trout have shown that the 693 mμ chromogen occurs in the non-saponifiable extracts from livers and viscera. The 620 mμ band, as such, could not be detected. Direct absorption spectra showed the presence of three broad bands with maxima at 470, 350 and 287 mμ, respectively, the ultra-violet bands varying in intensity with the 693 mμ band in the colour test. Lederer and Rosanova¹ have also found an intense band at 693 mμ in the colour test applied to freshwater fish liver oils from the neighbourhood of the Murmanak Sea. We understand (private communication) that an apparent connexion between absorption bands at c. 345 and 285 mμ and the 693 mμ chromogen has been confirmed by Prof. Heilbron and Dr. Gillam on Lederer's oils. Wald's discovery that a substance apparently identical with the 693 mμ chromogen can replace the vitamin A of rhodospin *without loss of physiological function* runs parallel with the similar replacement in the viscera and liver of brown trout. It therefore seems desirable provisionally to designate as 'vitamin A₂' the 693 mμ chromogen with its characteristic ultra-violet absorption.

In chemical separations with liver oils, the 693 mμ chromogen follows vitamin A, the ratio 620 mμ/693 mμ for a given species remaining very nearly constant. It is not difficult with some liver oil extracts to reach $E_{1\text{cm}}^{1\%}$ 693 mμ 500–1,000, but judging from the amount of vitamin A present, the pure substance will have $E_{1\text{cm}}^{1\%}$ 693 mμ < 5,000. On this basis, each brown trout contains of the order 0.12 mgm. of the new material.

It seems clear that the 693 mμ chromogen is not in any simple sense an artefact derived from vitamin A; but the position remains obscure with regard to bands at 640 mμ and 660 mμ which occasionally appear in the colour test.

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R. A. MORTON.
G. W. SIMPKINS.

University of Liverpool.
July 6.

¹ *Biochimica*, 2, 293 (1937).

Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products

DURING the course of an investigation on the antiscorbutic value of Kaffir beer, it was observed that beers treated with a 2 per cent concentration of metaphosphoric acid gave high values for 'vitamin C' when titrated with indophenol in the usual manner, the values varying between 1.1 and 38.5 mgm./100 ml.

Delf¹, working with guinea pigs and monkeys, concluded that Kaffir beer was of slight antiscorbutic value. Levy and Fox², using hydrochloric acid for

acidification, examined eleven specimens of mine brewed beer and found values of 0.2–0.5 mgm./100 ml.

Bernbauer *et al.*³ showed that when *Aspergillus niger* was allowed to grow in sugar mixtures, substances with the same reducing properties as ascorbic acid were formed. Whether these possessed antiscorbutic activity or not was not clear (Kříženecký and Nevalonnyj⁴ and Hermann and Fodor⁵).

As with ascorbic acid, norite charcoal (Fox and Levy⁶) completely removed the reducing power. However, only a small fraction (0.8 mgm. out of 13.0 mgm.) was restored after hydrogen sulphide treatment. Hubbard squash extract (Tauber *et al.*⁷) entirely removed the reducing power. The folin uric acid reagent (Medes⁸) gave identical values with indophenol titration in the presence of 2 per cent metaphosphoric acid.

The effect of pH on the indophenol titration of the beer was as follows:

INDOPHENOL REDUCING POWER OF KAFFIR BEER AT DIFFERENT pH VALUES (in mgm. 'ascorbic acid' per 100 ml. beer).	
2.5 N HCl	8.0
1.2 pH	0.8
1.4	0.8
1.6	0.8
1.8	0.8
2.0	(doubtful end-point) 1.5
2.2	13.0
2.4	13.0
2.6	13.0

Guinea pig experiments showed the reducing substance to be almost devoid of antiscorbutic activity, the animals dying of scurvy in three to four weeks. Controls on orange juice remained healthy, and on autopsy showed no signs of scurvy.

The reducing power of the beer was followed at different stages of its preparation, and it was found that a large increase took place during the boiling of the mash, and a further increase during fermentation.

From these experiments it is concluded that the bulk of the reducing substance is not ascorbic acid. The true ascorbic acid content of the beer probably corresponds to the values of about 0.8 mgm./100 ml. obtained with the norite procedure and by titration at a pH between 1.2 and 1.8. The concentration was far too low to have any appreciable effect on the guinea pigs in the doses given. It is also shown that ascorbic acid oxidase (cf. Zilva⁹) and Srinivasan¹⁰), and the folin uric acid reagent (cf. Fujita *et al.*¹¹) are not specific for ascorbic acid.

F. WILLIAM FOX.
WILLIAM STONE.

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South African Institute for
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June 21.

¹ Delf, *Publ. S. Afr. Inst. Med. Res.*, 2 (No. 14), 47 (1931).

² Levy and Fox, *S. Afr. Med. J.*, 9, 181 (1935).

³ Bernbauer, Gdrlloh and Kbeher, *Biochem. Z.*, 298, 60 (1936).

⁴ Kříženecký and Nevalonnyj, *Z. Unterz. Nahr. u. Genussm.*, 66, 278 (1933). (Quoted by Bernbauer *et al.* (3).)

⁵ Hermann and Fodor, *Biochem. Z.*, 278, 233 (1935).

⁶ Fox and Levy, *Biochem. J.*, 30, 208 (1936).

⁷ Tauber, Klemmer and Mshkind, *J. Biol. Chem.*, 119, 211 (1935).

⁸ Medes, *Biochem. J.*, 29, 2251 (1935).

⁹ Zilva, *Biochem. J.*, 30, 1215 (1936).

¹⁰ Srinivasan, *Biochem. J.*, 30, 2077 (1936).

¹¹ Fujita, Akiji and Hihara, *Biochem. Z.*, 290, 182, 192 (1937).

Absorption of the Soft Component of Cosmic Radiation

It is now generally accepted that the soft component of cosmic radiation consists of electrons which are absorbed mainly by emission of light quanta and consequent production of pairs (cascade showers). The absorption of these particles is usually measured by two or more counters separated by a plate of some absorbing material of variable thickness. This method measures the probability of a primary electron either self penetrating the plate or producing at least one secondary electron emerging from the bottom of the plate.

Since the probabilities for the relevant processes are proportional to Z^2 , it is often assumed that the absorption curves for the soft component should be independent of the material when plotted on a scale proportional to NZ^2 (N = number of atoms per c.c.). This assumption, however, rests on an erroneous interpretation of the theory for the following reason.

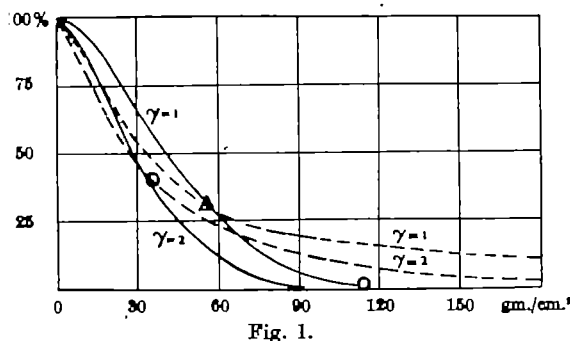


Fig. 1.

The production of secondaries by the cascade process only takes place if the energy is higher than the critical energy E_c , at which the energy loss by radiation is equal to the energy loss by ionization. E_c is larger for light materials than for heavy ones. $E_c = 10 \times 10^6$ e.v. for lead; 60×10^6 e.v. for aluminium; 150×10^6 e.v. for air. Thus, the lower electrons from light materials will be more energetic than those from heavy materials. Naturally, the probability for the production of fast secondaries is smaller than that for slow ones. If we plot, therefore, the absorption curves on a Z^2 -scale, we should expect the curves to fall off more rapidly for light elements than for heavy ones.

We have calculated, on the basis of the quantum theory¹, the probability for an electron penetrating a plate of certain thickness or producing at least one secondary with energy greater than E_c . The curves obtained depend on the primary energy spectrum of the electrons. We have assumed a $E/E_c + 1$ law and have put $\gamma = 1$ and 2. For E smaller than the critical energy E_c for air, we assume the energy spectrum to fall off rapidly, the exact shape of the energy spectrum being of no importance for the result. The shape of the absorption curves is mainly determined by primary electrons with comparatively small energies, for which the validity of the theory is proved by direct experiments² (that is, up to 3×10^6 e.v. for lead and 10^6 e.v. for aluminium). The high-energy part of the spectrum only affects the tail end of the curves, which in any event cannot readily be distinguished from the hard component. (In Fig. 1 the curves are calculated assuming that the theory is valid for all energies.

Fig. 1 shows the theoretical absorption curves for lead (full) and aluminium (dotted) on an ordinary gm./cm.² scale. We see that to a rough approximation the curves follow an *ordinary mass absorption law*. The experimental points ($\circ$ for Pb, Δ for Al) are taken from the measurements by Auger, Ehrenfest and Leprince-Ringuet³. They are in good agreement with the theory for γ between 1 and 2. The accuracy is, however, not high enough to determine γ exactly.

W. HETTLER.

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¹ Carlson and Oppenheimer, *Phys. Rev.*, **51**, 220 (1937). Bhabha and Hettler, *Proc. Roy. Soc., A*, **159**, 432 (1937).

² Blackett and Wilson, *Proc. Roy. Soc., A*, **160**, 804 (1937) Anderson and Neddermeyer, *Phys. Rev.*, **50**, 263 (1936).

³ *J. Phys. Radium*, **7**, 58 (1936).

Capture of Orbital Electrons

In two recent papers¹ Møller has shown that on the present theory of β -decay for a heavy nucleus emitting positrons of low maximum energy, the ratio F_K/F of the probability of K -electron capture to that of positron emission may be large. On the other hand, experiments by Jacobson² for a light nucleus (radio-scandium, $W_0 = 1.1 \pm 0.1$ MV., $Z = 21$) show that this ratio is $< 1/10$. We wish to point out that Jacobson's result is in agreement with a modified form of the theory³, but that this form makes a definite prediction about the low energy end of β -spectra.

The usual procedure of writing the interaction term as

$$(\psi_N^\dagger \Lambda' \psi_P) (\psi_e^\dagger \Lambda'' \psi_n) \quad \dots \quad (a)$$

where (N, P) (n, e) represent the heavy and light particles respectively, leads to a transition probability⁴

$$A \left| \int \psi_N^\dagger \psi_P d\tau \right|^2 (\psi_e^\dagger \psi_e) (W_0 \pm W)^\alpha \quad \begin{matrix} \alpha = 2 \text{ Fermi} \\ \alpha = 4 \text{ Konopinski-Uhlenbeck} \end{matrix}$$

The $\pm$ sign depends upon the electron being absorbed from a state of positive or negative energy. For the ratio F_K/F the evaluation of $(\psi_e^\dagger \psi_e)$ from the known form⁵ of the wave-functions for a K -electron, gives for small Z

$$F_K/F = 2\pi\gamma^2 (W_0 + 1)^\alpha \int_1^{W_0} W(W^2 - 1)^{1/2} (W_0 - W)^\alpha \quad \begin{matrix} \alpha = 2 \text{ Fermi} \\ \alpha = 4 \text{ Konopinski-Uhlenbeck} \end{matrix}$$

where $\gamma = Z/137$.

If $Z = 21.0$, $F_K \sim 0.22$ for $\alpha = 2$, and 2.3 for $\alpha = 4$. F depends sensitively upon the exact value of W_0 , varying from 0.63 to 1.17 in the Fermi case, and from 0.39 to 1.0 in the Konopinski-Uhlenbeck case, as W_0 varies from $2.2 mc^2$ to $2.4 mc^2$. We therefore require a very precise knowledge of W_0 to determine F_K/F exactly. Even with $W_0 = 2.4 mc^2$, F_K/F is about 1/5 for $\alpha = 2$, and 2.3 for $\alpha = 4$, so that the K -electron capture could scarcely have been overlooked, particularly in the Konopinski-Uhlenbeck case.

There is the further possibility of writing the interaction term in the form

$$(\psi_N^\dagger \Lambda' \psi_n) (\psi_e^\dagger \Lambda'' \psi_P) \quad \dots \quad (b)$$

(This corresponds to the case $C = -1$ in the note recently published by Mercier⁶. For this value of C , however, the formulæ there given are not applicable.)

For $Z \sim 20$ the components ψ_1, ψ_2 of the K -electron are small compared with the components ψ_3, ψ_4 . Similarly, ψ_p has two large and two small components differing by a factor of the order of 1/10. We may suppose Λ^* to be an operator combining the two small components of ψ_p with the two large components of ψ_3 . This arrangement gives a factor 1/100 in the terms containing the small proton components, and a factor 1/200 in the terms containing the small electron components. Thus, by addition, F_2/F will contain a factor 3/200 from this combination; that is, for $Z = 21.0$, we may take F_2 to be 0.003 for $\alpha = 2$, and 0.035 for $\alpha = 4$. The positron emission will now be given by

$$F = A \int_1^{\infty} W \cdot (W + 1) (W^2 - 1)^{1/2} (W_0 - W)^{\alpha} dW \quad (c) \quad \begin{matrix} \alpha=2 \text{ Fermi} \\ \alpha=4 \text{ Konopinski-Uhlenbeck} \end{matrix}$$

F will again depend sensitively upon the value of W_0 , but we can take as suitable values 1.5 for $\alpha = 2$ and 0.75 for $\alpha = 4$. This gives for F_2/F approximately the values 1/500, $\alpha = 2$, and 1/25, $\alpha = 4$. It is possible that K -electron capture for the ratio 1/25 has escaped detection, although its existence should be revealed by further experiments. The interesting point arises that, if the $\alpha = 4$ interaction is assumed, we obtain a definite prediction of the low-energy end of the positron spectrum, which is given by the integrand of (c). This leads us to expect a large number of slow positrons. It is important to note that this latter conclusion seems to hold only for allowed transitions. For forbidden transitions (c) has a more complicated form.

In the Fermi theory, F_2/F is about 1/3 or 1/500 according as one adopts the law (a) or (b). The actual interaction law may also be a linear combination of (a) and (b), and it is easy to calculate the proportion necessary to give any intermediate ratio. It should be noted that, as this ratio decreases from 1/3, we require a rapid increase in the percentage of (b); for example, when the ratio has decreased to 1/30 we already need more than 90 per cent of the interaction (b).

We see that if we accept the experimental evidence that the probability of absorption of a K -electron relative to that of positron emission is less than the value required by the Konopinski-Uhlenbeck theory, then the theory must be replaced by a modified form which gives many more slow positrons and fewer slow electrons. This appears to be in reasonable agreement with the direct observation of the spectrum.

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June 10.

¹ Møller, *Phys. Rev.*, 51, 84 (1937); *Phys. Z. d. Sowjetunion*, 11, 9 (1937).

² Jacobson, *NATURE*, 139, 879 (May 23, 1937).

³ Hoyle, *Proc. Camb. Phil. Soc.*, 33, 236 (1937).

⁴ Fermi, *Z. Phys.*, 53, 171 (1934).

⁵ Darwin, *Proc. Roy. Soc. A*, 118, 674 (1928).

⁶ Merzner, *NATURE*, 139, 797 (May 8, 1937).

the microphotometer curves of the resultant pattern reveal clearly four distinct components of $H\alpha$ with intensities and positions roughly as given by theory. There are no ghosts in the Lummer plates and the interference of lines of the secondary spectrum of hydrogen has been eliminated.

We are now engaged in obtaining quantitatively the intensity and position of these components.

We feel that this method (new, so far as we know) may be of service in the study of the fine and hyperfine structure of the spectrum lines of other elements.

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¹ *Phys. Rev.*, 30, 266 (1927).

Raman Spectra of Oxonium Compounds

M. WOLKENSTEIN and G. K. SYRKIN have published in a recent communication in *NATURE*¹ the Raman spectrum of equimolecular mixtures of ether and hydrogen chloride in the liquid state¹. In 1935 we studied² the Raman spectrum of the system ethyl ether plus hydrogen bromide at low temperature (228° K.) and announced there further work on this subject. The publication of these results was delayed owing to unforeseen circumstances.

We investigated solutions of the compound $\text{CH}_3\text{OH} + \text{HCl}$ (HBr), $\text{C}_2\text{H}_5\text{OH} + \text{HCl}$ (HBr) ($\text{CH}_3\text{O})_2 + \text{HCl}$ (HBr) and $(\text{CH}_3)_2\text{CO} + \text{HCl}$ (HBr) in excess of hydrogen halides. The compounds were prepared, dissolved in excess liquid hydrogen halide and the resulting solution filled into the Raman tube, all in one operation, in a high vacuum apparatus at low temperatures, thus eliminating all possibilities of chemical reaction (formation of R. Hal.). Under these conditions, we obtained spectra of the solutions which were characteristically different from the spectra of the components. We obtained the following frequencies:

$\text{CH}_3\text{OH} \dots \text{HCl}$ ($t = -75^\circ \text{C}$, molecular ratio = 1:1.8). 465(3), 645(3), 991(4), 1083(5), 1181(1), 1357(3), 1440(5), 2955(10), 3019(7), 3364(3).

$\text{CH}_3\text{OH} \dots \text{HBr}$ ($t = -63^\circ \text{C}$, mol. ratio = c. 1:5). 391(3), 497(4), 639(4), 887(2), 984(3), 1066(3), 1440(8a), 2907(4), 2970(10), 3047(5).

$\text{C}_2\text{H}_5\text{OH} \dots \text{HCl}$ ($t = -75^\circ \text{C}$, mol. ratio = 1:2.1). 398(3), 507(3), 613(3), 646(3), 873(3), 1021(3), 1094(2), 1281(2), 1343(3), 1450(6), 2923(8), 2977(10), 3357(1).

$\text{C}_2\text{H}_5\text{OH} \dots \text{HBr}$ ($t = -65^\circ \text{C}$, mol. ratio = c. 1:5). 431(2), 530(4), 597(4), 706(3), 829(5a), 925(1), 1048(3), 1290(1), 1377(2), 1450(6), 2940(8), 2984(10).

$(\text{CH}_3)_2\text{O} \dots \text{HCl}$ ($t = -80^\circ \text{C}$, mol. ratio = 1:2.5). 356(1), 433(3), 505(3), 800(7a), 947(1), 1006(1), 1063(3), 1444(8a), 2323(6), 2323(10), 3003(9).

$(\text{CH}_3)_2\text{O} \dots \text{HBr}$ ($t = -51^\circ \text{C}$, mol. ratio = 1:1.7). 265, 396(3), 506(3), 824(7b), 896(3), 965(1), 1023(1), 1440(8a), 2334(4a), 2348(10b), 3037(9a).

$(\text{O}_2\text{H})_2\text{O} \dots \text{HCl}$ ($t = -80^\circ \text{C}$, mol. ratio = 1:3.5). 337(1), 418(2), 491(3), 767(3), 823(3a), 955(3), 997(3), [1058(1)], 1370(3), 1450(7), 2373(1), 2942(10), 2981(10).

$(\text{O}_2\text{H})_2\text{O} \dots \text{HBr}$ ($t = -45^\circ \text{C}$, mol. ratio = 1:2.5). 303(1), 406(5), 470(1), 673(1a), 830(0), 920(0), 996(4b), 1071(1), 1137(0), 1263(1), 1459(6b), 2356(0), 2940(10), 2984(10).

The detailed discussion of the spectra led to the conclusion that the compounds do not exist in solution of excess hydrogen halide as 'oxonium' compounds $(\text{R}^+ \text{O} \text{H}) + \text{X}^-$, but as compounds with tetravalent oxygen. We propose calling this type a compound an 'oxan' compound.

Structure of $H\alpha$ of Hydrogen

THE structure of the lines of the Balmer spectrum of hydrogen was investigated in this laboratory some years ago. Recently we have attacked the problem again, using two Lummer plates, not crossed as in the investigations of Kent, Taylor and Pearson¹, but dispersing in the same plane. With this arrangement,

The question whether the former addition compounds appear as oxonium or oxan compounds is to a high degree dependent on the physico-chemical conditions (temperature, state of aggregation, solvent, etc.). By varying the conditions, a gradual transition from the 'oxonium' to the 'oxan' form is possible. It is not improbable that equilibria exist between the two above-mentioned extreme types. We have started a more intensive examination of this question.

A detailed account of the Raman investigations, as summarized above, will be published in the *Zeitschrift für physikalische Chemie* (B).

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¹ Wolkstein, M., and Byrkin, J. K., *NATURE*, **130**, 288 (1937).

² Brigleb, G., and Lauppe, W., *Z. phys. Chem.*, (B) **20**, 164 (1935).

Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces

THE adsorption isothermals of benzene and methyl alcohol vapours at the surface of mica are of sigmoid form, concave to the pressure axis until the first monolayer is nearing completion, and thereafter becoming more and more steeply inclined to it as saturation is approached. Though the adsorption energy decreases on completion of the first monolayer to a value very near the normal heat of liquefaction, the polymolecular films formed at saturation have properties quite different from the bulk liquids. This is strikingly demonstrated in a series of experiments we have recently carried out, a few of which are briefly recorded in this note.

When a freshly split mica plate is placed under a jet of the supersaturated vapour of benzene, methyl alcohol or water, condensation of bulk liquid does not occur until a film of critical thickness has been built up. By suitably controlling the conditions, films of thickness less than this, yet thick enough to show interference colours, are readily produced. A drop of the same liquid, placed on such a film, may flatten, but does not lose its identity as a lens, showing that the angle of contact, though small, is finite. Methyl alcohol, which spreads rapidly on fresh mica in the open air, will not do so in the presence of its own supersaturated vapour; on the contrary, a spread film was found to break up into drops when brought under the vapour jet. The alternative view as to the origin of the film colours, namely, that they may be due to diffraction from a mist of invisible droplets, is not borne out by the facts; for example, we were able to float lenses of different liquids right across the films without disturbing them in any way.

Much evidence has been found by us in favour of Hardy's view¹ that a drop of pure liquid placed on a clean solid surface invariably reaches a stable state only when a single lens is in equilibrium with an adsorbed film. Without permitting ourselves this degree of generality, we would emphasize the marked sensitiveness of the contact angle to changes in the degree of saturation of the vapour phase, and to the presence therein of even traces of a second adsorbable component; both these effects are often neglected in making measurements of contact angles.

Interesting effects are produced by placing drops of different liquids near each other on a mica plate, and these are at least rendered less incomprehensible

by the realization that adsorbed films can be thick, and that the energy relations at the edge of a drop are markedly dependent on the local concentration of the second component of the film. If a drop of concentrated acetic acid, containing enough water to prevent its spreading, is placed near one of the very dilute acid (or of water) resting on clean mica, the former first elongates, then advances towards the dilute acid. Before contact, however, the latter drop is sharply repelled and driven forward to the edge of the plate. Arriving there, it is usually repelled by the edge, with the result that it dodges round its pursuer (which is attracted to the edge and remains clinging there), and comes to rest in the centre of the plate. A similar behaviour has been observed with other pairs of liquids, though the 'edge' effect is often less noticeable; for example, a lens of *n*-hexane will drive one of benzene in front of it until the former has all evaporated.

The highly convex lenses formed by hexane drops on mica spread immediately when brought under the jet of benzene vapour, whilst lenses of benzene condense on the spread film. The incomplete miscibility of hexane and benzene in the form of drops on mica is astonishing, though numerous other examples might be quoted. If a drop of hexane is placed on top of one of benzene as it rests on mica, the mixture divides itself into two parts—a spread film which quickly evaporates, showing interference colours, and a lens (mainly of benzene) which is repelled rapidly to the edge of this film. The possible application of such phenomena as a means of effecting separations immediately suggests itself. The drops used in these experiments must of course be small.

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¹ Hardy, Sir W. B., *Proc. Roy. Soc., A*, **83**, 318 (1913); *Phil. Mag.*, **26**, 40 (1919), *Institut Internat. de Chimie Solvay, Brussels* (1925).

Reliability of Pacific Seismological Stations

IN a former paper I gave a comparison of the accuracies of seismological stations, based on the residuals for *P* in the International Seismological Summary¹. The fraction of the residuals between $\pm 4s$ was taken as the standard and called the 'reliability'. It came out rather low for most of the Pacific stations, though I suggested that the estimates might be too low, on account of errors in the epicentres due to too little weight having been given to the near stations. In some work on southern earthquakes, preparatory to a further study of the core waves, I have re-determined a large number of Pacific epicentres (up to the end of 1931), taking into account the effects of the ellipticity of the earth; the result is a great improvement in the reliabilities. They are now as follows:

Riverview, 17/17 = 1.0; Melbourne, 14/16 = 0.9; Apia, 8/10 = 0.8; Adelaide, 11/16 = 0.7 (probably too low as distant earthquakes give 11/12 = 0.9); Manila and Wellington, 13/17 = 0.8; Christchurch, 8/11 = 0.7; Amboina, 10/15 = 0.7; Batavia, 11/16 = 0.7; Honolulu, Perth and Malabar, 0.6; Sydney, 0.4; the rest, nearly as before.

Most of the change is due to the correction for the ellipticity of the earth, provided by Bullen². At

large distances this varies with azimuth by nearly 5 seconds when geographical co-ordinates are used, and introduces a large systematic error into southern epicentres if it is not allowed for. Bullen and I found on determining epicentres from the nearer stations¹, that southern earthquakes habitually showed negative residuals of about $-4s.$ at great distances, and attributed these to slight focal depth; it appears now, however, that they were entirely due to the ellipticity. The great majority of Pacific earthquakes can be taken as having foci at an inappreciable depth.

The law of error in seismological observations seems to be practically the normal law with a uniform distribution superposed. The standard error corresponding to the normal part is found to be $2.0s.$ both for the good and for the intermediate stations; the difference between them is not in the accuracy of the normal observations, but in the frequency of defective ones, usually attributable to microseisms and weak beginnings.

There appears to be a slight difference between Pacific and continental travel times, amounting to about $2s.$ for $P.$ between 5° and 50° out of a total time of 8 minutes, and indicating a higher velocity below the Pacific. This might be expected if there has been more cooling below the oceans than under the continents. Larger differences have been claimed previously, of the order of 10 per cent, but these are rendered impossible by the observations now available.

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¹ *Mon. Not. Roy. Ast. Soc., Geophys. Supp.*, 3, 423-443 (1936).

² *Mon. Not. Roy. Ast. Soc., Geophys. Supp.*, 4, 143-157 (1937).

³ *Bur. Centr. Seism. Trav. Sci.*, 11 (1935).

Magnetic Quality of Nickel Wire as Influenced by the Surface

IN a previous note¹, test data were given which showed the very large increase of magnetic permeability of nickel wire which could be obtained by applying to the surface a thin skin of copper and allowing it to soak for some hours at a sufficiently high temperature.

The influence of the surface of a wire on its magnetic quality has been examined further as follows:

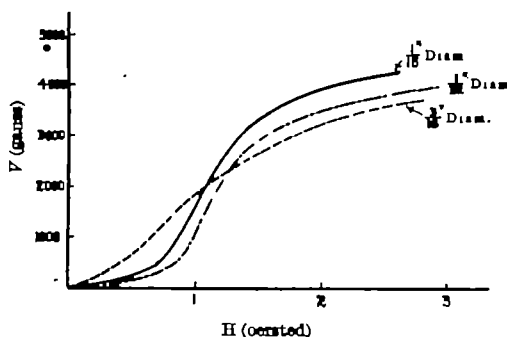


Fig. 1.

Commercially pure nickel wires of diameters $1/32$ in., $1/16$ in., and $3/16$ in. respectively, were heated in an atmosphere of hydrogen for a sufficiently long

time to reach a condition of maximum permeability in each case. After having cooled slowly to room temperature, the magnetization curves for each wire was obtained and these curves are shown in Fig. 1.

It will be seen that the initial portion of the curve for the $1/32$ -in. diameter wire is very flat and this part of the curve becomes steeper as the diameter increases. That is to say, the greater the ratio of surface perimeter to cross-sectional area, the less easily is the wire magnetized for low values of H . In other words, the magnetic characteristic of the wire is intimately dependent upon the diameter. The tests have also shown that the remanence and the coercive force are both considerably greater for the wire of $1/32$ in. diameter than for the other wires.

These results have important theoretical and practical implications, which will be considered in a paper which is now in course of preparation for publication elsewhere.

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¹ *NATURE*, 139, 928 (May 29, 1937)

Darkening of some Commercial Titanium Dioxide in Daylight

DURING an investigation of the discoloration by light of some ceramic glazes containing titanium compounds and of the subsequent fading of the discoloration when the glaze is kept in the dark¹, it was observed that certain varieties of commercial titanium dioxide are themselves affected by daylight. These varieties pass from their normal creamy colour to a deeper yellow-brown tint on exposure. The original colour is restored in the dark. This property of some commercial titania appears to have escaped notice in Great Britain, though Lee², in his study of reversible photo-sensitivity in haackmanite, draws an analogy with a certain brand of titania which showed the property mentioned in this letter.

The samples of titanium dioxide studied were stored in ordinary glass vessels exposed to daylight transmitted through the glass of the laboratory windows. The darkening of the titania, observed against samples kept in the dark, was apparent after only three hours in some instances. The effect is shown by those particles or perhaps portions of particle-surfaces adjacent to the illuminated glass wall of the container. Hence it is important that the powdered titania should move as little as possible during illumination if the darkening is to be obvious.

No experiments were made with the photo-sensitive brands of titania as components of paints or pigments, but they conferred similar properties on some ceramic glazes containing them. However, ceramic glazes darkening in light were made from titania and from rutile where these materials themselves showed no apparent darkening.

A definite explanation of the darkening of titania cannot be cited, though it appears likely that the colours shown by the exposed and by the unexposed material mark the establishment of an equilibrium condition of either a chemical or a physical nature. A chemical explanation might involve the oxidation of ferrous iron present in the titania to a more deeply coloured ferric compound (cf. the possible

mechanism for the darkening effect of titania on the colour produced by iron in enamels³). Titania is a source of photo-activation of chemical processes, including some oxidation processes⁴. Less likely is a change in the state of oxidation of the titania itself. (Renz discusses the reduction of titania in light in the presence of certain organic liquids and reducing solutions⁵.) Among physical explanations, changes in the crystalline variety of titania present (of the crystalline phases known to mineralogists as rutile, anatase and brookite) or in the grain-size of the titania do not seem very probable. Alteration in the degree of dispersion of some colloidal material suspended in the titania is another possibility (see, for example, the summary of Doelter's work given by Lee⁶ and the references provided by Clarke⁶).

The above suggestions are by no means exhaustive, and the possibility of a connexion between the darkening of some titanium dioxide by light and the darkening of titania on heating should be borne in mind. Meanwhile, notice of the phenomena described may be of value to those workers interested in titanium and its compounds.

I wish to thank Dr. Harry W. Webb for reading through this letter.

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¹ Parmelee, C. W., and Badger, A. H., *J. Amer. Ceram. Soc.*, 17, 1 (1934), last par. but one in the paper.

² Lee, O. I., *Amer. Mineral.*, 21, 764 (1936).

³ Low, J. B., *Spectroscop.*, 67, 215 (1934).

⁴ Goodeve, C. F., *Trans. Faraday Soc.*, 33, 340 (1937).

⁵ Renz, C., *Helv. Chim. Acta*, 4, 961 (1921).

⁶ Clarke, J. R., *J. Soc. Glass Tech.*, 5, 155 (1921).

A New Form of Resorcinol

A NEW form of resorcinol has recently been investigated in this Laboratory which compares as follows with the structure already described by Robertson¹.

	α -Resorcinol	β -Resorcinol (new form)
space group	C_{2v}^2 (Pna)	C_{2v}^2 (Pna)
axes		
a	10.53	7.91
b	9.53	12.57
c	5.66	5.50
cell volume	568 A. ³	547 A. ³
molecules per cell	4	4
molecular symmetry	none	none
calculated density	1.278	1.327

The principal intensities and higher orders of single crystal X-ray photographs show that the molecules in the β -crystals have turned round to align themselves in the b -axis direction.

The new form is conveniently prepared by slow evaporation of benzene solutions at ordinary temperatures, using specially dried air². Vacuum sublimation of resorcinol under certain conditions gives a preponderance of β -crystals, in large shiny flakes, which can easily be distinguished from the long needles of the α -form. According to Lantz³, resorcinol undergoes a transformation above 70.8° C. into a denser modification, which is perhaps identical with the β -form.

The two forms of resorcinol are of considerable interest for the theory of intermolecular resonance, since the hydroxyl 'bonds' in the two structures need not necessarily be of the same length. Although

this point can only be decided by a quantitative measurement of intensities of reflection, the manner of discovery of the β -form suggests that a difference in the hydroxyl bonds is quite possible. Repeated crystallization of resorcinol from 99.6 per cent 'heavy' water gives a deuterio-resorcinol which, according to Munzberg⁴, has the structure $C_6H_4D_2(OD)_2$. Whereas $C_6H_4(OH)_2$, when crystallized from boiling benzene gives good crystals of the α -form, the deuterium compound gives poor feathery crystals of the β -form; in one case a crystal was obtained which had the α -structure at one end and the β -structure at the other. On vacuum sublimation, $C_6H_4D_2(OD)_2$ again behaves differently in giving a preponderance of crystals with the α -structure.

The thermodynamic relationship between the two forms and their magnetic anisotropy are being measured. The possibility of a transformation from one form to the other in the solid should perhaps be considered in connexion with temperature effects described by Nilakantan⁵.

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July 5.

¹ Robertson, J. M., *Proc. Roy. Soc., A*, 157, 70 (1936).

² Ubbelohde, A. R., *J. Chem. Soc.*, 972 (1933).

³ Lantz, H., *Z. phys. Chem.*, 84, 611 (1918).

⁴ Munzberg, E., *Z. phys. Chem.*, B, 33, 23 (1936).

⁵ Nilakantan, P., *NATURE*, 140, 30 (1937).

Carbon-Halogen Distance in the Methyl Halides

In attempting to correlate the data on inter-atomic distances in polyatomic molecules, certain serious discrepancies have come to light between the spectroscopic method and the diffraction method as regards the carbon-halogen distances in the methyl halides. The differences are tabulated in Table 1. The reason that this had not been noticed earlier is that certain mistakes have been present in the deductions from the spectroscopic data and also that many new data are available. These results are particularly interesting when compared with the corresponding distances in the carbon tetrahalides,

TABLE 1.

	Old spectroscopic value ¹	New spectroscopic value	Diffraction value ²	Value in CX_4 ³
CH_3F	1.4	1.385 ± 0.004	1.42 ± 0.02	1.36 ± 0.02
CH_3Cl	1.8	1.65 ± 0.05	1.77 ± 0.02	1.765 ± 0.005
CH_3Br	2.0	1.88 ± 0.06	2.06 ± 0.06	1.93 ± 0.03
CH_3I	2.05	2.12 ± 0.15	2.13 ± 0.06	—

which are given in the last column. Thus it will be seen that, according to the diffraction method, in the methyl halides the carbon-halogen distance is always greater than, or equal to, the corresponding distance in the tetrahalides, whereas the spectroscopic method would seem to indicate that exactly the opposite is the case. The latter seems much more likely from consideration of the mutual repulsion of the halogen atoms in the tetrahalides.

Further support for this interpretation comes from an examination of the force constants for the C-halogen bond in the two cases. These are compared in Table 2, where it will be noticed that the force constant is always considerably larger in the methyl

halide than in the tetrahalide. The force constants in the first column were obtained by the method of Sutherland and Dennison¹, while those in the second were obtained by that of Urey and Bradley².

TABLE 2
Carbon-halogen force constants in 10⁶ dynes/cm.

	C—F	C—Cl	C—Br
CH ₃ X	5.8	3.6	2.9
CH ₂ X	4.0	1.8	1.4

One may not convert this difference in force constant into a difference in internuclear distance directly by means of the Clark³ or the Badger⁴ relation, since the bonds are under considerable strain in the tetrahalides. Badger, however, has shown how it is possible to make an allowance for this and has actually predicted a difference of 0.19 Å. between the C—Cl distance in CH₃Cl and CCl₄. This is of the same order as that found above.

Duchesne⁵, and Linnett and Thompson⁶ have recently remarked on the apparent large change in the C—C force constant in going from C₂H₄ to C₂Cl₄, and have suggested interpretations involving resonance between different structures. It seems probable, however, that at least a part of this change is due to the C—C bond being under a strain in C₂Cl₄ from the mutual repulsions of the Cl atoms. The potential functions used by Duchesne took no account of interaction between the Cl atoms.

A full treatment of these matters will be published in due course.

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July 9.

¹ Sponer, "Molekülspektren", Springer, 1935. Gerhard and Dennison, *Phys. Rev.*, **43**, 197 (1933).

² Brockway, *Rev. Mod. Phys.*, **8**, 231 (1936).

³ Sutherland and Dennison, *Proc. Roy. Soc., A*, **143**, 250 (1935).

⁴ Urey and Bradley, *Phys. Rev.*, **33**, 1970 (1933).

⁵ Douglas Clark, *Phil. Mag.*, **18**, 459 (1934).

⁶ Badger, *J. Chem. Phys.*, **3**, 710 (1935).

⁷ Duchesne, *NATURE*, **130**, 238 (1937).

⁸ Linnett and Thompson, *NATURE*, **130**, 509 (1937).

Oestrogenic Substances in the Dead Sea

THE Dead Sea, situated at one of the deepest points of the earth, contains a high concentration of salts (more than 25 per cent). In the depth of the Dead Sea there is a sandy mud which we have found to exhibit a certain oestrogenic activity. For the mud of the southern part of the Dead Sea the oestrogenic activity is about three times as great as for the northern part. The deep sea water contains 100 M.U. per litre, while the surface water is free of oestrogenic substances. The salt manufactured from the Dead Sea (salsana) contains 100 M.U. per kgm. Our results are given in the following table.

Part of the Dead Sea	Depth	Hormone activity (M.U. per litre)
<i>A. Water.</i>		
North near Kallia	Surface	Less than 6.6
" " "	Near the bottom	100
South	Surface	Less than 20
<i>B. Mud</i>	M.U. per kgm.	M.U. per kgm. dry weight
North near Kallia	30	45
South	100	100
<i>C. Salsana</i>		100

Other steroid hormones (male sex hormone, progesterone) could not be detected.

The mud was found to contain a yellow dye-stuff which according to its physical properties (absorptor and fluorescence spectra *inter al.*) belongs to the lyochrome group.

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Maturation in the Thelytokously Parthenogenetic Tenthredinidae

SINCE Doncaster's preliminary work in 1908¹, nothing has been recorded on the maturation of the thelytokously parthenogenetic Tenthredinidae. This author concluded that the chromosome number in the oocyte, polar nuclei and egg pronucleus was 8, and that there were two maturation divisions giving rise to an egg pronucleus and three polar nuclei². Recent work on the species *Pristiphora pallipes* Lep., by our colleague, Mr. L. O. Comrie, raises strong doubts regarding Doncaster's interpretations on chromosome number and behaviour, but confirms him regarding the number of maturation divisions and polar nuclei.

In the thelytokously parthenogenetic species *Thrinax macula* Kl., we find that in the female-producing egg there occurs only one maturation division, non-reductional, with the formation of one polar nucleus. Evidently there exist different methods of maturation in the thelytokously parthenogenetic saw-flies.

Doncaster's species are thelytokous, with rare males, whilst *Thrinax macula* reproduces by obligatory parthenogenesis (in the laboratory at least), though certain females parthenogenetically produce all-male (or almost all-male) broods, such males being found reproductively useless.

The female chromosome constitution is $2n = 14$, that of the male possibly $n = 7$. Good oögonial figures, not easily obtained, show 12-16. Chromosomes of the maturation spindle at no time exhibit tetrad formation; each of the 14 chromosomes is split longitudinally; 14 travel to each pole, arranged, very often, temporarily as 7 couples. Two vesicles are formed, the inner sinking into the yolk without further maturation.

The polocyte is either extruded or it divides on a wide asterless spindle and displays clearly 14 large rod-shaped chromosomes split longitudinally. The outer group derived from this division is extruded from the egg, but the inner group becomes vesicular, may undergo a further division, and ultimately degenerate.

Embryonic tissues show approximately 12-14 very small chromosomes. Follicle cells from pupal ovaries best show the number (14), morphology and arrangement of the chromosomes. Corroborative counts from other tissues are obtainable during metamorphosis, though polyploid spindles are more common, especially in tracheal and gut cells.

Spermatogonia have not been obtained. The first spermatocyte division is abortive and a minute cytoplasmic polar bud is nipped off. The second spermatocyte with 7 chromosomes produces two spermatids each with 7 chromosomes. In several cases were seen whole cysts of cells with 7 loosely arranged pairs of chromosomes; we interpret them

provisionally as 7 split chromosomes of the first spermatocytes preparing for the second (equational) division. The cytology of male maturation and spermatogenesis therefore closely resembles that typical of *Hymanoptera*.

Attention is directed to these considerations regarding *T. macula*: (1) In our experience the chromosome number of 14 is very exceptional among saw-flies, for some 40 species studied by ourselves and our colleague, Dr. F. Greenshields, show that 16 is usual (possibly it is 12 in a species of *Claudius*). (2) Its autoregulation behaviour is 'orthodox', for such occurs in the majority of animals thelytokously parthenogenetic. (3) It is uncertain whether the female chromosome constitution (14) is double that of the male, though the count of 7 in the male spermatocyte supports this view.

Our conclusions have been reached from intensive study of abundant material. The usual fixatives were used, but Petrunkewitch gave the best result with eggs; for the most part we stained with iron hæmatoxylin, but gentian violet, safranin and Fuenlen's reagent gave good results.

This work has been done with the assistance of a grant from the Department of Scientific and Industrial Research and whilst one of us (A.R.S.) is a teaching fellow under the Carnegie Trust. To both these bodies we give our thanks.

A. D. PHAEOCK.

ANN R. SANDERSON.

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July 10.

¹ Doncaster, L., *Quart. J. Micro. Soc.*, 49 (1906). (These species, vide *Smith, British Freshw. Insect. F.*, 1918, are: *Phanera subconcoloris* F., *S. pubescens* Bets., *Crocus varius* Vill., *Hemiteles croceus* Geoffr.)

² Doncaster, L., *Quart. J. Micro. Soc.*, 51 (1907).

Body Orientation in Crustacea

THERE is, I think, a fallacy which is frequently made in many of the problems dealing with the body orientation of Crustacea. I believe that practically all biologists dealing with this subject have accepted the idea that the position of the centre of gravity is a matter of great importance. Thus, to quote just one of the many statements which have been made along these lines: S. R. Williams¹ says, "A sinking animal, like a lifeless body, always falls with the heavy end downwards." Lifeless bodies do not sink with the heavy end downwards unless their specific gravity is considerably greater than the liquid in which they are sinking. Not only can this be demonstrated by experiment but also it is in agreement with standard text-book hydrodynamics.

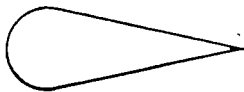


Fig. 1.

A CONE OF THIS SIZE AND SHAPE MADE OF ASH, SPEC. GRAVITY 0.817, SINKS HORIZONTALLY IN PETROL, SPEC. GRAVITY 0.74 AND RISES HORIZONTALLY IN A MIXTURE OF ALCOHOL AND WATER, SPEC. GRAVITY 0.95.

Recently I have made a series of cones of different materials (Fig. 1). In all cases the diameter at the

base was a quarter of the length, but, in addition, the broad end of the cone was made hemispherical. The centre of gravity of the cone itself would, of course, be three quarters of the distance from the tip, while the hemispherical attachment would bring the centre of gravity still farther from the point. The cones were made of different kinds of wood, box, mahogany, ash and ebony while the liquids used were water, water and alcohol, petrol. Ash floats in water but sinks in petrol. Box just floats in tap-water but will sink after it has been soaked for several days. Another excellent material is the ordinary carrot, which will always sink slowly in tap-water. The size of the cones varied from half an inch in length to six inches. It is unnecessary for me to give the actual figures for the specific gravities here; suffice it to say that a cone of the shape figured either sinks or rises horizontally, although the position of the centre of gravity is very definitely towards the one end.

To get satisfactory results, the specific gravity of cone and liquid must be reasonably close, and it is much easier to obtain the horizontal position with small cones. Cones were made of zinc, tin, lead and iron, and any of these drop through tap-water with the heavy end first.

From the above experiments, it is, I think, definitely proved that provided the lifeless body sinking or rising is doing so in a liquid that approximates its own specific gravity, the position of the centre of gravity has very little influence. There is very little definite information about the actual specific gravity of living Entomostraca. Several attempts have been made to find it, but since these have all been made either with a dead or narcotized animal which was made to float in liquids of known specific gravity, the result can only be a rough approximation.

However, it is quite certain that in most cases the animals are just slightly heavier than the liquid in which they are swimming. According to Williams, the specific gravity of *Cyclops albidus* is 1.022 while that of *Cypridopsis vidua* Muller (an oetradod) is 1.046; since the specific gravity of any natural water must be above 1.0, it is fairly clear that an additional spine or a slight increase in the extension of the head of a *Daphnia* cannot affect body orientation by influencing the position of the centre of gravity.

This is scarcely the place to discuss the somewhat voluminous literature on the subject, but the position of the centre of gravity plays a very large part in Woltereck's theory², which has been discussed somewhat fully by Skogsberg³ and accepted. It has also been accepted by Wagler⁴. From the mathematical point of view (I am greatly indebted to one of my colleagues, Mr. H. C. Nest, for looking up this theorem for me) the matter is treated fully by Ramsey in "A Treatise on Hydromechanics", Part 2: "Hydrodynamics", p. 190, "Stability". At the end of the theorem it is stated that "this accords with the observed tendency of a body to turn its flat side or its length across the direction of its motion".

To put the matter more crudely: when a body is sinking through a liquid, the most stable position is one in which it presents the greatest area in the horizontal plane. In other words, there is a very definite tendency which brings the greatest possible plane into the horizontal position; but if the speed of sinking is at all great, other factors may influence the attitude taken up by the sinking bodies. Small Entomostraca, even though the specific gravity of

chitin may be as high as 1.4, are incapable of sinking rapidly. Actually the chitinous casts of Daphnids sink quite slowly; so do those of freshwater ostracods.

The swimming, floating and sinking of these minute crustaceans at present constitutes an almost impossible problem, and it depends, I believe, entirely on the nature of the eddies and vortices set up. Mere speculations, though they may be very attractive, are not likely to carry one very far; but I think one can safely conclude that with organisms comparable in size and specific gravity to *Daphnia* or *Chirocephalus* the position of the centre of gravity

plays no part whatsoever as a factor determining body orientation.

A. G. LOWNDEN.

Marlborough College,

Wilts. June 16.

¹ Williams, S. R., "The Specific Gravity of some Fresh-water Animals in Relation to their Habits, Development and Composition", *American Naturalist*, 34, 95-106 (1900).

² Woltereck, R., "Über Funktion, Herkunft und Entstehungsurachen der sogen. "Schwabe-Fonstatae pelagischer Oidoceren" *Zoologica*, 28, Heft 67: 2 (Stuttgart, 1913).

³ Skogberg, T., "Studies on Marine Ostracods". Part I. (Cyprid mids, Halocyprids and Polycoepids.) Pp. 109 (1920).

⁴ W. gler, H., "Branchiopoda, in Kükenthal and Krumbach's Handbuch der Zoologie", Bd. 8. H.1 (1926-27), pp. 358-359, p. 416.

Points from Foregoing Letters

Prof. I. M. Hailbron, A. E. Gillam and Drs. E. Lederer and V. Rosanova have spectrographically examined the liver oils and vitamin A concentrates from more than sixty batches of seven different species of freshwater fish, and find that the main absorption bands are at 693 m μ (and inflection 620 m μ) for chloroformic antimony trichloride, and 345 m μ for alcohol. These properties are in contrast to those of marine fish and mammalian liver oils and concentrates, where the corresponding maxima are 620 and 328 m μ respectively, and may possibly be due to a second vitamin A with some degree of specificity for freshwater fish.

A substance with absorption bands at 350 and 287 m μ , giving a green colour with antimony trichloride (λ_{max} 693 m μ), is stated by Drs. J. R. Edisbury and R. A. Morton, and G. W. Simpkins to appear in the liver, viscera and sometimes eyes of fish, particularly freshwater fish. It resembles vitamin A so closely that it is tentatively designated 'vitamin A₁'.

F. W. Fox and W. Stone state that a substance other than ascorbic acid and having no antiscorbutic activity is formed in large quantities in Kaffir beer. It behaves as ascorbic acid with indophenol at a pH higher than 2.0, with the folin uric acid reagent, and with ascorbic acid oxidase. It does not react as ascorbic acid with norite charcoal or with indophenol at a pH between 1.2 and 1.8.

Theoretical curves for the absorption of the soft component of cosmic radiation by lead and aluminium have been calculated by Dr. W. Heitler on the basis of the quantum theory. The few available values from experimental measurements fall satisfactorily on these curves.

F. Hoyle states that, to account for the result of Jacobson's recent experiments, it is necessary to assume a β -decay interaction term which combines the wave-functions of the heavy and light particles in a more interrelated form than the expressions proposed by Fermi and Konopinski-Uhlenbeck. This modification makes more definite predictions of the low-energy end of positron and electron spectra, which seem to give reasonable agreement with the empirical β -decay curves.

From the Raman spectra of solutions of ethyl ether in excess halogen acids, Dr. G. Briegleb and W. Leuppe conclude that, in solution, they form 'oxan' compounds containing tetravalent oxygen.

By directing jets of supersaturated vapours of common liquids against surfaces of mica, Prof. D. H. Bangham, S. Mosallam and Z. Saweris have produced films which give rise to interference colours, and yet

have properties very different from the bulk liquids, these they regard as thick adsorbed films.

Taking into account the ellipticity of the earth, Dr. Harold Jaffreys has redetermined a large number of epicentres of Pacific earthquakes, and finds great improvement in the reliability of Pacific seismological stations.

Further experiments by Dr. T. F. Wall on the influence of surface treatment on magnetic properties show that nickel wires, heated in hydrogen and then cooled (for low values of the magnetic field strength), the greater the ratio of the surface perimeter to the cross sectional area, that is, the smaller the diameter, the less easily magnetized they are. An increase in the coercive force and in the remanence is likewise observed as the diameter decreases.

W. O. Williamson directs attention to the reversible darkening of some commercial titanium dioxide under the influence of light, and indicates a number of possible explanations.

A new crystal form of resorcinol is described by A. R. Ubbelohde and Dr. J. Montearth Robertson. This resembles the beta form of the tetradentoro-resorcinol crystals, and the authors suggest that there is a difference in the hydroxyl bonds in the two crystal forms, due to a difference in the intermolecular resonance.

The distance between the carbon and the halogen atoms in the methyl halides, recalculated from the spectroscopic data by Dr. G. B. B. M. Sutherland, are markedly smaller than the previously accepted ones and those obtained by the method of electron diffraction. The revised values appear the more likely to be correct on comparison with the corresponding distances in the carbon tetrahalides and with the force constants for the carbon-halogen bond in the two cases.

Prof. A. D. Peacock and Dr. Ann R. Sanderson find in the thelytokously parthenogenetic saw-fly, *Thrinax macula*, that the female chromosome constitution is $2n = 14$, that of the rare male (from second spermatocytes) $n = 7$, and that there is only one maturation division, non-reductional, in oogenesis. The work of Doncaster and of Comrie with other species of thelytokously parthenogenetic saw-flies shows two maturation divisions in oogenesis, and Peacock, Sanderson and Greenshields find that the female chromosome constitution in some 40 species of saw-flies is $2n = 16$. Accordingly, autoregulation of chromosome number in saw-flies is maintained by at least two methods, whilst *T. macula* is exceptional in its chromosome constitution.

Research Items

The Oolitic Limestone Escarpment in Bronze Age France

MISS MARGARET DUNLOP, in a study of the significance of the Oolitic limestone escarpment in the Bronze Age in France (*Man*, July 1937), points out that the grouping of Bronze Age finds in France is such that it is possible to discern three types of environment—maritime, riverine and plateau. In the cooler, wetter conditions of the Middle Bronze Age in the ninth century B.C. the forest-tree plateau, and the Oolitic limestone ridges in particular, are significant in the distribution of certain objects of material culture. They form a natural region imposing topographic restrictions on those using them, and may be said to be a distinct, though secondary, cultural province in the life of Bronze Age France and a feature of vital importance in the maintenance of exchange and some semblance of organization during the unsettled conditions of the Hallstatt phase of readjustment. The major Bronze and Early Iron Age cultural spreads affecting the French Oolite are as follows: c. 1750 B.C., an infiltration from the Rhine Valley and south Germany, characterized by the large broad triangular dagger and the flanged axe; (Jura, Dauphiné, down Rhone, etc.); c. 1400 B.C., invasion from south Germany and Bohemia—dagger with blade with two rivets, simple sword (Jura, Charente, south to Gard and Puy de Dome, tumuli of Côte d'Or and Jura, Herault); c. 1200 B.C., invasion and infiltration from north European plain—riveted pistilliform sword, winged lance with eyelet holes, terminal winged axe (Aube, Marne, S. Brittany); c. 850 B.C., first Hallstatt invasion from south Germany and western Austria—short bronze sword (Oolitic outcrop, eastern tumuli); c. 600 B.C., renewed invasions from same sources—iron sword with bronze rivets, hilt terminating in double circle (distributed as in previous period, concentration around iron mines of Châtillonais, north of Côte d'Or).

Extinct Mammals and Man in America

FURTHER evidence relating to the contemporary existence of man and an extinct mammalian fauna was obtained in pluvial deposits near Clovis, New Mexico, in the course of 1936. An account of the results of the work of the expedition, which was under the direction of Dr. E. B. Howard, acting on behalf of the Philadelphia Academy of Natural Sciences, has been prepared by Mr. John Lambert Cotter (*Proc. Acad. Nat. Sci. Philadelphia*, 89). The site under investigation was that known as "the gravel pit" in Blackwater Draw, between Portales and Clovis. The stratigraphy of the pit is characterized by the occurrence of three more or less distinct layers, aggregating approximately seven feet: first, brownish sand, extending two and a half feet from the surface; second, a bluish material containing sand, grit and clay, three feet; third, a speckled sand, one and a half feet thick. The blue stratum and the speckled sand were found to contain certain bone remains, with which were associated two Folsom-like points, a fragmentary point, a scraper, several flakes, all of

chalcodony, and two bone artefacts, such as have not previously been associated with a Folsom industry. The occurrence of the bones resolves itself into certain characteristics: the bones of the bison, except for a cannon bone and a scapula, occurred in the blue material immediately above the mammoth. The mammoth bones occupied the contact between the blue material and the speckled sand. Below the mammoth bones in the speckled sand were horse bones and traces of turtle-shells, thirteen inches below the contact of blue material and speckled sand. The lithic and bone artefacts were in definite association and contemporaneous with the mammoth bones. The bone artefacts show bevelled surfaces at their ends, which are compared with the splicing technique of the Eskimo and Indians of North America.

The Haemorrhagic States

THE haemorrhagic states were the subject of a discussion at a combined meeting of the Sections of Medicine and Pathology, Bacteriology and Immunology of the British Medical Association at its recent meeting in Belfast. Prof. L. J. Witts delivered the opening paper. He said that these conditions did not lend themselves to rigid classification. In the treatment of haemophilia, the local application of coagulant snake venoms was an important advance, but liver extract, oestrum and moccasin venom had been failures. For the idiopathic thrombocytopenic purpura removal of the spleen was the most successful treatment, but its mode of action was uncertain. Vitamin C was of value in scurvy only, and not in other haemorrhagic states. Dr. Capon discussed haemorrhagic conditions occurring occasionally in the newborn (about one in 400 cases) and found that the majority were relieved by an intramuscular injection of whole blood. Dr. Timperley maintained that an extract of egg-white, prepared by his special method, controlled internal haemorrhage in haemorrhagic states, but its efficiency was not confirmed by other speakers.

Grass-drying

SINCE the Agricultural Research Council issued its first report in 1935 on the preservation of grass and other fodder crops, much new information on the subject has been obtained and considerable advances made. While fewer than a dozen driers were in use in Great Britain during 1935, nearly fifty were at work in 1936. A survey of the problems connected with grass-drying and its effect on the economy and management of farms has been made by E. J. Roberts, and published as a report entitled "Grass Drying" to the Committee of the Council (London: H.M. Stationery Office. 2s. net). An introductory chapter describes the different methods of preserving grass, while others follow which deal with the extent of the grass-drying movement, the production of suitable herbage, the water content of the herbage,

cutting and hauling, furnaces, fuels and power, grass-drying machines and the feeding value of young grass. In the concluding chapter, the cost and profitableness of producing dried young grass are considered. Drying only becomes worth while if the special nutritive qualities of young grass can be conserved, and in wet seasons when growth is so rapid that the drier cannot deal with all the produce, definite areas should be devoted to hay-making or ensiling. The collection of short young grass originally offered some difficulty, but machines have now been devised which overcome this. The cost of production of dried grass in 1936 varied considerably on different farms; but the average figure, allowing for rent, overhead expenses and depreciation, was about £8 per ton, a figure which at the present price of concentrated feeding stuff allows a margin on true nutrient values. The chief obstacle to an extension of the process is the high capital cost of driers; but doubtless these will be lowered as experience is gained, and the enthusiasm shown both by the farmers and by the manufacturers of driers will go far to overcome the difficulties at present encountered.

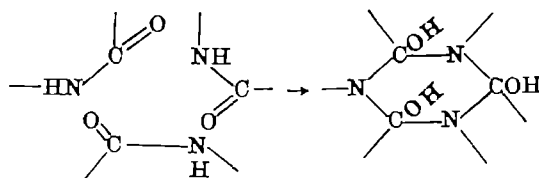
The Soviet North Polar Station

REPORTS received in Moscow by radiogram from the floating observatory in the vicinity of the North Pole and supplied by the Soviet Union Year Book Press Service have already announced some results of interest. In lat. $88^{\circ} 54' N.$ long. $21^{\circ} W.$ the depth of the Arctic Ocean was found to be 2,345 fathoms (4,290 metres) and in lat. $88^{\circ} 47' N.$, long. $10^{\circ} W.$ 2,391 fathoms (4,374 metres). These readings compare with Peary's 1,500 fathoms (2,743 metres), no bottom, within five miles of the Pole and Amundsen's 2,050 fathoms (3,750 metres) in lat. $87^{\circ} 43' N.$, long. $10^{\circ} 21' W.$ Since the station is steadily drifting farther important soundings may be expected. In relation to Wilkins's sounding of 2,974 fathoms (5,440 metres) in lat. $77^{\circ} 45' N.$, long. $175^{\circ} W.$, it would appear that the deepest parts of the arctic basin occur in the Beaufort Sea and adjoining the wide Asiatic continental shelf. Another discovery of importance is the occurrence of a layer of water at a depth of 275–600 metres with a temperature above $0^{\circ} C.$ and a high salinity. This would appear to be the Atlantic water which Nansen discovered to be sinking, in the Spitsbergen area, below the colder and less saline polar water. Lastly, plankton determinations show a much more abundant pelagic life than had been anticipated.

Patterns of Proteins

In a recent paper (*Proc. Roy. Soc., A*, 160, 59; 1937), Dr. D. M. Wrinch presents a reasoned account of her theory of the molecular constitution of proteins. This is an attempt to provide a unitary explanation of three characters common to all soluble proteins: (a) The molecules are largely made up of amino- and imino-acid molecules. They contain peptide linkages but few free NH_2 groups. (b) There is a general uniformity among proteins of widely different chemical composition. (c) A large number of crystalline proteins have highly symmetrical crystals. These properties she claims to explain on the basis of higher order polymerization of amino-acids. The simple peptide link can only give rise to rings or chains of amino-acids. To get more complex aggregates it is necessary for each molecule to be linked to three or four others. This can be done by

an inner transformation according to the scheme:



On the basis of this transformation, it is possible to build up trigonal plane groups of different stages of complexity. These 'cyclol' sheets have, owing to the fact that all the amino-acids are of the α type—an observation which here, it is claimed, obtains significance for the first time—have all their side chains on one side of the plane. They can further be attached together either by means of these side groups or by hydroxyl bonds, thus forming larger aggregates, which must necessarily be integral multiples of the smallest of them, as Svedberg had found. Owing to their unsymmetrical character, such cyclol plates will be surface-active and the hypothetical structure gives a good agreement for the surface densities of protein films. Owing to the great complexity of protein chemistry, it may be long before it is possible to verify any of these hypotheses, but it must be admitted that the solution offered, although it contains arbitrary elements, is both simple and elegant.

Observation of a Fireball Train

In a recent paper (*J. Brit. Astro. Assoc.*, 47, 7; May 1937), Mr. M. A. Ellison describes a fireball observed on March 21 about $10^h 02^m$ U.T. The brightness was greater than that of Venus, and the colour was a golden-red. The most important point about this fireball was the velocity of the train. Mr. Ellison estimates that, at a height of 60 miles, the drift velocity was 133 miles per hour. From the configuration of the train, it is possible that the middle portion was subject to a current of even higher velocity than the ends. Many will be surprised at this velocity in the higher regions of the atmosphere, where it is believed that diffusion is a more potent factor in mixing the gases than currents of wind. If Mr. Ellison's figures be correct, it is obvious that the latter cannot be ignored in the stratosphere.

Aerodynamic and Electrodynamical Equations

N. P. KASTERN (Report of Academy of Sciences, U.S.S.R., December 9, 1936) has attempted to account for many phenomena, usually explained by relativity or quantum mechanics, on a strictly classical basis, merely by adding small extra terms to Maxwell's electrodynamical equations. At the same time he adds similar terms to Euler's equation of hydrodynamics, and unites these two sets of equations into a common system. It is claimed that the new hydrodynamic equations, as applied to vortex motion of gases (which is of great importance in aviation) explains several well-known phenomena inexplicable by the old equations. As for the new form of Maxwell's equations, the extra terms are non-linear, and involve a variable velocity of light. It is stated that the quantum properties of the field can be deduced from this basis. The grounds for this assertion are not fully explained, but they appear to be connected with an analogy between moving tubes of force and gaseous vortices.

Validity of Laws of Electrodynamics

IN the course of an investigation carried out for an electrical engineering company, I found that some generally accepted laws of electrodynamics were incorrect, and that serious mistakes were therefore being made by electrical engineers. As the laws here

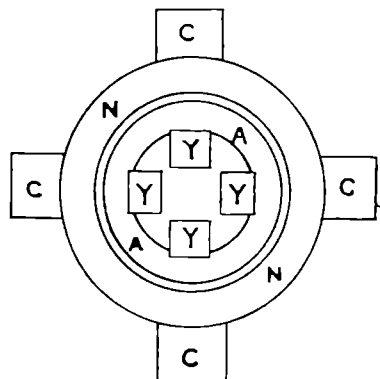


Fig. 1.

referred to have been taught by such high authorities as Maxwell and Jeans, they are naturally being repeated in most of the text-books that are now used in our universities and technical colleges: in fact, none of these laws (which has already caused patents to be taken out for circuit breakers that will work in a very different way from what was expected, and for electric motors that will not work at all) is taught in all text-books that deal with the subject, including those used on the Continent and in America.

The law to which I have just referred is sometimes ascribed to Laplace, sometimes to Biot and Savart, sometimes to Ampère, and sometimes to Maxwell; but all teachers appear to regard that law as infallible. It may be stated as follows, though it is more frequently stated in a less complete form.

When a straight conductor element of length dx carries a current i in the OX direction of rectangular co-ordinates (right-handed) and lies in a magnetic field where the flux density has a component b in the OY direction, it is acted upon by a force $i.b.dx$ in the OZ direction.

The units here referred to are, of course, those of the c.g.s. system usually employed in text-books of electromagnetism. The current is accordingly in amperes and the force in dynes. In view of the doubt with regard to the name of the investigator by whom this law was first enunciated, I propose calling it 'the $i.b$ law'. This name seems appropriate, since the law says that $i.b$ is the force intensity (dynes per centimetre length of conductor) at the point in question.

But when the $i.b$ law is applied to the case shown in Fig. 1, which is a direct-view of a direct-current slip-ring dynamo designed by Dr. A. E. Clayton, it tells us that the machine will work, though Dr. Clayton found that it would not. From his description of the machine, in the *Electrician* of July 2, 1915, it appears that he may not have designed it with the idea that it would work, but with the

idea that its failure would disprove Faraday's law of electromagnetic induction. He evidently overlooked the fact that its failure has disproved the $i.b$ law; for he continued to teach this law, which is repeated in his latest books on dynamo design. But the following considerations will make it clear that the $i.b$ law has been conclusively disproved by the failure of this machine.

In Fig. 1, C, C, C, C are the ends of the straight iron cores upon which the field coils are wound, N is the ring-shaped north pole of the magnet, A is the ring-shaped core of the armature, and Y, Y, Y, Y are the ends of the straight iron yokes that connect this armature to a similar one at the south pole end and rotate with these armatures. All the rings here referred to were of rectangular cross-section, and the armatures were ring-wound on the parts between the yokes.

The machine should evidently work as a motor, according to the $i.b$ law, when the windings are suitably fed with direct current through the slip-rings; for the conductors that are in the main flux (between the armature cores and the magnet poles) should be subjected to a force much greater than any opposing force acting on conductors in the leakage flux, owing to the great permeance of the magnetic path in the iron yokes. Actually, however, the machine would not work; and this will be under-

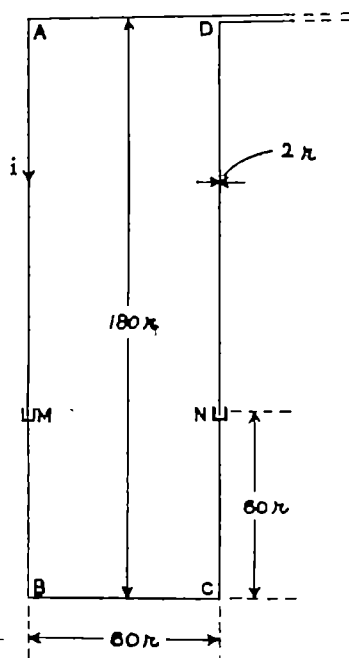


Fig. 2.

stood when attention is directed to the fact that the amount of flux linking the winding would not begin to change when the armature began to rotate, with the consequence that (according to Neumann's law) no back-e.m.f. would be generated.

Dr. Clayton eventually came to the conclusion that his machine was a failure from every point of view: that is to say, it not only failed to work, but also (in his opinion) failed to give a disproof of Faraday's law. His present view is that Faraday's "lines of magnetic force" were rushing from yoke to yoke when the armature was rotating, cutting the inside conductors on their way, and thereby generating an e.m.f. that counterbalanced the one generated in the outer conductors. Many electrical engineers are unable to see any justification for this view; and Dr. Clayton will certainly find it useless as a defence of Faraday's law against the following argument.

Fig. 2 shows an experimental circuit-breaker arrangement, with mercury cups at *M* and *N* (where the arcs would be formed when the actual circuit breaker began to open). When this arrangement is surrounded by air, or by any other medium of unit permeability in the c.g.s. electromagnetic system, the amount of flux *dc* that is cut during a downward movement of *MBCN* through the distance *dy*, with the current kept constant, can be calculated by methods explained in text-books of electromagnetism. It will thus be found that *dc* consists of a part

$$2 i dy (0.054 + 0.161)$$

that comes from *MADN* and is cut by *BC*, and a part

$$2 i dy (0.054 + 0.030)$$

that comes from *MBCN* and is pulled across *AD*, so that

$$dc = 0.6 i dy.$$

According to Maxwell (see Art. 541 of his "Treatise on Electricity and Magnetism"), the total amount of flux-cutting must be equal to the total increase in the flux that links the electric circuit. But when we try to verify this in the present case, by making a direct calculation of the extra flux linkage *dk* that is due to the downward movement of *MBCN* through the distance *dy*, we get

$$dk = 17.5 i dy.$$

The great difference between *dc* and *dk* is accounted for by the fact that the stretching of *AB* and *DC* through the distance *dy* causes additional flux to be sent through the area *ABCD* by the added lengths *dy* at *M* and *N*.

If *MBCN* is moving downwards with a velocity of *v* centimetres per second, and if the movement through the distance *dy* takes place in the time *dt*, we have *dy/dt* = *v*, *dc/dt* = 0.6 *i v*, and *dk/dt* = 17.5 *i v*. The induced e.m.f. will therefore be 0.6 *i v* or 17.5 *i v*, according to whether Faraday's law or Neumann's law is correct. To settle this question, I attached *MBCN* to one end of a strip of wood that was arranged to turn about a knife-edge in the manner of the beam of a balance. This enabled me to measure the electromagnetic force *F* exerted on *MBCN* when various currents (up to 1,300 amperes) were flowing in the circuit. The strip of wood was fastened to the middle of *BC*, and was at right angles to the plane of *ABCD* when in the position of equilibrium.

As will be seen from Maxwell's Art. 583 or my article in *World Power* of March 1932, the energy equation is either

$$F dy = \frac{1}{2} i dc \quad (1)$$

or

$$F dy = \frac{1}{2} i dk, \quad (2),$$

according to whether Faraday's law or Neumann's law is correct; and a measurement of *F* with any

given value of *i* will show whether (1) or (2) is the correct equation. In each of the numerous cases that were tried, with various ratios of *BM* to *BC* and of *BM* to *BA*, the measured force was in close agreement with equation (2), though it was frequently (as in the case of Fig. 2) between 20 and 30 times as great as the force indicated by equation (1).

It may therefore be concluded, not merely that there is sometimes a great difference between the *d* and *dk* that Maxwell thought to be identical, but also that Neumann's law is right and Faraday's is wrong. W. F. DUNTON.

DURING recent years the points raised by Mr Dunton in the above note have been discussed a considerable length in electrical journals. Indeed controversy over the laws of electromagnetic induction has flared up periodically during the last half century. About forty years ago Carl Hering devised a number of ingenious experiments to show that 'flux cutting' was the essential factor in the generation of electromotive force. Some twenty years later Blondel described in the *Electrician* an experiment in which the total flux linkage—as defined by the product of the flux and the number of turns—was reduced from a large value to zero without e.m.f. being induced in the circuit, his method being to unwind a coil which had been wound upon a cylindrical magnet. A few years prior to this, I had carried out a number of experiments in an attempt to establish discrepancies between the 'flux cutting' and the 'rate of change of flux' theories, and in the correspondence consequent upon the publication of Blondel's work I described one of the models I had made for the purpose.

This model is the one described above by Mr Dunton; before it was built it was anticipated that no e.m.f. would be generated in its winding, and its behaviour on test fulfilled those expectations. However, I finally concluded that the action of the model was in line with that of the slotted armature generators now universally used, and the result of my investigations was to lead me to conclude that the total amount of 'flux cutting' is always equal to the change in the flux linkages. In short, my conclusions were in agreement with Art. 541 of Maxwell's classic book.

The behaviour of the model as a motor was never considered, but it follows that if its behaviour as a generator is in line with the slotted armature machine such will also be the case for motor action. The action of motors with slotted armatures is well known, and it is also well known that the torque developed between stator and rotor is altogether greater than would correspond to the product of the current in the conductors and the flux density in the slot. In my opinion the model gave no evidence regarding the laws of electromagnetic induction and electrodynamic other than that long since available with slotted armature machines.

For the past few years, Mr. Dunton has, in a most energetic and far-reaching manner, challenged the validity of some of the commonly accepted laws. His work arises out of calculations connected with expanding circuits—such calculations being of particular importance in the design of circuit-breakers. One such example is given in Fig. 2 of Mr. Dunton's communication. Now the flux linked with a circuit may be changed in various ways, of which one (a) is by changing the current carried by the circuit, and

other (b) is by maintaining the current constant and expanding the circuit as indicated, for example,

Mr. Dunton's Fig. 2. To my mind, there is no essential difference between these two cases. Nothing to be gained by confusing the issue with mathematics, for the only real issue involved is the manner in which the magnetic field comes into being. If it is taken that the growth of the field in (a) is accompanied by a corresponding flux cutting it surely must follow that any new flux created in (b) also necessitates corresponding flux cutting.

Quoting now from Mr. Dunton's letter: "The net difference between dc [that is, the flux cutting] and dk [that is, the change in the flux linkages], accounted for by the fact that the stretching of B and DO through the distance dy causes additional x to be sent through the area $ABCD$ by the added paths dy at M and N ". From this it is evident that Mr. Dunton has not concerned himself with

how this additional flux comes into being, and if his interpretation of flux cutting be taken there is no flux cutting in case (a) above. It is my view, therefore, that Mr. Dunton's arrangements of expanding circuits give no evidence—in support or otherwise of the validity of Art. 541 of Maxwell's "Treatise on Electricity and Magnetism"—other than that presented by the case of simple circuits carrying changing currents.

The issue involved is, of course, one of pure physics. With the great developments that are taking place in atomic physics one can look forward to the time when physicists will wrest further secrets from Nature and give to electrical engineers a clearer conception of what is really happening in magnetic fields, and of the 'mechanism' by which E.M.F. is actually induced in a circuit. But at the moment I see no reason for abandoning existing conceptions.

A. E. CLAYTON.

The Carnegie Institution of Washington

THE report of the president of the Carnegie Institution of Washington for the year ending October 31, 1936, reviews the relationship of its existing policies to research, and examines some of their implications as well as giving a brief account of researches in progress (Washington, D.C.: Carnegie Institution, 1937). The Institution has so far limited itself largely to securing new data and to the organization of information relating to mathematical research, investigation of natural phenomena and to history. The value of science in terms of its contribution to meet human needs is shown in many ways, but the Institution has also been concerned with the ways in which science can be effectively utilized to deal with difficult human relations such as those represented by economics and government. These possibilities have been recognized with the assumption that the best method of procedure is by co-operation between the sociologist, economist, or student of government and representatives of sciences with closely allied methods or problems.

The Institution has endeavoured to secure the practical application of results of research, whether from the physical or biological sciences or in human issues, as in psychology, and the importance of bringing together, in appropriate organizations, scientific workers and engineers and students of social and economic problems, with a view to the utilization of new ideas and techniques, is stressed. Responsibility in this field rests in part upon the scientific worker, and it is essential that the possible influence of science upon thought, and in the development of techniques which influence modes of thought, could receive close attention. Even in international relations the cultural and economic significance of science should not be overlooked.

In the field of astronomical research the work of the Mount Wilson Observatory has reached a stage when the accumulation of data permits the formation of new patterns with new theories and new points of view. The appearance of a bright nova in the constellation of Lacerta on June 18, like that of Nova Perseus, has received careful study, while a super-

nova has been discovered in one of the extra-galactic nebulae of the Virgo cluster. An extensive preliminary survey has been made of the number and distribution of the extra-galactic nebulae corresponding to the Milky Way, and measurements of the red shift of remote nebulae have received intensive study. The Department of Terrestrial Magnetism, in addition to studies on the causes of fluctuations in the earth's field, has investigated the question of magnetic disturbances, including world-wide magnetic storms, as well as the relation of magnetism to atomic physics, in which field it has been shown that protons and neutrons are probably identical in every respect except that of electrical charge. The Geophysical Laboratory has investigated the equilibrium between crystalline minerals, usually silicates, and their melts, including the equilibria of rock-forming silicates at atmospheric pressure, and has been responsible for a series of determinations of the radium content of samples obtained from the ocean-bottom.

Important seismological research has been carried out at Pasadena, and the Division of Plant Biology has been responsible for intensive studies of individual functions and components of plants as well as in photosynthesis, including the carotenoid pigments and the absorption of carbon dioxide by the unilluminated leaf. The work of the Division of Animal Biology has been characterized by increasing co-operation with other groups. Definite evidence has been obtained concerning factors involved in the origin of tumours. Much light has been thrown upon the development of the layers which are defined in early stages of the embryo, and studies in endocrinology have been concerned with the influence of prolactin, and the milk-producing hormone.

Other important studies have been concerned with genetics and nutrition, while the Division of Historical Research has concentrated attack on the early history of the Maya and major questions relating to the advance of civilization which have emphasized the value of data from other civilizations for testing modes of life and growth of an advancing civilization.

Fourth International Grassland Congress

THE paper-reading sessions of the fourth International Grassland Congress were held at Aberystwyth on July 14-18, under the presidency of Prof. R. G. Stapledon. A preliminary tour was arranged from Oxford through Leicestershire, the Cotswolds, Herefordshire and central Wales; a party of two hundred delegates left Oxford on July 10 and arrived in Aberystwyth on July 14. Delegates who participated in this tour had excellent opportunities of studying the modern developments in English grassland farming, such as the use and production of pedigree seed, artificial drying of grass, etc., and were therefore in a better position to appreciate the papers read afterwards by British specialists at the Aberystwyth meeting.

The numerous papers offered for presentation to the Congress were divided among plenary and sectional sessions. The plenary papers were divided into three groups, dealing with nutritional questions, herbage plant breeding and general grassland respectively. The sectional sessions, held on July 16, covered the six subdivisions of grassland research, namely, (1) grassland ecology, (2) seed mixtures, (3) plant breeding and seed production, (4) manures and fertilizers, (5) nutritive value of pastures and fodder conservation, and (6) management, yields and economics of pastures.

The subject-matter of the papers read is perhaps best dealt with according to country; this Congress differed in scope from its three predecessors, held in Germany, Scandinavia and Switzerland respectively, as the 450 delegates came from thirty-seven countries in all parts of the world, and were therefore interested in more varied aspects of the grassland problem than at the earlier conferences.

The British papers were concerned chiefly with the breeding of pure-bred grasses and clovers (T. J. Jenkin and R. D. Williams, Aberystwyth), the production and marketing of seed of pure-bred strains (T. E. Miln, Warrington, and Gwilym Evans, Aberystwyth), the use of lime and phosphate in grassland improvement (J. A. Hanley, Newcastle, and R. G. Heddlie and W. G. Ogg, Edinburgh and Aberdeen), the production and nutritive value of artificially dried grass (H. E. Woodman, Cambridge, and E. J. Roberts) and the economics of grassland improvement (John Orr, Manchester).

An important European paper was that delivered by A. I. Virtanen, Finland, on the associated growth of legumes and non-legumes; the old-established fact that non-legumes benefit by an association with legumes has been explained by recent work in his laboratory at Helsinki. Exact work with sterile culture technique has conclusively shown that nitrogenous compounds are excreted into the soil from legume nodules, and that this excretion commences immediately upon the formation of nodules. The excreted nitrogen compounds are products of nitrogen fixation and not decomposition products of proteins; the excretion products have been studied in an attempt to shed light on the mechanism of nitrogen fixation. The excretion is apparently an equilibrium reaction. Excretion of amino-acids has been demonstrated with all legumes so far examined (different species of clover, peas and lucerne). Application of nitrate appears to lower markedly the excretion.

A wide range of topics was covered by readers from other European countries. The Scandinavian countries have always been in the forefront as regards breeding of herbage plants; they were here represented by N. Sylván and H. Osvald, Sweden, and O. Valle, Finland. C. K. van Dealen, Holland, also stressed the importance of using indigenous or pure bred seed when sowing down pastures.

Papers on the grasslands of Hungary, read by K. T. Kolbai and J. von Pukovich, indicated the rapidly increasing interest in the subject in this country, where there are now three grassland unions with 60,000 farmer members. Another paper from the same country, by N. von Bittera, dealt with the peculiar problems of applying fertilizers to arid grassland, a subject of direct importance to the delegates from North America, Africa and Australia.

The profitability of applying nitrogenous fertilizers was discussed by readers from Sweden, Holland and Germany, the conservation of grassland herbage in the form of silage by delegates from Great Britain, Switzerland and Germany, and the good effect of alpine pasturing upon the health of stock by V. Venzani and E. Carbone of Italy. One of the leading grassland experts from Germany, E. Klapp of Bonn compared the effects of mowing and grazing upon pastures in general and upon certain herbage grasses and legumes in particular.

The outstanding value of pastures in erosion control has been an important factor in the rapid growth of pasture research in the United States and Canada in recent years. It was therefore not surprising that these two countries should be well represented at the Congress; the American delegation, under its chairman, P. V. Cardon, principal agronomist in charge, Division of Forage Crops and Disease Bureau of Plant Industry, U.S. Department of Agriculture, numbered fifty persons, the majority of whom were travelling in one party under the guidance of Dr. D. B. Johnstone-Wallace, Cornell University, on a tour of centres of grassland and scenic interest in Great Britain, Scandinavia, Germany, Austria, Switzerland and France.

Papers representing the current American outlook were read by three members of the U.S. Department of Agriculture, namely, P. V. Cardon (Bureau of Plant Industry), W. R. Chapline (U.S. Forest Service) and C. R. Enlow (Soil Conservation Service), who dealt respectively with the new herbage plant breeding programme, the revegetation and rehabilitation of the range lands of the western States and the value of pastures in erosion control. D. B. Johnstone-Wallace described his experiments with wild white clover at Cornell University in New York State which have been attracting so much attention in recent years among the pasture agronomists working in the more humid parts of the eastern United States.

L. E. Kirk discussed the herbage plant breeding problems of eastern and western Canada, while O. McConkey directed attention to the serious mineral deficiencies in the pastures of eastern Canada.

H. R. Marston presented in scientific terms the Australian sheep farmers' argument that "sow pastures ruin the wool" of the merino sheep. Improvement of the nutritional level of a pasture from

ie which has seriously handicapped production will rtainly affect the quality (fineness) of the fleece, it this change may just as certainly be made, if ed be, by the alteration of the type of sheep used r wool-growing on these areas. Small-framed, neely covered breeds of merinos which have been lected to produce fine wool when grazed on richer eas are well known.

E. Bruce Levy described the conversion of rain rest to grassland in New Zealand; the forests inverted are mainly of two types: rain forest roprier and sub-antarctic southern beech forest. The ages of the conversion to the famous pastures of ew Zealand were described in full, particular credit eing given to the pioneer back-country bush settlers.

A similar topic was discussed by G. H. Holford, New ealand, who illustrated his talk with a colour film.

The changing agricultural outlook in South Africa, ulting from the ravages of soil erosion, was ecribed by the representative of the South African epartment of Agriculture, J. W. Rowland. A re-ientation of the principles of arid land farming ust come about, governed by a full consideration

of the land, in the light of the complex inter-relationship between the soil, the plant and the climate.

The Congress ended with a tour through Northumberland to Edinburgh, when a day was spent in the Central Highlands of Scotland and the Trossachs.

The report of the Fourth Congress, containing the full text of all papers read, together with their English and German abstracts, will be published in October or November of this year, price £2 per copy. A volume containing the abstracts only (in English and German) is now available, price 5s., and may be obtained from the joint Secretaries, Fourth International Grassland Congress, Aberystwyth.

At the general meeting of the International Grassland Congress Association on July 16, Dr. D. S. Huisinga of the Netherlands repeated the invitation, already given at the Third Congress at Zürich, to hold the Fifth Congress in the Netherlands in 1940. The invitation was gratefully accepted, and Dr. Huisinga was elected president of the Fifth Congress. The Association was invited by Count Teleki of Hungary to hold its sixth meeting in that country in 1943.

Geology of Jersey

THE claims of Jersey in the Channel Islands as a field of research for British geologists and as a most suitable locality for field classes for students as more than once been urged. The chief reason why Jersey is not more widely used for the latter purpose, in spite of its undoubted attractions, is the lack of a modern complete connected account of the geology of the island.

In September 1934, the Geological and Mineralogical Society of Brittany visited the island under the direction of A. J. Robinson and A. E. Mourant. The report of the excursion has recently been published as a memoir of the Society¹, and should prove invaluable to geologists intending to visit Jersey. The work is in French; but it is typical scientific French, and the writers clearly realized that many of its readers would be English-speaking. Probably for this reason, the work of those English geologists who established the succession and relationships of the rock groups of Jersey is barely mentioned. In justice to them, however, it should be stated that the relationships described by Wells and Wooldridge² are accepted by the writers of the memoir, with one exception; they claim that no important break occurs between the St. Lo shales and the volcanic group.

A broad outline of the geology of Jersey is condensed into the first few pages, while the rest of the rest part of the memoir is taken up by a detailed day-by-day account of the excursion. The memoir, however, much more than a mere itinerary: it includes discussions of the many problems of age and old relations which still await complete solution. It has the commonly-accepted view that the lavas are of Pre-Cambrian age and probably to be correlated with the Uriconian volcanic rocks of Britain, re-examined in the light of a careful comparison between the Jersey lavas and those of the mainland of Brittany, and in view of the claim strongly urged by M. Y. Milon, of the University of Rennes, that the lavas of Paimpol are of Carboniferous, not Pre-Cambrian, age.

M. Milon himself contributes interesting "Notes and Observations on the Geology of Jersey and Armorica". In particular, the age and conditions of accumulation of the Rozel conglomerate group are discussed, and it is concluded that these rocks, so strikingly similar to the Permian breccio-conglomerates of eastern Devonshire, were deposited on the borders of a Permian-Triassic cuvette, under 'continental' conditions.

In addition to the solid geology, the Pleistocene deposits, the raised beaches and the caves are adequately described by M. A. Bigot in the second part of the memoir.

Although natural inland outcrops are few in Jersey, the island provides a magnificent series of coastal exposures in the cliffs and extensive wave-cut platforms. In the main, these exposures are not difficult of access; but the casual visitor is liable to disappointment unless the tides are studied and the routes so chosen as to take full advantage of the periods of low water. With commendable foresight, the authors recommend in the introduction that the conditions are most favourable during the period comprising the three days before new or full moon and the five days which follow. The authors are resident in Jersey, and their detailed local knowledge has ensured that in the course of the five journeys described the time would be used to the best advantage and the maximum of geology would be seen. Each route is clearly shown on a sketch-map, with localities numbered to correspond with the text. For those with more time at their disposal, additional excursions are suggested.

Among the nineteen figures included in the text are several geological sketch-maps on a generous scale, while a folding geological map on the scale of 1:50,000 and five plates are incorporated.

A. K. W.

¹ "Contributions à l'étude géologique des Îles de la Manche et du Trégorrois." *Mém. Soc. Géol. et Min. de Bretagne*, 3 (1936). Obtainable from Prof. Y. Milon, Institut de Géologie, Rennes (30 francs), and the Museum, 9 Pier Road, Jersey (5s.).

² *Proc. Geol. Assoc.*, 42, 78 (1931).

Science News a Century Ago

The Entomological Society

At a meeting of the Entomological Society held on August 7, 1837, Mr. Bowerbank exhibited specimens of cork infused by termites while on board ship, and suggested measures to prevent attack by such insects; Mr. Bambridge spoke of the damage to apple trees in the neighbourhood of Lambeth by a small species of moth; and Mr. Westwood gave an account of an entomological visit he had lately made to Paris, noticing among other things a disease called muscadine with which silkworms had been very extensively attacked in France. The malady was a parasite which gradually enveloped the whole body in a white fungus and destroyed the worm, the mischief being produced by the explosion of a fungus, which is taken in by the spiracles or pores of the skin, as has been proved by M. Audouin, who has inoculated several worms and beetles with it. In concluding, Mr. Westwood made some remarks on the progress of entomology in France, which he stated to be in advance of Great Britain, there being more working cultivators, and the collection at the Jardin des Plantes being superior to that at the British Museum; M. Audouin had just completed a course of fifty lectures on entomology.

Bradley's Zenith Sector sent to the Cape

WHEN Malear became Astronomer Royal at the Cape of Good Hope in 1833, one of his first tasks was to re-measure and extend the arc of meridian measured by the French astronomer Lacaille in 1752. To further this work, Airy, on February 24, 1837, wrote to Captain Beaufort, the hydrographer at the Admiralty, suggesting that Bradley's sector then at Greenwich should be used for verifying the astronomical determinations. The Admiralty agreed to the suggestion, the sector was re-mounted, careful drawings were made of every part, instructions were prepared for its use, and on August 10 it was sent to Woolwich Dockyard and shipped for the Cape. Malear commenced his verifications of Lacaille's arc in 1838, between 1840 and 1847 the field work was accomplished, and the sector was returned to Greenwich in 1850.

The sector was originally made by George Graham for Bradley in 1727. It had a radius of $12\frac{1}{2}$ ft. and a range of $12\frac{1}{2}^\circ$. It was mounted by Bradley at his aunt's house at Wanstead, and it was from observations made with it that he was led to the discovery of aberration and nutation. In 1742, Bradley succeeded Halley as Astronomer Royal, and in 1749 the sector was removed to Greenwich. It is now preserved with other historic instruments at the Royal Observatory.

Sir Thomas Malear, who was born in 1794 and died in 1879, was director of the Cape Observatory until 1870. He was knighted in 1860, and for his geodetical work received the Lalande Medal of the Paris Academy of Sciences and a Royal Medal of the Royal Society. He is buried in the grounds of the Observatory.

Magneto-Electric Currents

"M. AUGUSTE DE LA RIVE has been studying the properties of magneto-electric currents, and among other results he finds that the helix of a metallic

thermometer heats to 7° when there are but 1 currents alternating contrary every second; to with nine currents; to 100° with twenty currents and to 133° with forty currents; and that a wire of platinum has been heated red-hot when a succession of currents have been even more rapid. Chemical effects are subject to the same influence only that there is a limit at which the heat of decomposition slackens. The influence of this speed is a felt in physiological processes, which acquire more greater energy than when produced by voltaic currents; a phenomenon which may be attributed to the interruption and alternatively contrary direct of magneto-electric currents, and which, perhaps may become advantageous in the practice of medical art" (*Athenaeum*, Aug. 12, 1837).

Typhoid and Typhus Fevers

THE issue of the *American Journal of Medical Sciences* of August 1837 contains the first clear distinction between typhoid (dothineritis) and typhus fevers. The writer was Dr. W. W. Gerha, physician to the Philadelphia Hospital, Blockley, a his paper was entitled "On the Typhus Fever which occurred at Philadelphia in the Spring and Summer of 1836". The principal differences between the two diseases are summed up as follows: "Dothineritis is usually a sporadic disease, although it sometimes appears to be a widespread epidemic. In the latter case the symptoms are so well marked that they are never doubtful except in a few of the earliest examples. Now typhus is rarely sporadic, and scattering cases do occur, they are generally connected with an epidemic and follow it. . . . (2) Typhus is evidently very contagious; in the epidemic of 1836 it is quite as contagious as small-pox. . . . Dothineritis is certainly not contagious under ordinary circumstances, although in some epidemics we have striking reason to believe that it becomes so. (3) The initial symptoms of the two affections chiefly differ in the greater stupor, dullness and prostration of typhus, which are in strong contrast to the moderate cephalalgia and disturbance of the senses in dothineritis. . . . When the disease is completely formed, the characters on which the distinction between the two forms of fever rest are: (1) The suffusion of the eyes, which occurs in every case, nearly every case of typhus fever, with the dusky red aspect of the countenance. (2) The extreme stupor and inactivity of the mind, even when positive delirium does not exist. (3) We also observe typhus no constant abdominal symptoms, and first merely dullness on percussion and feebleness of respiration at the posterior surface of the lungs. To these symptoms be added the peculiar eruption of petechiae which is scarcely ever absent in white there remains hardly a possibility of error."

A Female Rhinoceros in the Zoo

THE August issue (No. 59) 1837 of *Neue Notizen aus dem Gebiete der Natur- und Heilkunde* contains the following announcement: "A female rhinoceros in the garden of the Zoological Society of London the latest and most interesting acquisition which this menagerie has made. It is a very fine young animal, but only half the size of the male rhinoceros which has been in the possession of the Society for several years. This is the first time, so far as we know, that a rhinoceros pair (male and female) has been exhibited at the same time in Europe."

Societies and Academies

Dublin

Royal Irish Academy, May 31

J. J. HARTLEY: The Dalradian rocks of the Sperrin Mountains. The paper dealt with the Dalradian sequence as developed on the borders of Counties Derry and Tyrone in Northern Ireland. The stratigraphical succession was described, and a detailed correlation suggested with Kintyre and Corval in south-west Scotland. Attention was directed to the influence the important faults which traverse the area have upon the structure and the light which they throw on the character of the folding. The question of the metamorphism was briefly discussed.

J. KAYE CHARLESWORTH: A map of the glacier lakes and local glaciers of the Wicklow Hills. This portrays the distribution of the local glaciers (in the main after A. Farrington) and of nine chains of glacier lakes impounded by the extraneous ice on either side of the Wicklow Hills.

K. G. EMILJUS, E. B. CATHOART and C. M. MINNIS: Some electrical and optical properties of iodine vapour. The intensity distribution and absolute intensity in the iodine atom electron affinity spectrum have been calculated for typical discharge conditions from the results of probe analysis and theoretical capture cross-sections. The main part of the spectrum is usually in the far ultra-violet. The intensity in the near ultra-violet is so small as probably to preclude its observation. A high-frequency discharge with a constricted positive column is described which is of interest in connexion with the mechanism of the positive column. The effect of formation of negative ions in hindering removal of impurities by the discharge is pointed out.

Paris

Academy of Sciences, June 7 (C.R., 204, 1693-1768).

HYACINTHE VINCENT: The antitoxic power of glutathione on the diphtheritic and tetanic toxins. Glutathione shows a slight but distinct antitoxic power towards the toxin of diphtheria.

ANDRÉ BLONDEL: The experimental study of coloured signals intended for navigation.

WOLFGANG DEBLIN and ROBERT FORTET: On two notes of Kryloff and Bogoliouboff.

W. STERODZINSKI: A class of surfaces of affine space.

HENRI DULAC: Research on limit cycles.

DRAGOSLAV S. MITRINOVITCH: A differential equation of the first order occurring in various problems of geometry.

ANDRÉ MACHIEUX: Concerning a criterion of the reality of the velocities of nebulae. Criticism of the method of E. Hubble based on spectroscopic and photometric data.

GÉRARD PÉLIAU: The matrix representation of the Maxwell equations.

GEORGES ALBERT BOUTRY and GEORGES TRÉFOUIL: Commutable and stable electrical contacts. The variation in the resistance of sliding or plug contacts is too large for use in high-precision electrical thermometry. A new form of contact is described (mercury-platinum in a vacuum) giving resistances constant to within two microhms.

OLIG YADOFF: The electrical and mechanical ageing of copper conductors under the prolonged action of the electric current. Prolonged passage of

current (two years) through copper conductors produces a loss in mechanical strength and a slight increase in the electrical conductivity.

ROBERT FORREY: The intensity of orbital interaction in compounds with multiple ionization.

GABRIEL BOSSCHUETER and JACQUES FERRIER: The infra-red absorption spectra of water, liquid, solid and in solution. Comparison of the infra-red spectra of water in the liquid and in ice with solutions in carbon tetrachloride and carbon bisulphide.

MILIE. DINAH BIQUARD: The Raman spectra of some ketones. The influence of ring formation.

STANISLAW ROUPPERT: The action of the magnetic field on the absorption of selenium.

AUGUSTE ROUSSET: New measurements of the factor of depolarization of light diffused by argon. Improvements in the construction of the apparatus lead to a factor of depolarization for argon equal to 3×10^{-4} with incident parallel polarized light. The factor is certainly below 10^{-3} .

SALOMON ROSENBLUM and MARCEL GUILLOT: The γ spectrum of RaB and RdAc.

PIERRE BARCHEWITZ and RENÉ FREYMANN: The complexity of the (OH) infra-red absorption bands.

JOSEPH LAISSUS: The cementation of nickel by beryllium. The Brinell hardness of nickel cemented by beryllium is one of the highest determined on metallurgical products.

MARCEL PRÉVIER: The heterogeneous combustion of mixtures of carbon monoxide, hydrogen and oxygen on a vitreous surface. The heterogeneous combustion of most mixtures of hydrogen, carbon monoxide and oxygen is controlled by the velocity of oxidation of the hydrogen.

ANDRÉ CHRISTEN and JEAN KRAFT: The uranyl phosphites. The sole product of the interaction of solutions of phosphorous acid and uranyl acetate is a neutral uranyl phosphite, $\text{UO}_2\text{HPO}_3 \cdot 2\text{H}_2\text{O}$.

MILIE. SUZANNE HÉMAR: The precipitation in the cold of a copper salt by an alkaline carbonate.

HENRI GUÉRIN: The magnesium arsenates.

H. CLÉMENT and J. SAVARD: The halide of pentamethylmagnesium.

LOUIS LONGCHAMON: The dehydration of coals.

HELGE G. BACKLUND: Some eruptive rocks of the basalt series from the eastern coast of Greenland.

HENRI HUMBERT: *Gentianothamnus*, a new genus of Gentianaceae from Madagascar.

ROBERT WHILL: The existence of a monoconidome in the medusoid of a polypus (*Pennaria(?) tiarella*) with tetraconidome.

ERNEST KAHANE and MILIE. JEANNE-LÉVY: The mechanism of the sensitization with acetylcholine.

MILIE. ÉTIENNETTE BIZET and RAYMOND-HALLET: The opposed effects of two alkaloids from the same vegetable drug.

ÉMILE F. TERBOINE, MILIE. A. M. DE LA BERNARDIN and PAUL LÉLU: Action of the external temperature on the metabolism of creatinine and creatine.

ANDRÉ BOIVIN and MME. LYDIA MÈREBEAU: The existence of a thermo-labile toxin and neurotope (exotoxine) in the bacterial bodies of the Shiga bacillus.

LÉON BINET, CHARLES JAULMES and GEORGES WELLES: The antitoxic power of glutathione. Researches on the tetanus toxin.

ERNEST FOURNIAU, JACQUES TRÉFOUIL, FEDERICO NITTI, DANIEL BOVET and MME. JACQUES TRÉFOUIL: The anti-streptococcal action of organic sulphur derivatives.

Moscow

Academy of Sciences, *C.R.*, 15, No. 1; 1937.

N. S. KOŠLIakov: A transformation of definite integrals and its application to the theory of Riemann's function $\zeta(s)$.

E. LIUSTICH: Some methods for mechanical integrators.

V. G. ČILIDZE: The derived numbers of a function of two variables.

V. NIEMYTZKI: (1) The integral non-linear equations comparable to the linear equations. (2) The most generalized integral non-linear equation.

N. PIKUNOV: The limit problem for an equation with partial derivatives of hyperbolic-parabolic type.

E. J. PIREPELIKIN: An apparatus for quick and accurate reduction of self-registering micro-photometer records.

A. A. ŠIŠLOVSKIY: A comparison of absorption and fluorescence spectra of anthracene in different states of aggregation.

F. A. KOBOLEV: The application of Toeplitz's method to measuring the absorption of ultra-sounds in liquids.

K. G. MIKHUŠ: Side processes of oxidation during the reduction of nitrogen compounds of the aromatic series (2). Action of a bivalent iron salt on aryl-hydroxylamines.

I. B. PLIŠAKOV: The stratigraphy of the Tertiary oil-bearing beds of the south-eastern part of the Soviet Sakhalin.

A. G. EBBEIN: The Pontic rocks of Mingrelia.

I. A. SMORODINCHV, N. N. KBYLOVA and V. I. PASONINA: Changes of protein fractions in meat ripening.

V. A. NOVILOV: Derangement of metabolism in the leaves of lucerne when infected with the rust *Uromyces striatus* Schröt.

N. DRAGOMIROV: (1) Experimental induction of retina in amphibian embryos. (2) Influence of the adjoining ectoderm on the organization of the eye bud.

Vienna

Academy of Sciences, May 13.

BERTA KARLIK and KARL PREIBRAM: Infra-red luminescence spectrum of samarium. The spectrum found by Tomaschek is ascribed to divalent samarium.

MARISTTA BLAU and HERIETHA WAMBACHER: Measurement of the length of proton tracks by the photographic method. A few tracks have been recorded of protons liberated by neutrons from a polonium-beryllium source and of a length corresponding to an energy of between 7.9 and 10 million electron volts. The percentage of these high-energy neutrons is determined.

MARGARETHE HOLUBA: Influence of absorption in the interior of a radioactive preparation on the emitted radiation.

K. W. F. KOHLRAUSCH and R. SKRABAL: Studies of the Raman effect (71). Cyclopropane carboxylic acid, acrylic acid and their derivatives.

A. W. RHITZ and R. SKRABAL: Studies of the Raman effect (72). Nitrogenous bodies (4). Nitriles.

S. FRIEDLBERG and H. LAMPEL: Determination of the point of attack of drugs affecting the brain by measurement of the heat developed in different parts of the brain.

KLAUS UNNA and LEOPOLD WALTERSKIRCHEN: Influence of pituitrin on the action of some diuretics.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICERS in the Electricity, Radio and Aerodynamics Departments of the National Physical Laboratory, Teddington—The Director (August 9).

LECTURER IN MECHANICAL ENGINEERING in the Batley Technical College—The Director of Education, Education Office, Batley (August 14).

ASSISTANT (grade II—engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (O.R. Branch) (August 16).

TWO DEMONSTRATORS IN INORGANIC CHEMISTRY in the University of Leeds—The Registrar (August 23).

JUNIOR LECTURER IN MYCOLOGY in the Imperial College of Tropical Agriculture, Trinidad—The Secretary, 14 Trinity Square, London E.C.3 (August 31).

ASSISTANT LECTURER IN MATHEMATICS in the University of Manchester—The Registrar (September 1).

ASTRONOMER ROYAL FOR SCOTLAND AND PROFESSOR OF ASTRONOMY in the University of Edinburgh—The Private Secretary, Scottish Office, Whitehall, S.W.1 (September 18).

UNIVERSITY PROFESSOR OF PHARMACOLOGY in the College of the Pharmaceutical Society of Great Britain—The Academic Registrar, University of London, W.C.1 (September 14).

UNIVERSITY READER IN BACTERIOLOGY in the British Postgraduate Medical School—The Academic Registrar, University of London, W.C.1 (September 15).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Manchester Municipal College of Technology—The Registrar (September 20).

METALLURGIST, ENGINEER OR CHEMIST for the Mond Nickel Co.—The Manager, Research and Development Dept., The Mond Nickel Co., Ltd., Thames House, Millbank, S.W.1.

TECHNICAL ASSISTANT in the Information Department of the Automobile Research Laboratories—I.A.R., Research Department Great West Road, Brentford, Middlesex.

Official Publications Received

Great Britain and Ireland

National Trust for Places of Historic Interest or Natural Beauty Freehold and Leasehold Properties of the Trust and Protected Properties. Pp. xv+88+26+8 plates. Report, 1936-1937. Pp. x+140 (London: National Trust.) [8]

Institute of British Geographers Publications Nos. 4 and 5: (4) Transactions and (5) Insolation and Relief, their Bearing on the Human Geography of Alpine Regions. By Alice Garnett. Pp. xvi+71. (London: George Philip and Son, Ltd., Liverpool: Philip, Son and Nephew, Ltd.) 12s. 6d. [8]

Report of the Import Duties Advisory Committee on the Present Position and Future Development of the Iron and Steel Industry (Cmd. 5507.) Pp. 117 (London: H.M. Stationery Office) 2s. net. [9]

Other Countries

Transactions of the San Diego Society of Natural History. Vol. 8 No. 23: A Further Report on Birds from Sonora, Mexico, with Descriptions of Two New Races. By A. J. van Rossem and the Marques Hachenska. Pp. 321-336. Vol. 8, No. 24: Paleontology of the Pleistocene of Point Loma, San Diego County, California. By Robert W. Webb. Pp. 337-348. Vol. 8, No. 25: Descriptions of New Mammals from Arizona and Sonora, Mexico. By Laurence M. Huey. Pp. 349-360+plate 23. Vol. 8, No. 26: A Northwestern Race of the Mexican Black Hawk. By A. J. van Rossem and the Marques Hachenska. Pp. 361-365. (San Diego, Calif.: San Diego Society of Natural History.) [5]

Proceedings of the Academy of Natural Sciences of Philadelphia Vol. 80. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 7: Reptiles and Amphibians. By Arthur Loveridge. Pp. 285-296. (Philadelphia: Academy of Natural Sciences.) [5]

Imperial College of Tropical Agriculture. Sixth Annual Report on Ocaso Research, 1936. Pp. 61. (Trinidad: Government Printing Office.) 5s. [5]

National Research Council of Canada. Heat Loss through Windows: a Summary of Available Information. By R. Ruedy. Pp. 38. (Ottawa: National Research Council.) [5]

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1936. Pp. 18. (Pretoria: Government Printer.) [5]

Union of South Africa: Department of Mines. Bulletin No. 8 "Wonderstone" By Dr. Louis T. Nel, Dr. H. Jacobs, J. T. Allan and G. B. Boswell. Pp. 44+6 plates. 6d. Bulletin No. 9: The Ochre Deposits of the Rivondale District, Cape Province. By D. J. L. Visser. Pp. 31. 3d. Memoir No. 31: The Pegmatite Area south of the Orange River in Namaqualand. By Dr. T. W. Geyer, F. O. Partridge and G. K. Joubert. Pp. 180+16 plates 7s. 6d., including Map. (Pretoria: Government Printer.) [5]

Baltische Geodätische Kommission. Sonderveröffentlichung No. 6. Relative Bestimmungen der Schwerkraft auf den Landesszentralen Anagelheit von der Baltischen Geodätischen Kommission in der Jahren 1930 und 1935. Pp. in+123. (Helsinki: Baltische Geodätische Kommission.) [5]

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Science in Social Services

IN his farewell address on June 24 to the London School of Economics, Sir William Beveridge emphasized the need for both observation and detachment in the social sciences. Failure to be scientific in method and detachment on the part of both economists and statesmen, he said, had largely been responsible for the tardy development or recognition of the social sciences, alike in the neglect of observation of facts as the basis of theories and as the control of theories, and in the lack of detachment from partisan actions and the giving of judgment on controversial political issues. The social services of Great Britain might well have been cited by Sir William Beveridge to illustrate his point. They continue to grow piecemeal, and every session Parliament adds something to the imposing structure; but it is nearly thirty years since the last comprehensive inquiry into public social provision in Great Britain was made. Continually, however, we witness particular aspects of the social services criticized strongly to prove or disprove some political tenet or preconceived idea, and it is rare indeed to find them considered in relation to a comprehensive and well-defined social policy.

The report on the social services which has just been issued by P.E.P. (Political and Economic Planning) accordingly meets a definite need as well as provides a noteworthy example of the type of impartial and comprehensive analysis of the facts desiderated by Sir William Beveridge. The report has the freedom from preconceptions which characterizes the investigations of P.E.P. and gives us a comprehensive and detailed examination of each of the social services.

With some of these individual social services, which are grouped in three categories—namely, constructive community services, such as education and public health and the employment exchanges; social insurance services, such as national health insurance, unemployment insurance, widows', orphans' and old-age contributory pensions, as well as workmen's compensation; and social assistance services, such as non-contributory old-age pensions, unemployment and public assistance—scientific workers may have their own particular contact as individual citizens. With the collective review of the services as a system, the mapping of the ground they cover, and the intervening gaps, as well as with the indications which this report affords of trends in policy which are not yet fully developed in the existing social services, scientific workers will, however, have a keen, if not a professional, interest.

The admirable survey and analysis which are provided in this report are primarily a stimulus to further constructive thinking; and opinions in some matters that have sometimes ranked as established convictions will require re-examination by unprejudiced students. Despite the great increase in the last thirty years of expenditure on social services, which now reaches the sum of £400,000,000 a year, that is, nearly £9 a head, or about a tenth of the national income of 1934, 71 per cent of which is financed out of rates and taxes, the report shows clearly that there has been no spectacular transfer of wealth from rich to poor. Indirect taxation of the working classes has increased side-by-side with the direct taxation of the well-to-do.

The main argument of the report is not that we should begin to economize on our social services but that we should plan them better. At present they are the result of piecemeal political and administrative improvisations which need replacing by a more deliberate social service policy, a continued review with a programme of priorities and the filling of gaps. Many of these gaps, as well as serious anomalies and defects, wide disparities, and abuses, appearing unchecked in our present system, are duly pointed out in the report, which leaves no doubt of the room for reform. But the report does more than this. It assists the emergence of a mature philosophy and a broad strategy of the social services, and thus the replacement of fairly strong but largely unconscious tendency by conscious purpose.

This establishment of guiding principles, and of authority to ensure their observance in practice, is best secured not by a Royal Commission, which is regarded as too cumbersome, but by the establishment of a Social Service Statutory Committee, acting as an advisory general headquarters staff. The value of this type of detached examination and criticism is demonstrated by the experience of the Unemployment Insurance Statutory Committee and of the Law Revision Committee. The suggested committee would have three main duties: to study the basic principles of the services; to promote efficient and economic working, indicating any needful change of administrative and financial structure; and to direct attention to anomalies and gaps, making remedial proposals.

Scientific workers will be quick to recognize in this suggestion something of the ideas expounded by General Smuts in his Sidgwick Memorial Lecture on "Democracy"; and this further plea for an extension of scientific method and inquiry into controversial matters which should be settled on a basis of fact, and not prejudice, will be welcomed by them. Equally, too, the report makes clear the impossibility of isolating politically the social services. Economic policy, social service policy, and industrial wage policy are closely interlocked. Under our present health insurance system bad industrial organization may be persistently subsidized. The powers provided under the National Health Insurance Act to survey the health of local communities, and penalize employers responsible for high sickness rates, have never been used, and certain factories and offices continue to be so unsatisfactorily arranged or operated that

they give rise to excessive numbers of sickness claims.

The increasing part which scientific workers take in the administrative side of industry gives the special responsibilities in these matters, and the report also comments on the failure of those in charge of the great public social insurances of the United Kingdom to be alive to these questions and to take the broad view of their functions helping to reduce accidents and disease, which some private enterprise insurance companies have done. Dereliction of duty of this type is one of the prime concerns of associations of professional workers, and it is clear that such associations need much more general support from the rank and file of the professions and also continued stimulus. Their functions are to be fully and wisely discharged.

The clear thinking of this report, no less than its analysis of the facts, can scarcely fail to be highly suggestive to many scientific and professional workers and to stimulate further thought and effort in many fields. There are, however, other matters of immediate personal concern to scientific workers on which the report touches. For example, in its summing-up of the problems of the family, the report favours the introduction into the general wage and salary system of Great Britain of the principle of family allowances, which social reformers as well as industrialists have been largely opposed. The report argues that public social services must either consciously be used as an agency for adjusting burdens between large and small families, or else they will tend more and more to reinforce those commercial and other agencies which are steadily making life less attractive for the average citizen to rear a family.

A second matter raised by the report, which is also of direct concern to scientific workers, is that of the personnel of social service administration. On this subject it makes two main criticisms. The preparation of the report has revealed a serious amount of compartmental outlook and experience as characterizing those engaged in the administration of the social services at this stage. There are many men and women who are well informed about particular branches or aspects, but it is rare to find anyone who has given much thought to the inter-relations of the social services with one another, or to their repercussions on social or economic life and to their lines of development.

One of the first needs of to-day is the breakdown of this sectionalism and departmentalism; those concerned with particular aspects or subjects should start thinking intensively about the place of their own specialism in the whole scheme of the social services. In part, this is a matter in which professional associations could exert a useful influence, and their direct contribution to the effective co-ordination of the social services with one another, and with national policy as a whole, or to the re-examination of the forms of democratic control and public accountability in the social services, should not be negligible. In part, however, it is a matter of recruitment, and here the report refers to the failure to implement the recommendations of the Departmental Committee on the Recruitment and Training of Local Government Officers, in its report issued in 1935.

The need for improved recruitment and training is not, however, confined to the local government service. Although the quality of the personnel is often of the highest order, existing arrangements for the recruitment and training of officers for certain forms of social work, for example, the work of the Unemployment Assistance Board, are not entirely satisfactory. Apart from the importance of recruiting officers for the social services whose training and outlook raises them above departmentalism and stimulates constructive thought

about the place of their special work in the social services and policy generally, the formal training requirements of various departments or branches of the service are very narrow and overweighted by technical questions arising out of statutes, regulations and codes of instructions.

The report suggests that there is a real need for a comprehensive course of training in social case work to be taken by all who wish to engage in this career; and it is clear that, in this matter also, professional associations could offer a very useful contribution. Moreover, the report shows that there are very important spheres of social service in which, whether because of their experimental or controversial nature at the time, the exceptional freedom of opinion and experiment demanded for teaching or research, or the individual attention required for intimate personal problems, voluntary organizations are not only more appropriate but also may have essential functions to fulfil.

At a time when scientific workers generally are considering so closely the social consequences of their work, the PEP report not only provides a very stimulating survey of the field which indicates definite directions for further research, but also issues a challenge to really practical efforts which can scarcely be ignored by such workers if their interest in social affairs and social science is sincere.

History of Elementary Mathematics

Geschichte der Elementar-Mathematik in systematischer Darstellung:
mit besonderer Berücksichtigung der Fachwörter.
Von Dr. Johannes Tropicke. Band 3: Proportionen, Gleichungen. Dritte, verbesserte und vermehrte Auflage. Pp. iv+239. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 10 gold marks.

ALL who are interested in the history of mathematics will be delighted to see that Dr. Tropicke continues to make progress with the publication of the third edition of this invaluable work which, in the form it took in the second edition, has long been an indispensable book of reference. It is nearly thirty-five years since the date of the preface to the first edition (summer 1902) in two volumes; the second edition, much enlarged and

modified in arrangement, came out in seven volumes or parts between the years 1920 and 1924, and grew to a compass of nearly 1,300 pages in all. The third edition, in consequence of the mass of fresh material which has accumulated since 1924 through new discoveries and researches, bids fair to show an increase in size of one third or thereabouts. It is gratifying to find that each volume as it comes out brings the subject of it up to date. There are many references in the present volume to books and papers of date so recent as 1936. Some slight inconvenience will be caused by the fact that, owing doubtless to the amount of work involved, the volumes are appearing at considerable intervals—vol. 1 appeared in 1930, vol. 2 in 1933, and vol. 3 in 1937—so that, as each volume comes out necessitating a multitude of fresh references, the references in the earlier volumes

also have to be added to or corrected. This disadvantage, however, is minimized by ingenious tables given at the end of each volume showing the correspondence of the pages in the second and third editions respectively, and the changes in the numbering of the various footnotes.

The subject of proportions takes up only one tenth of the volume, the other nine tenths being devoted to equations. This is because, with the gradual evolution of algebraical notation, the subject of proportions has come to occupy less and less space in original works and text-books. The Greeks, for example, had largely to use proportions and their transformations (by compounding, etc.) as a substitute for what we state and manipulate in the form of equations; in their 'geometrical algebra', this was the only means by which they could overcome the restriction of their work to not more than three dimensions. It was not until Heron's time that their treatment of equations became arithmetical enough to enable a number representing an area to be added to a number representing a length and so on, whereas the Babylonian, many centuries before, had done this without any hesitation. Beyond indications that the idea of ratio and proportion is found in Babylonian mathematics and in the Moscow Papyrus, the section on proportion shows little change from the second edition.

The history of equations is treated under the following heads: general historical survey, the distinction between the known and the unknown quantity, technical terms, equations of the first degree (a) with one unknown, (b) with more unknowns, equations of the second degree, 'reciprocal' equations, quadratic equations with more than one unknown, equations of the third degree and solutions of the same by algebra, geometry and trigonometry respectively, as well as solutions by approximation and by the method of 'false hypothesis' (*regula falsi*), equations of the fourth degree, equations of degree higher than the fourth, and lastly indeterminate equations including 'Diophantine analysis', etc.

The bulk of the new material which called for treatment in the new edition relates to mathematics before the time of the Greeks. Thanks to the new editions of the Rhind Papyrus by Peet and Chace respectively, to the publication by W. W. Struve of the Moscow Papyrus in 1930, and to the extensive discussion to which they have given rise, we are now in a much better position to judge of the scope of the ancient Egyptian mathematics. More important still, the publication by O. Neugebauer of Babylonian cuneiform texts of mathematical content going back to 1800 and 2000 B.C., and the books and papers that have been written upon them in recent years (by O. Neugebauer himself,

Kurt Vogel and others), have thrown a flood of light on the achievements of the Babylonians in arithmetic and algebra. It is now shown that the Babylonians of those early days consistently used and manipulated with ease the sexagesimal system of numeration (including the successive sexagesimal fractions) necessitating the use of multiplication tables going up to 59 times 59; they solved quadratic equations by steps precisely equivalent to the use of the regular formulae of our text-books though without any statement of a rule and with no better technical terms for the unknowns (which we call x , y , z , etc.) than the words 'length', 'breadth', 'depth' and such-like written in full. Some of their problems lead even to a type of cubic equation which can be put in the particular form $x^3 + x^2 = a$; one of these gives $x^3 + x^2 = 4, 12$ ($= 252$), and the solution $x = 6$ is merely stated, leaving us to speculate how it was arrived at, which would be a complete mystery but for the discovery of a table of sums of numbers of the form $n^3 + n^2$ for different values of n from 1 to 1,0 or 60. All these things are duly recorded in the volume before us, with very full references.

The dependence of the Greek solutions of quadratic equations on geometry, and ultimately on the discovery by the Pythagoreans of the method of 'application of areas', has long been known; but the specific connexion with propositions in Euclid (Book 2 generally and Props. 4, 5, 6 in particular, Book 6, 27-29, and Props. 84-86 of the "Data") is here treated at much greater length and much more fully elucidated with diagrams than it was in the earlier edition.

A word should be added about the appendixes. These include, besides the tables showing the correspondence between page numbers and note numbers in the third and second editions, three noteworthy features. (1) Chronological tables showing the gradual evolution of modern algebraical notation. (2) Original examples of the actual working-out of solutions of equations, from the Babylonians downward to Newton. These with their great variety of notations are fascinating to follow: there are seventy-two of them, and they include solutions by Al-Khwārizmī, Leonardo of Pisa, Regiomontanus, the authors of German and Latin MSS. of 1461 and 1481, Nic. Chuquet, Johan Widman, Luca Pacioli, Grammateus (Heinrich Schreiber), A. Riese, Christoff Rudolf, Michael Stifel, Cardano, Johannes Buteo, Bombelli, Stevin, van Schooten, Kepler, Harriot, Fermat, Descartes and Newton. (3) Solutions by means of conics of the cubic equations, $x^3 = a$, $x^3 + bx = a$ from Omar Khayyām's algebra.

The book cannot be too strongly recommended.

T. L. H.

Mechanism of Growth in Plants

Growth Hormones in Plants

Authorized English Translation of "Die Wuchstoffs-theorie und ihre Bedeutung für die Analyse des Wachstums und der Wachstumsbewegungen der Pflanzen". By Prof. Boysen Jensen. Translated and revised by George S. Avery, Jr. and Paul R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer. McGraw-Hill Publications in the Agricultural and Botanical Sciences. Pp. xiv+268. (London: McGraw-Hill Publishing Co., Ltd., 1936.) 21s.

THIS book is very necessary, and has been well done. During the last decade, no field of work has been more popular among students of plants; the output of papers has been enormous. The field is very adequately covered in this book, which also contains a very extensive bibliography.

Prof. Boysen Jensen's original experiments demonstrating the continued phototropic curvatures of the base of the coleoptile after its tip had been cut off and then replaced when only this apical region was afterwards illuminated laterally, formed the basis upon which all this superstructure of experiment and theory upon growth regulation in the plant has since been erected, so that it is entirely appropriate he should be the author of this volume, which is now translated and revised by American workers in this new field.

Prof. Boysen Jensen is able to show that the theory that substances may be released from the apical tissue of the coleoptile and transported in some way to the elongating base of this structure, where they control the rate of elongation of the basal region, has rallied to its support a host of new experimenters with new methods; that analogous substances have been synthesized or extracted from such unlikely substances as urine; and that these substances are now suggested as essential parts of a general growth mechanism in the plant, regulating shoot growth and root growth, phototropic and geotropic response and, still more recently, suggested as controlling cambial activity.

The book covers very thoroughly, though necessarily very briefly, the whole of this wide field, and is most valuable, therefore, as presenting a clear, authentic picture of the range of experimental investigation in this new field. The first chapter contains a most ingenious double-page illustrated chart of the development of the new field of work, though this sketch, naturally brief,

links Loeb with views from which he departed very widely in his later writings on regeneration.

Such a book as this naturally evokes an appraisal, in the mind of the reader, of the general effect of this new phase of activity upon our knowledge of the plant. The present reviewer in earlier years ventured into print as a sceptic of the new hypothesis: he has had to consider again in the light of this book whether he finds this view of the mechanism regulating plant growth convincingly established.

The strength of the case has always been the experimental demonstration, first given by Boysen Jensen, that the severed tip of the coleoptile, laterally illuminated, in some way so modifies the growth of the coleoptile base beneath, with which no living tissue connexion is left, that a phototropic curvature occurs in this basal region. Since that time a host of experimenters, associated particularly with the Utrecht school, have devised most ingenious experimental technique showing that substances which diffuse from the base of the excised coleoptile tips, and which may be collected on agar disks or in other ways, can modify the growth-rate of the coleoptile. Much has now been learnt of the growth of the coleoptile; throughout the period of phototropic response the growth is almost entirely by cell extension, not cell multiplication, so that a tendency has been to term this growth-modifying substance an auxine rather than a hormone, and much valuable work has been done on an analysis of the factors controlling cell extension; but it may be gathered from this review that as yet no definite conclusion can be drawn as to the way in which auxine or hormone affects this mechanism of cell extension.

The channels and mechanism of transport of the hormone from apex to base still remain mysterious, but in view of the state of our knowledge of water or food movement in the plant this is perhaps not surprising; the reviewer is still intrigued by the hypothesis that the growth regulator is secreted mainly by the apex of the coleoptile. There is a curious contradiction here that runs throughout this field of work. Investigators of the coleoptile have learnt to regard the growth-regulating mechanism as regulating cell extension, but their experimental results are freely quoted by investigators who are claiming growth-regulating effects on the meristematic tissues of buds or of cambia. Similarly, many investigators now report, in other plants, a distribution of the growth hormone which is correlated with the

meristematic activity of the plant tissue, and yet this apex of the coleoptile, like most other monocotyledon leaf apices, is a region that has ceased to grow.

In this book Prof. Boysen Jensen repeats the curious argument that as a decapitated coleoptile begins to grow after a few hours, this must mean that there has then been a physiological regeneration of the tip from which growth hormones are again resuming their flow. The first experimenters to postulate this regeneration do not seem to have troubled to look to see if it occurred, and apparently the experimenter in this field is not interested in the fact that there is no visible regeneration. Fatty deposits accumulate over the cut stump, which ceases to bleed; no new cells are formed and no striking accumulation of protoplasm is visible in the cells below the injury. But it is not clear why regeneration is necessary; cells of the original apex were inert to all appearance, the cells below the cut surface are similarly so. It is one of the curious anomalies of this coleoptile story that the cells which are supposed to be most vigorously active in hormone production are conspicuously inactive in every other way, whilst the cells which will show most elongation during growth are situated in the part of the coleoptile farthest removed from them. The difficulty has been discussed by Went and others, and leads to further hypotheses, but the strength of the position of the author, and of the numerous botanists who think with him, lies in the fact that there is no alternative hypothesis which

adequately explains basal curvature in the hypocotyl when laterally illuminated only at the tip especially when that tip has been excised and replaced.

There may yet, however, be found some other explanation of this mechanism of stimulus reception and growth response, and at least until this mechanism is more fully understood some caution seems advisable in extending the hypothesis to cover growth mechanisms in general in view of the fatal facility with which a hypothesis can be constructed to explain anything, by postulating substances from unknown sources moving by unknown channels to work by unknown methods. The same mechanisms may apply in other growing systems as in the coleoptile—though meristematic tissues in dicotyledons may be expected to differ widely in behaviour from the vacuolating tissues of a monocotyledon leaf—but as yet we seem far from the stage when a satisfactory picture of growth regulation can be based upon our conceptions of such growth-regulating substances.

None the less, very interesting facts have emerged as to the action of some substances, in some cases chemically pure substances, in promoting callus formation on wound surfaces or in accelerating root production; and the rapidly growing army of workers in the new field, indicated by the extensive bibliography, is an ample guarantee that the possibilities of this new method of interpreting growth phenomena in the plant will be fully explored. J. H. PRIESTLEY.

Metallurgy of Gold

The Metallurgy of Gold

By Sir Thomas Kirke Rose and W. A. C. Newman. (Griffin's Scientific Text-Books.) Seventh edition, revised throughout and re-set. Pp. xiii+561. (London: Charles Griffin and Co., Ltd., 1937.) 36s. net.

DURING most of the period covered by known history, gold has occupied a special position in the thoughts and affairs of men. It has been responsible for explorations, migrations, wars and conquests, and it was in efforts to obtain it by transmutation that the science of chemistry had its origin. Recent developments in civilization have been such as to require the use of increasing quantities of iron and steel, copper, aluminium and certain other metals, which have become increasingly important through their numerous applications at the same time as gold has tended to disappear into deposit vaults. Nevertheless, the

position of gold is still unique, and the quest for it is scarcely less eager than in the past.

Other metals become more important as the number of useful purposes for which they can be employed increases. Gold, however, is scarcely affected by such factors, and although its present use is symbolic rather than tangible, it is being produced in larger quantities and sold at a higher price than at any previous time. Gold, in effect, is an economic instrument, and, unlike other metals, it passes out of the sphere of industry into that of economics and finance after it has been extracted from its ores and refined. This affects the metallurgy of gold, in that little attention is given to such aspects as alloying, fabrication, treatment and behaviour under different conditions of service, which are of great importance in the metallurgy of other well-known metals. Thus, in the book under review, most of the space is

voted, as it should be, to the plant and technique and the phenomena involved in obtaining gold from its ores.

The book begins with an account of the physical and chemical properties of gold. This is followed by a description of the binary alloy systems formed by gold and a number of other metals. Many such systems have been studied, and some of them exhibit features of considerable scientific interest; but the only metals alloyed with gold for practical purposes are copper, silver, palladium, nickel and zinc. In the third chapter, the chemistry of the compounds of gold is considered, and the remainder of the book consists of fourteen chapters on the processes of crushing, grinding, concentrating, extracting and refining used in the metallurgy of gold, and three on assaying and ore testing.

In one sense, this book may be regarded as the seventh edition of a classic work the first edition of which appeared in 1894 and the sixth in 1915. In another sense, however, it is a new book, for the name of W. A. C. Newman appears for the

first time on the title-page along with that of the original author, Sir Thomas Kirke Rose. The combination has proved very effective, for whereas the general plan of the book and much of the original matter have been retained, new chapters on flotation and ore testing have been added and the original chapter on chlorination omitted, while throughout the text as a whole new information has been included and obsolete matter deleted so as to present a balanced account of the subject as it is to-day. All this is very important, for standard works of this kind are, or should be, primarily intended for those who desire to learn something about the subject, and are not prepared to provide interesting reading for those who are sufficiently well informed to sort out the up-to-date information from that which applies to the past. Actually the present work is more up to date than most new editions of classic works produced after a lapse of time, and better arranged than a new book appearing for the first time.

J. M. R.

Geology in Engineering

Engineering Geology

by Prof. H. Ries and Dr. Thomas L. Watson. Fifth edition. Pp. vii+750. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25s. net.

THE fifth edition of this well-known work is to be especially welcomed in Great Britain, where geologists pay far less attention to the allied sciences than is the case abroad, with the result that we have not yet produced a book dealing with the application of geology to civil engineering problems—a position to be regretted.

The number of rock-forming minerals dealt with in Chapter i is rightly reduced to the bare minimum required by engineers, some two hundred pages on rocks and their structural features following. Rock-weathering and soils, treated in Chapter iv are probably of less importance to engineers than is realized by the authors, while the treatment of run-off is disappointing, since this offers a ready, and so far untapped, field for the application of precise geological methods. It is, however, a relief to find a book which does not give Stokes's law for the elutriation of sediments. The section dealing with sub-surface waters is extremely interesting, and goes to show that a great deal more work has been done on this branch of the subject in the United States of America than in Great Britain.

Landslides are discussed adequately in Chapter vii, the matter on wave action being less closely linked with civil engineering practice. Lakes and glaciers are quite briefly treated. The geology of reservoir and dam sites is well covered in Chapter xi; but some of the recent work on building stones, both here and abroad, is not mentioned in the following chapter, which is otherwise ample enough.

The technology of limes, cements and plasters is so varied that one is not surprised to find it described briefly in eighteen pages, and this is also true of the clays and clay products treated in fourteen pages. It is obvious that a book which goes on to deal with coal, petroleum and natural gas, ore deposits and the outlines of historical geology, requires considerable ingenuity on the part of the authors as to what to include and what to omit, so that the allocation of only fourteen pages to road materials, a subject the importance of which has greatly increased in recent years, is quite understandable. In a later edition, perhaps, the application of recently developed microscopic methods might be added to this portion with advantage.

This work can be recommended to the student of civil engineering and to the practising engineer as being certainly one of the best, if not the only one, of its kind.

B. H. KNIGHT.

The Mechanism of Nature

being a Simple Approach to Modern Views on the Structure of Matter and Radiation. By Prof. E. N. da C. Andrade. Revised and enlarged edition. Pp. xii+188+8 plates. (London: G. Bell and Sons, Ltd., 1936.) 6s. net.

THIS book is chiefly intended for the man who has not had the advantage of a scientific education but is anxious to know something of modern scientific developments. There are no mathematical formulæ to put the reader off. Sir James Jeans says somewhere that without considerable mathematical knowledge it would be quite impossible for anyone to understand those branches of science which deal with the fundamental nature of the universe, as, for example, the theory of relativity, the theory of quanta and wave mechanics. So the reader must not expect to be able to do this unless he be a well-equipped mathematician. Prof. Andrade, however, is so skilful in the use of words that his statements impart all there is to know on these subjects short of the employment of mathematics.

In this, the fifth edition, the whole book has been revised and alterations and additions have been introduced to bring it into harmony with recent work. The treatment of cosmic rays has been modified to accord with advances made since the last edition, and a brief account is given of the recent discovery and meaning of heavy hydrogen, the neutron and the positron, of artificial radioactivity and the striking development of artificial transmutation of matter. The explanation of the cause of isotopes—substances which have the same chemical properties but different atomic weights—is of much interest; 'heavy hydrogen' is the most remarkable of these. Another matter of interest is the question of how artificial atomic transmutation was brought about, to which Lord Rutherford has contributed so much. It has, however, so far never produced weighable quantities of any new atom, but established the possibility of transmutation. This, of course, completely revolutionizes the classic ideas of the nature of the atom. All these are treated with admirable clearness by the author, who is a master of exposition where complicated matters are concerned.

H. L. C.

Aftermath:

a Supplement to the Golden Bough. By Sir James George Frazer. Pp. xx+494. (London: Macmillan and Co., Ltd., 1936.) 21s. net.

It might seem that the twelve volumes of "The Golden Bough" had already covered the ground more than adequately, and stood in no need of a supplement. Here, however, the author has gathered together data, not numerous, which had escaped his attention previously, and the more important items of evidence bearing upon his arguments, which have accrued in field work since the publication of the last edition of the major work. Hence this new volume is a corpus of additional facts, corresponding in its division into chapters with the arrangement of topics in "The Golden Bough", but making no addition to theory, except by way of corroboration.

Much of the material will already be familiar to anthropologists, who have not failed to note on numerous occasions how investigations in the fields of inquiry have served to confirm interpretations first tentatively suggested in "The Golden Bough". Prof. Seligman's Frazer Lecture dealing with the magical ritual of kingship, of which his own investigations among the peoples of the Upper Nile formed the starting-point, affords perhaps the most striking instance of the prescience shown by Sir James, not once alone, but on many occasions. Notwithstanding advancing years, the hand of Sir James has not lost its cunning. His latest work in no way falls behind its many predecessors in style and charm of diction.

Marconi:

the Man and his Wireless. By Orrin E. Dunlap, Jr. Pp. xxii+360+16 plates. (New York: The Macmillan Co., 1937.) 16s. net.

THE author gives a good and temperate account of the life-work of one of the world's greatest inventors. One of the early pioneers of radio attributed Marconi's success chiefly to his instinctive intuition as to what was wanted and the best way of getting the solution. It must not be forgotten that he had a companion with plenty of capital behind him and that his success or failure depended upon the rapid development of radio in the early days. With this money behind him he had the courage to launch out on great experiments. The fact also that the organization was called the Marconi Company added greatly to his prestige and always kept his name prominently before the world. When 'Cables obtained control of Wireless' in England, and the Marconi Company became practically a manufacturing organization, the most interesting period of its life has passed.

The author describes both the 'man' and the 'inventor', and links them together into one personality. Marconi crossed the Atlantic eighty-nine times on voyages of scientific research and good will. This view of him from an American angle throws much light on his career. We hope that it will not become customary in the United States to refer to Oliver Heaviside as Sir Oliver Heaviside.

Hardness of Metals

By Dr. F. C. Lea. Pp. vii+141. (London: Charles Griffin and Co., Ltd., 1936.) 12s. 6d. net.

THE hardness of metals, as Dr. Hugh O'Neill once said, like the storminess of seas, is easily appreciated but not readily measured. Prof. Lea has attempted to describe the various methods of measuring hardness, to establish, from the results of a long series of tests, the relationships between hardness measured by each of these methods, and thence, by means of curves and a chart, to make it possible within certain limits of accuracy to obtain corresponding hardness numbers as determined by the various methods. The book is not so much a discussion of 'the hardness of metals', therefore, as a collection of hardness data obtained on a series of materials comprising chiefly heat-treated steels.

Boucher de Perthes and the Foundations of Prehistoric Archaeology

PREHISTORIC archaeology, being one of the younger among the sciences, has had few opportunities of celebrating centenaries. It is a little more than a hundred years ago that the excavation of Kent's Cavern, Torquay (1825-29), first afforded a warrant for the tentative suggestion that man had lived in some remote past as a contemporary of an extinct mammalian fauna. Until this coexistence was demonstrated conclusively, discussion of the antiquity of man had no solid factual basis of inference on which to proceed. For this reason, Boucher de Perthes, on account of his discoveries of flint implements in the valley of the Somme, derived from geological strata in which they were shown to be associated with the fossilized remains of extinct mammals, has been regarded as the founder of prehistory, and more especially of that branch of archaeological studies which deals with the industries and cultures of the Old Stone Age.

It was in August 1837, according to his own record made not long afterwards, that Boucher de Perthes initiated his investigations of the geological deposits of the Somme valley for evidence of early man, and acquired the first objects in his collection. There is reason for thinking, however, that the correct date may have been in the following year. In fact, if Boucher de Perthes's statements be accepted, it is difficult to follow the course of events, or arrive at a just estimate of the credit to be assigned to him in the crucial discoveries in the later 'thirties and the 'forties of the last century.

In 1837, Boucher de Perthes was neither archaeologist nor geologist. On his return to Abbeville from Paris in 1830, he was known only as an unsuccessful writer of satirical drama and tendentious political economist, who had been expelled from the public service on account of his radical views; while up to 1841 he was immersed in the publication of a vast work entitled "La Création" on metaphysics, a subject in which, on his own showing, he had never read a word, and in which he relied not so much on his reason as his imagination. Writing in 1863, he claimed that so far back as 1805, when as a youth of seventeen he visited the Cave of Roland at Varsailles, and again in the Papal States in 1810, he idea of discovering evidence of man as a contemporary of extinct mammals had been before him. But in making this claim, as well as others for an early dating of his views on the antiquity of man, his recollection was coloured by after

events. These dates cannot be substantiated. His memory was highly imaginative, and he verified neither his recollections nor his dates.

Recent research in the early records of archaeological studies in France has shown that prehistory, unlike Minerva, did not spring full-fledged from a single head. In Great Britain, the discovery of flint implements at Hoxne by John Frere in 1797 gave a lead; similarly, in France from the early years of the nineteenth century, archaeological discovery, as for example in the work of Jouannet in Périgieux, was pointing the way to the recognition of primitive phases in the development of civilization transcending by far the time limits then fixed by archaeologist, palaeontologist and geologist alike, whose vision for the time being was bounded by the views of Cuvier on the recent origin of man.

The apparent paradox of Boucher de Perthes's achievement as the founder of prehistory by his discoveries in the valley of the Somme, when contrasted with his character, attainments and previous history, has led M. Aufrère of the Institut de Géographie in the University of Paris* to examine not only his published works and correspondence, but also the drafts of his writings and letters with their numerous deletions, alterations and amendments, as well as the records of scientific activity at Abbeville at that period among those with whom Boucher de Perthes and his father before him were in touch. The result has been to throw an entirely new light on the course of events, and to give a new orientation in the investigations made by Boucher de Perthes, while meting out justice to the inspiration to which they were due.

The story begins with the foundation of the Société d'Emulation at Abbeville in 1795. Of the original members the most distinguished was Emmanuel Baillon, who had been of signal assistance to Buffon in his great work on natural history by his accurate observation of birds. Five years later, Cuvier was elected a member, and the announcement of his election was accompanied by a box of fossil bones of mammals found by the members in the neighbourhood of Abbeville. Cuvier's influence on the ideas and pursuits of the members of the society was considerable, especially in the domain of geology and palaeontology. His view of the recent origin of man largely determined their attitude in discussing archaeological material.

* *Le Mouvement Scientifique à Abbeville dans la Première Moitié du XIX^e Siècle et les Origines de la Préhistoire (1795-1840)*. Par L. Aufrère. *Sciences, Assoc. Fr. pour l'Avant. des Sciences*. No. 4, 1936; *Banquet sur les Premières Découvertes de Boucher de Perthes et les Origines de l'Archéologie Primitives (1838-1844)*. Par L. Aufrère. *Épreuves et Synthèses*, No. 1. (Paris. L. Staude, 1936.) Also other papers.

This accounts for the readiness of Boucher de Perthes and others to maintain, or, on occasion, revert to, the view that the stone implements discovered in the Somme deposits, like those found elsewhere, were 'Celtic'.

In the work of the fifty years which followed the foundation of the society, closing in 1844-45 with the presentation of the account by Boucher de Perthes of his discoveries, the achievement of certain of the members stands out. Of some of these only a brief mention must suffice.

The first in chronological order is Laurent Traullé (1758-1828), palaeontologist and archaeologist, wild in theory, but excellent in observation and discovery. It was he who supplied Cuvier with the fossil remains of elephant, rhinoceros, Bovidae, horse and deer. He was the finder, in 1814, of a 'Celtic' hafted axe; but his most noteworthy contribution to archaeology was the recorded observation of the stratified cultural sequence in the deposits of 'Celtic', Roman and 'Francisque' in this invariable order—an observation pregnant for archaeology, albeit unfortunately forgotten until revived more than twenty years later. Most important of all, however, was his account of the stratification of the geological deposits of the Somme valley, the first of its kind.

Of those who were working at Abbeville in the years preceding Boucher de Perthes's investigations, two names to be noted are those of Alfred Tillet de Mautort and Dr. F. P. Ravin (1795-1849); both careful observers of geological evidence, whose detailed accounts of stratification in recording archaeological finds brought archaeology and geology into intimate relation. Dr. Ravin's authoritative records of geological formations were later to prove of much value to Boucher de Perthes, who made use of his specialized knowledge to support and authenticate his own observations.

The full implication of the relation between geology and archaeology in the work of Ravin and de Mautort was developed by Casimir Picard, a name that has been forgotten, but deserving a better fate as that of an outstanding personality in the scientific, and more especially the archaeological, activities of the Abbevillians between 1830 and 1840. Picard was born at Amiens in 1806, and went to Abbeville from Paris as a qualified medical man in 1828. Widely interested in scientific pursuits, but especially botany, palaeontology and geology, he had unbounded energy, and on attaining office in the Société d'Emulation rapidly spurred that body to strenuous activity. He was associated with Boucher de Perthes in the organization of the Abbeville Museum, an association which, as M. Aufrère suggests, may have been responsible for the

foundation of prehistory. His powers of lucid and cogent archaeological argument were far in advance of his time, and would stand the test of modern application. In fact, his contributions to archaeological theory went far to lay the foundation of archaeology as a science. Of these, the most important were the rehabilitation of the flint implement as something more than an unfinished stage, or a reject in the manufacture of a polished implement, as was then held; the demonstration of the relation of core, or nucleus, and flake as correlatives in the technique of flint fracture; and the argument from stratification for the contemporaneous character of deposits and contained artefacts, and hence the inferred coexistence of man and extinct fauna as contemporaries.

In May 1838, Picard presented a preliminary sketch of a report on the antiquities of Abbeville to be prepared in response to an official request. From this it appears probable that he had in mind a project for a series of excavations and investigations in the neighbourhood of Abbeville. Unfortunately, pressure of other interests, such as the foundation of the Linnean Society in Northern France in 1838, drew him away; and three years later, in March 1841, he died at the early age of thirty-four years. Had his life been prolonged, there can be no doubt that the early history of prehistoric discovery in the Somme valley would have been far different. His precision and appreciation of scientific method would have averted the ineptitudes which delayed the acceptance of Boucher de Perthes's very considerable contribution to the advancement of knowledge.

Picard's archaeological insight and his enthusiasm, however, were not to be without effect. On more than one occasion Boucher de Perthes recorded that his investigations, whether beginning in 1837 or in 1838, were first undertaken, with some reluctance and even distaste on his part, in order to continue the work which Picard had planned and no doubt hoped to carry out himself. His death took place before he realized that anything but a 'Celtic' antiquity was involved, and that his plan of campaign, if it produced any result at all, would lead to the discovery of diluvial man. Nor was Boucher de Perthes, in his early investigations at La Portelette, Menchecourt and the Hôpital site, in better case. So far from appreciating that his aim, as he afterward claimed, was fossil man, it was some time before the distinction, which appears on the title-page of his capital work, between "antiquités celtiques" and "antiquités antédiluviennes" was presented to his mind. Unfortunately, when the reported occurrence of pottery and stone implements, especially of axes, which first appeared in 1841

onvinced him, though he had not seen these finds *in situ*, that he was dealing with diluvial man, the heterogeneous character of the finds, which included Venetian glass, as well as knives and axes of stone which would now be termed eolithic, only provoked ridicule when submitted to expert examination. Boucher de Perthes then reverted to the idea that they belonged to a 'Celtic' civilization, though still maintaining their association with an extinct fauna. It was not until 1843 or 1844 that he saw, *in situ*, the first of the axes, now to be regarded as Lower Palaeolithic, which confirmed his contention of the existence of diluvial man. This find from the Hôpital site

heralded the evidence which, notwithstanding such vagaries as a large proportion of fractured flints of non-human origin, and a collection of so-called representations of animal forms, was to win a verdict in his favour from the British commission of inquiry of 1859.

So far as the foundation of prehistory was the outcome of anything like a scientific conception of the aims and methods of archaeology, the credit belongs to Picard rather than to Boucher de Perthes; but to the latter must be conceded a tenacity of purpose which carried through the actual investigation and won recognition in the end.

The Proposed Everglades National Park, U.S.A.

By Dr. John Kunkel Small, New York Botanical Garden

THE proposed Everglades National Park, recently authorized by the Congress of the United States, after thirty years agitation, is of importance to all who are interested in outdoor life. Its area (capable of enlargement) of two thousand square miles is less than that of several national parks in the United States and elsewhere; but it surpasses in the abundance, variety, and activity of plant and animal life. In most large parks life is in a decline. Variety is giving way to uniformity. Erosion is tearing down mountains; species are disappearing; plant and animal life is maintained with difficulty in increasingly artificial conditions. Such is not the case in the Everglades. Both at the outer fringes of mangroves and far within, land is naturally and continually increasing. Life in the warm humid climate is luxuriant, active—primeval, as if species were making. Plants and animals live as they have for ages, and as they may continue to live for years to come.

The area (Fig. 1) is not technically within the tropics, but the Tropic of Cancer lies only seventy-five miles distant, and ocean currents, prevailing winds, and migratory birds have found a strictly tropical rendezvous scarcely surpassed anywhere in congenial conditions and lack of disadvantages. The area is about equally divided between land and water. The highest points of land are scarcely ten feet above tide, and the water has an average depth of but a fathom or so. Most of the area is accessible by boat in protected waters, a mode of transportation least disturbing to wild life. However, when roads and trails are desirable they can be built at little expense.

ANIMAL LIFE

There are few places where marine life is so abundant and active; the greater part of it is in continuous motion and change, either anchored or free swimming. On one hand, this fact can be observed and studied in the shallow crystal-clear waters of the vast continental shelf on which the Florida Keys now stand and which fringe the mainland. These waters are teeming with life, in almost innumerable quantities and variety. A handful of mud from a bleak and lofty area like the United States Great Smoky Mountain Park will remain motionless; a handful from the Bay of Florida will be in continuous motion as a result of the included active marine life. The kinds of lowest animals—sponges, jellyfish, corals, sea-anemones, moss-animals, molluscs, sea-urchins, sea-cucumbers, starfish and stone lilies—are legion.

Associated with these, fish of almost innumerable kinds, forms, and colours, and great range in size, abound in the waters, fresh and salt. The vast numbers of fish may be realized by the fact that the schools are often so large that they fill bays and sounds to the exclusion of a great part of the water.

Ascending in the life-scale, we find amphibians and reptiles. Frogs abound. Several kinds of large turtles are found, and the alligator and the crocodile are outstanding. Among serpents is the dangerous cotton-mouth moccasin and the largest and most dangerous American reptile, the diamond-back rattlesnake, which sometimes attains a length of nine feet. Lizards are numerous, but most of them are small.

More evident than the amphibians and reptiles are the birds. The bird life of this region is prodigious, ranging from the minute humming-bird to

the wood ibis and the golden eagle. Naturally, from the make-up of the country, both land and water birds abound. The latter are often seen in greater abundance. As a result of their feeding habits—diurnal and nocturnal—flocks of innumerable birds, like flakes of snow in a storm, may be seen in flight both day and night. The sight of their going and coming between the feeding-grounds on a bright moonlight night, not to mention the uncanny noises of their cries and the swish of wings, is something never to be forgotten. Black and various colours of plumage are continually seen. Very conspicuous are the white and pink ibis and the rare roseate spoonbill, of which thousands, even hundreds of thousands, were

of eastern North America roam through the wilderness. Prominent among these are the panther, lynx, bear, deer. Curiously enough, the otter lives here just as it does in the Hudson Bay region. The larger aquatic mammals are the massive sea-cow and the whale.

PLANT LIFE

Broad-leaved vegetation is the most evident form of plant life to the casual observer, whether it be in swamp, prairie, or hammock; but underneath it grow ferns and flowering plants bewildering in attractiveness and variety. In this tropical wilderness, vegetation grows to its full stature and natural age without interference from man.

It is true the destructiveness of Nature is rampant; but it is normal and in its way orderly. Plants and animals grow rapidly and soon return to dust, a process hastened here by a moist warm climate and the presence of a host of fungi and bacteria ever ready to do their work. In spite of the natural inroads, as the source of supply is inexhaustible, the floor is maintained while the land gradually rises higher and higher above the tides.

In the Everglades, tropical vegetation dominates; but the ranges of north temperate tree dovetail with those of the West Indian tropics. The north temperate elements have extended southward through the hammock and along the cool waters of the prairies. The tropical ones have been brought beyond the tropic by the warm ocean currents, the winds, and the birds; and

thus plants of opposite temperature requirement mingle, and there is a unique balance in life-form.

Withal it is a strange country, a land of anomalies and the grotesque. Here fish sing*; snakes often live in trees; epiphytes grow as terrestrials; terrestrials grow as epiphytes; giant oak trees are harbours for aerial plants and ferns; cacti grow in water; oysters grow on trees that dip into the creeks; large pine trees and broad-leaved trees grow on rocks lacking soil; fig-trees grow as petriphytes trying to strangle the rocks; giant palms more than a hundred feet tall and cactus trees thirty feet tall grow as humus-plants; strangler figs kill other trees, and often turn upon themselves and commit suicide.

* On the reef small fish attach themselves to the hull of a boat after dark and give off their plaintive notes all night long.

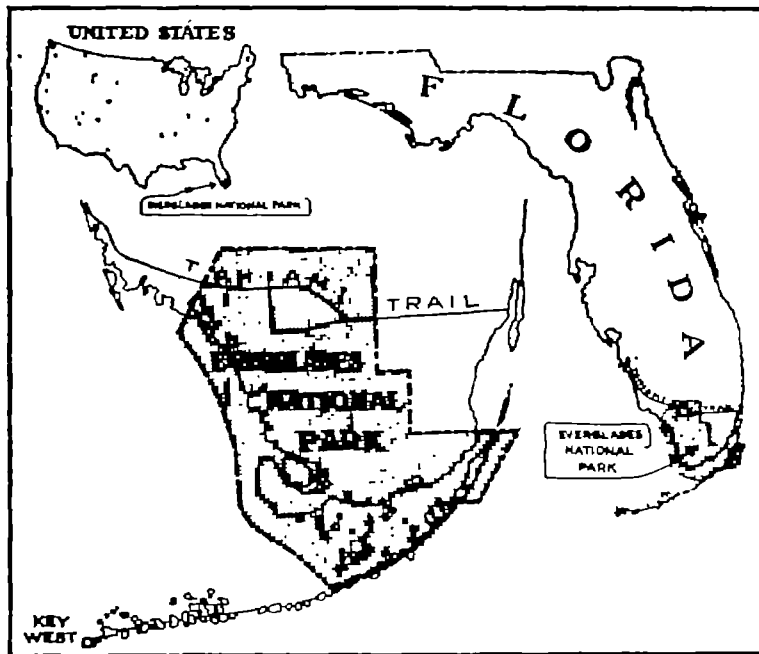


Fig 1.
THE PROPOSED EVERGLADES NATIONAL PARK.

formerly seen at a time. The well-known egret is a decorative associate. The smaller highly coloured migratory birds pass this way, and are evident in season at this midway station.

On the land, one finds the insects universal as well as yet innumerable. The numbers of kinds can be only roughly estimated. Fascinating and grotesque forms may be seen everywhere. A short description of them would fill volumes. Many of the kinds are almost or quite microscopic; but large and ornate butterflies and moths abound. Less graceful but fascinating are the devil-horses, a showy grasshopper commonly six inches long which travels over the land by the million devouring vegetation as it goes.

Mammals are present on the land and also in the water. Several species of the large quadrupeds

Bioclimatic Zones of Australia*

By Dr. J. Davidson, Waite Research Institute, University of Adelaide

TEMPERATURE and moisture are the chief factors affecting the physical environment of terrestrial plants and animals. In association with soil type, they exert a dominating influence on geographic distribution and seasonal abundance. In Australia, moisture is the chief limiting factor; temperatures during winter are moderate, the mean for the coldest month being above 43° F., except in parts of Tasmania and the highlands of Victoria and New South Wales. The essential elements of climate, on which the availability of moisture depends, are precipitation and atmospheric humidity; loss of moisture by evaporation influences the effectiveness of precipitation.

During recent years, attempts have been made by various workers in climatology to develop a formula by means of which the efficiency of rainfall may be assessed in relation to the moisture requirements of plants and animals. These investigators have taken into account the influence of temperature and atmospheric humidity on the rate of evaporation from an exposed surface. The simplest formula is the ratio proposed by A. Meyer in 1926, in which precipitation is related to evaporation by dividing annual values for rainfall by appropriate values for atmospheric water vapour saturation deficit, both expressed in inches or centimetres. Annual values for these elements are inadequate for bioclimatic studies, particularly in Australia, owing to the seasonal character of the rainfall and its unreliability over the greater part of the continent.

It is recognized that the best index to the relationship between climate and moisture at the soil surface is the ratio of precipitation to evaporation, the critical value being $P/E = 1$; with decreasing values dryness increases, with increasing values wetness increases. Unfortunately, suitable records for evaporation are available at comparatively few stations.

Where adequate data for temperature, rainfall, atmospheric humidity and evaporation are available they can be used to interpret the moisture and temperature 'conditions' in the environment of plants and animals. From the point of view of ecology, zones in which the essential elements of climate can be assessed in this respect may be defined as 'bioclimatic zones'. The flora and

fauna of the different zones may be related to similar or different environments. This emphasizes the significance of environment, in contrast with the conception of phylogenetic grouping of animals, implied in the boundaries of the faunal regions of the world as defined by Alfred Russel Wallace. The term 'bioclimatic zone' was used by A. D. Hopkins (1921), who considered temperature to be the most trustworthy guide to the range of the zones. Experimental work since that time has abundantly demonstrated that temperature alone does not give a true index to the effect of climate on the flora and fauna of an area; the index must express the effect of moisture and temperature working in combination.

I employed the Meyer formula as a monthly ratio (P/S_d) in order to assess the degree of wetness or dryness over Australia, month by month. For this purpose, P/S_d was interpreted in terms of evaporation, (P/E) by reference to records for evaporation at the capital cities. Values for P/E were computed for 235 stations in the Commonwealth. The continent was divided into areas showing the areas and months in which values for P/E are greater or less than 0.5; the value 0.5 was selected tentatively as the minimum value, below which adequate moisture will not be available for general plant growth. The areas were grouped to form the five moisture zones defined in Fig. 1. For each of these zones it is known how many consecutive months have values for P/E greater than 0.5.

The intensity of dryness in any zone depends upon the number of consecutive months that values for P/E are less than 0.5, together with the value of the ratio. The intensity of wetness in any zone depends upon the number of consecutive months in which values for P/E are greater than 0.5, and the value of the ratio. In the central portion of Fig. 1, values for P/E are less than 0.5 for every month of the year; the region is classed as an ecological 'desert', the vegetation is characterized by acacia - semi-desert, shrub steppe and porcupine grass climax associations. The boundaries of this region, as shown in Fig. 1, differ somewhat from those obtained by employing the climatic relationships of desert areas as interpreted by Köppen (1923). The arid regions are defined as having one to six consecutive months in which P/E exceeds 0.5; they have been grouped to form the arid and semi-arid zones. The humid regions are defined as having seven to twelve consecutive

* This article gives the chief features of a series of four papers by the author dealing with certain aspects of bioclimatology (*Trans. Roy. Soc. S. Aust.* 1934-1936); under the same title, it formed the subject of a paper given at the Auckland (1936) meeting of the A.N.Z. Ass. Adv. Sci. (Section D, Zoology).

months in which P/E exceeds 0.5; they have been grouped to form the semi-humid and humid zones. It is of interest to note the small area of Australia, north of the Tropic of Capricorn, which falls in the humid zone.

The temperature zones have been defined on the following basis:

A. *Hot*—the mean annual temperature exceeds 70°F .

The boundaries of the various zones appear to give a better fit to the actual climate in the zone than those developed by Thornthwaite (1933) who assessed "precipitation effectiveness" by evaluating the P/E ratio from data for rainfall and temperature.

There is a close agreement between the bioclimatic zones shown in Fig. 1 and the distribution of types of native vegetation; also there is

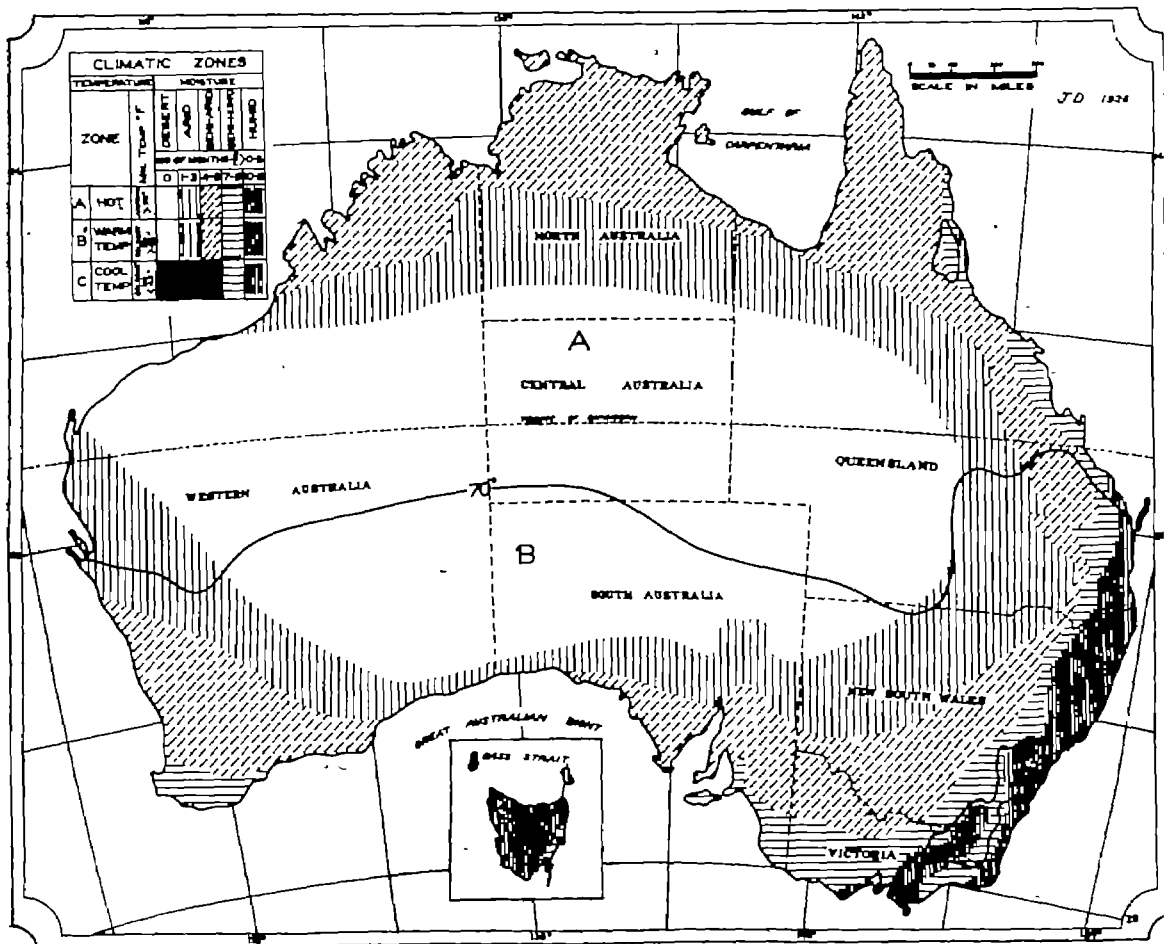


Fig. 1.

B. *Warm Temperate*—the mean temperature for the coldest month does not fall below 43°F .

C. *Cool Temperate*—the mean monthly temperature may fall below 43°F . during one to five months of the year.

In local areas at high elevations in Zone C, the average monthly temperature may fall below 43°F . for more than five months; these areas may be classed as having a cold climate.

The methods described above give a good index to the climate in the different zones; improvement in detail will be obtained when allowance can be made for the influence of additional factors affecting evaporation, such as air movements.

correlation between these zones and the distribution of areas where particular agricultural crops are grown, and the sheep and cattle carrying capacity of the pastoral country. This has an important bearing on the question of settlement in Australia. The methods may be useful as means of obtaining an estimate of the potential population of the Commonwealth, on the basis of land utilization and production.

It is easier to assess the influence on plants than on animals, of the physical environment as determined by climate. This is particularly so with active vertebrates which can readily move away from adverse local conditions.

Obituary Notices

Prof. E. B. Elliott, F.R.S.

PROF. EDWIN BAILEY ELLIOTT, sometime Waynflete professor of pure mathematics in the University of Oxford, honorary fellow of the Queen's College, and formerly fellow of Magdalen College, died at Oxford on July 21 at the age of eighty-six years.

Prof. Elliott was the son of Mr. Edwin Litchfield Elliott, of Oxford, and was educated at Magdalen College School, from which he obtained a demyship to Magdalen College. He took his degree in 1878, after obtaining first classes in mathematics, both in Moderations and in the Final School, and in 1878 was awarded the senior university mathematical scholarship. In 1874 he was appointed fellow and mathematical tutor at the Queen's College, holding the office for nearly twenty years, until in 1892 he was elected to the Waynflete professorship of pure mathematics, and so returned to Magdalen as a fellow. He resigned the professorship in 1922. He joined the London Mathematical Society in 1875, and was for a long time an active member, serving in the Council for many years beginning from 1882; he was president of the Society in 1896-98, being preceded in the chair by Major MacMahon and followed by Lord Kelvin.

All his life, Prof. Elliott produced a steady flow of papers giving the results of his investigation and research. They are to be found in the *Proceedings of the London Mathematical Society*, the *Quarterly Journal of Pure and Applied Mathematics*, and the *Messenger of Mathematics*. His chief work was done in the algebra of invariants, but he also published important papers on Frullani's integrals, on other definite integrals, and on differential invariants.

When Sylvester went to Oxford as Savilian professor of geometry, in succession to H. J. S. Smith, he was full of his theory of reciprocants and of the transformation of differential operators, a theory very much akin to Sophus Lie's theory of continuous groups. Under the influence of Sylvester's enthusiasm, Elliott wrote a paper "On the Interchange of the Variables in certain Linear Differential Operators" (*Phil. Trans. Roy. Soc.*, 1889). He was elected a fellow of the Royal Society in 1891.

His great work, "An Introduction to the Algebra of Quantics" (first published in 1895, second edition, 1913), made Elliott's name well known to all English mathematicians, and thirty years ago was a textbook for all students of higher algebra. He says in the preface, "The primary object of the book is that of explaining, with all the clearness at my command, the leading principles of invariant algebra. . . . Lucidity in mathematical works has often suffered from undue compression. My constant aim has been to guard against such a possibility here. . . . The title Algebra of Quantics is perhaps one of my own introduction. It probably needs no defence, and can

scarcely fail to convey the right meaning. The mathematical world has now for half a century associated the algebra of invariants and co-variants with the name of Cayley and with his 'Memoirs on Quantics' so that it may perhaps be regarded as appropriate that a new work appearing in a year which has seen the close of the labours of the renowned author of these memoirs, and dealing with their subject, should bear a name which recalls his memory".

It is interesting to note that in the "New English Dictionary" there are three quotations under the word "Quantic", the first being from Cayley (1854) whilst the last stands thus "1896. E. B. Elliott. (title) An Introduction to the Algebra of Quantics". The book is a masterly exposition of results due to Cayley and Sylvester, and of those due to Salmon, MacMahon and Elliott himself.

Elliott's last published paper (*J. Lond. Math. Soc.*, 1; 1926), which bore the title "A Simple Exposition of some Recently Proved Facts as to Convergence", was a proof of Hardy's theorem that if b_n denote the arithmetical mean of the positive numbers, $a_1, a_2, a_3, \dots, a_n$, and $k > 1$, then

$$\sum_1^n b_r^k < \frac{k}{k-1} \sum_1^n b_r^{k-1} a_r < \left(\frac{k}{k-1}\right)^k \sum_1^n a_r^k.$$

This was an inequality of great interest to all workers in the theory of convergence, and Elliott's proof was greeted with enthusiasm by Hardy as the best, and in fact the last, word on the subject.

All who have studied mathematics at Oxford in the last forty years will feel that they have lost a friend now that Elliott is gone. He was always ready to help and encourage his younger colleagues with criticism and advice, and mathematics at Oxford owes him a great debt. A. L. DIXON.

Prof. P. Gardner

PROF. PERCY GARDNER was born on November 24, 1846, and passed away on July 19 last, after a few days illness, interested almost to the last in ideas, persons and things, and above all, in his friends. He was educated at the City of London School, and after a year's experience of business went to Christ's College, Cambridge, where he graduated with first-class honours in the Classical and in the Moral Sciences Tripos, and was elected a fellow in 1872. He had already entered the British Museum, and under great chiefs, Lane Poole and Barclay Head, spent fifteen years in a remarkable combination of metrological and æsthetic studies which determined his outlook on antiquity, while it earned him European repute. In 1877 he visited Greece, at a stirring time; Mycenae and Olympia had been excavated; there was talk of work at Pergamon, and even around the Acropolis of Athens. In 1880

he was appointed Disney professor of archaeology at Cambridge, concurrently with his museum work; and it was with this double experience that he entered on his professorship of classical art and archaeology at Oxford in 1887. Since 1880, too, he had been one of the original editors of the *Journal of Hellenic Studies*, and responsible for the high standard of scholarship and wide scope at which it aimed.

Classical archaeology was in its infancy in 1887 as an academic subject in Oxford. Gardner's only predecessor, Sir William M. Ramsay, had been interested in exploration and in epigraphy, and had spent much of his time in travel. There were valuable collections, the 'Arundel Marbles' and the like from seventeenth century patrons of learning; and the new Keeper of the Ashmolean Museum, Sir Arthur Evans, was accumulating new materials in classical as well as prehistoric archaeology. But there were few books, no casts or place for housing them; for a disastrous bargain had glutted the University Galleries with replicas of the works of Sir Francis Chantrey. But even before the reorganization of the Ashmolean Museum, and as part of a comprehensive plan, originals were installed, casts were acquired, and a modest work-shed was provided. Gardner's own conviction, bred of museum experience, and illustrated by his monumental "Numismatic Commentary on Pausanias" (1887), that in ancient coins we have a compendious and inexhaustible series of miniature illustrations of all aspects of Greek art, as well as of religious belief and local tradition, gave him initial advantage in planning his academic programme under such conditions, and in dealing with such early pupils as Sir George Hill and Dr. J. G. Milne. The breadth of Gardner's interests at this time is illustrated by his share in a collaborated "Manual of Greek Antiquities" (1892); his judgment and critical taste by his "Catalogue of the Ashmolean Vases" (1895) and "Sculptured Tombs of Hellas" (1896), and his deep philosophic interest in æsthetic problems by his "Grammar of Greek Art" (1905). As pupils became more numerous, systematic publication was less frequent, especially since there was no departmental staff, and only occasional lectures by college tutors supplemented the professor's own teaching. For many years, Gardner did the work of a college tutor for all his men, as well as his own. But he was a frequent contributor to the *Numismatic Chronicle* and the *Journal of Hellenic Studies*, and remained an editor of the latter until 1926.

It was during this later period too, from the publication of "Exploratio Evangelica" in 1899, that he allowed himself to give expression to his profound interest in the critical and historical aspects of early Christianity, in regard to which he combined what were then advanced liberal views with a simple reverence and personal piety which commended his scholarship and philosophical outlook to a wider circle of readers. From 1915 until 1923 he was president of the Modern Churchmen's Union, and remained an intimate and trusted counsellor of theologians of many schools. Though he took little public part in university business, he was a convinced advocate of research as an essential of university training,

and of facilities for it after graduation; and his "Oxford at the Cross Roads" (1903) expressed frankly and strongly what only a few of his colleagues had then begun to envisage clearly, still less to advocate or practise.

In 1925 Gardner retired as emeritus professor, but continued for some years to publish, and even, on occasion, to lecture; combining in his "Principles of Christian Art" his two dominant interests. In 1934 a slender volume of "Autobiographica" unveiled much that only intimate friends appreciated or suspected, of his devotion to scientific truth, to the interpretation of beauty in men's handiwork, and to the realization of his own high standard of living.

J. L. M.

Dr. A. H. Church, F.R.S.

DR. EDITH PHILIP SMITH, of the Department of Botany, University College, Dundee, writes as follows:

As an old student of A. H. Church, I should like to add a few words of appreciation and recollection to the obituary notice appearing in *NATURE* of May 22.

No one who has not had the privilege of studying under Church can fully appreciate the manner of man he was. To his students he was an unfailing (but not an uncritical) friend. No slipshod or incomplete work was tolerated: everything had to be done to a finish, in which he set an example by his unremitting application to his own research. But it was his dispassionate accuracy and integrity of purpose which created the deepest impression.

Church was an inspired teacher. The condensed and often cryptic English of his writings (which has prevented their full appreciation) became clear and enthralling when expanded in lecture or tutorial.

Church's writings have not yet taken the place they deserve in botanical literature, partly on account of their difficult style, and partly because they were all in advance of their time. The "Types of Floral Mechanism", for example, contains the prolegomena to a serious theory of the flower, which has scarcely been assimilated after twenty-nine years. I was told by Church that he had the remaining material of his projected study of the flower completed, but that the expense of publication was prohibitive. I do not know whether any project is on foot for a memorial to Church at Oxford, but I can think of no more appropriate tribute to his memory than to assist in the publication of his floral studies (if they still exist).

We regret to announce the following deaths:

Sir Edward Davson, Bart., K.C.M.G., an authority on Colonial trade and Imperial economics and a trustee of the Imperial Institute, on August 7, aged sixty-two years.

Sir David Masson, K.B.E., F.R.S., emeritus professor of chemistry in the University of Melbourne, aged seventy-nine years.

Prof. F. C. S. Schiller, emeritus professor of philosophy in the University of California, on August 6, aged seventy-three years.

News and Views

Bicentenary of Dr. Charles Hutton, F.R.S.

On August 14 occurs the bicentenary of the birth of the well-known English mathematician Dr. Charles Hutton, who for thirty-four years held the chair of mathematics at the Royal Military Academy, Woolwich, and who for a long period was a prominent member of the Royal Society. Born in Newcastle-upon-Tyne, Hutton was the son of a colliery labourer and though he attended a dame's school in the Gallowgate, he was almost entirely self-taught. He began life as an assistant teacher at Jesmond, and from 1760 until 1773 he conducted a school of his own in Newcastle and while doing so contributed to the *Ladies' Diary* and other periodicals, and published some excellent elementary works on arithmetic, book-keeping and mensuration. The failure of a bridge in his native city led him to write his "Principles of Bridges and the Mathematical Demonstration of the Laws of Arches", and in 1773 after a severe competitive trial he was appointed to the professorship at Woolwich, where he worked until 1807. In 1774, he was admitted to the fellowship of the Royal Society; in 1775 he made the calculations in connexion with Maskelyne's experiments at Schiehallion, Perthshire, for determining the mean density of the earth, and in 1779 was made LL.D. of the University of Edinburgh and foreign secretary of the Royal Society. This position he held until 1783, when complaints having been made of the way he had carried out his duties, he resigned. Sir Joseph Banks was then president, and Hutton's resignation raised a storm of protest at the way he had been treated. At a meeting of the Society on December 18, 1783, however, when Hutton submitted his "Defence", a resolution was passed stating "that if Dr. Hutton hath been in the opinion of any Member of the Society incriminated, it is the opinion of the Society that he hath fully justified himself".

Hutton already in 1778 had been awarded the Copley Medal for his paper on "The Force of Fine Gunpowder, and the Initial Velocity of Cannon Balls", and for many years he continued to add to mathematical literature. In 1785 he published his "Mathematical Tables" and this was followed by his "Tracts on Mathematical and Philosophical Subjects", his "Compendious Measurer" and his "Elements of Conic Sections". In 1795 he published his "Mathematical and Philosophical Dictionary" which was described by the "Encyclopaedia Britannica" as the most valuable contribution to scientific biography that had yet appeared in England. In 1803, with the naturalist Dr. George Shaw (1757-1813), and the physician and chemist Dr. George Pearson (1751-1828), he began the abridgement of the *Philosophical Transactions*, an arduous task which occupied him for six years and for which he received £8,000. Retiring from his post at Woolwich in 1807 on a pension of £500 per annum, he took up his residence

in Bedford Row, London. Recognized as a most skilful teacher and a man of amiable character, he died on January 27, 1823, in his eighty-sixth year and was buried in the family vault at Charlton, Kent. His "Life" was written by his successor at Woolwich, Dr. Olinthus Gregory.

Digestive Troubles among Omnibus Workers

THE belief that gastric disorders are unduly common among busmen is widespread among the men themselves and their leaders. The problem was placed before the Industrial Health Research Board, and considered by a joint Committee of the London Passenger Transport Board and the Trade Union of Transport and General Workers, and it was the unanimous opinion that an answer should be sought to the following question: Do omnibus workers suffer from digestive complaints more frequently or more severely (or both) than other groups of workers of similar economic and social position? The Committee of the Industrial Health Research Board considered that the investigation of the problem had in the first place to be statistical, and it was decided to make a comparison of the incidence of sickness (limited to periods of more than two weeks' duration) among omnibus workers and tramway workers. The investigation was undertaken by Dr. Bradford Hill, and the results of his inquiry are now published (Report No. 79. Medical Research Council Industrial Health Research Board. H.M. Stationery Office. Price 6d. net). An examination was made of the sickness records of omnibus and tramway workers in the employ of the London Passenger Transport Board. The data were extracted for the years 1925-26 and 1933-35, but the records of the first period were found to be unsatisfactory and the analysis of the sickness experience was therefore confined to the data relating to the years 1933-35. The age distributions of the omnibus and tramway workers differ considerably, and it was necessary to compare the occupational groups age by age, and in reaching a comparative figure for all ages to allow for the differences in the age distributions.

It is found that the omnibus drivers at all ages had in 1933-35 a relative excess of gastric sickness (that is, in proportion to sickness from all causes) of 12-14 per cent over the figure shown by the tramway drivers. In the same way, it is found that the omnibus conductors at all ages had a relative excess of gastric sickness of 15-18 per cent over the figure shown by tramway conductors. But this relative excess varies very considerably with age, for omnibus drivers being confined to the age-group 30-49, and for omnibus conductors to the age-group 20-39, and the higher figures at these ages must be balanced by the lower figures at other ages. When this correction has been made, taking only sicknesses of more than two weeks' duration and a wide group of diseases as

attributable to gastric causes, it is found that there was in 1933-35 some excess of gastric illnesses recorded among omnibus workers as compared with tramway workers at those age-groups to which the majority of the former belongs, though at these ages the total sickness experience, from all causes, of the omnibus workers was rather more favourable than that of the tramway workers.

Japanese Trawlers in Indian Waters

A LEADING article in *Current Science* of May directs attention to the rapidly increasing activity of Japanese trawlers in the Bay of Bengal. On more than one occasion the Government of India has been warned that unless adequate steps were taken to improve and develop Indian fisheries in Indian waters, some other country would sooner or later step in and exploit this area for its own benefit; but with the exceptions of the Government of Madras and, more recently, of Bombay, little or nothing has been done by either the Central or Provincial Governments. For some years past the average catches made by Japanese trawlers operating in the Pacific have been steadily decreasing, partly owing to increased competition but also in the main, no doubt, owing to over-fishing, and in consequence they are now seeking for more profitable areas in other waters. So long ago as 1908-9, the *Golden Crown* carried out a series of experimental trawls for the Government of Bengal, and these showed that there were a number of excellent trawling grounds in this area. The average catch obtained compared very favourably with those taken in European waters. The experiment was a failure from the financial side mainly because of difficulties in the distribution and marketing of the catches.

Indian Coastal Fisheries and their Exploitation

If the Japanese now working in the Bay of Bengal can overcome the marketing difficulties, there seems to be no doubt that they will very materially increase the supply of fresh fish in those ports to which they bring their catches, and in this respect will benefit the inhabitants; at the same time, it must be remembered that this is but one side of the fishing industry and that much material is obtained in the trawl that can be turned, by suitable treatment, to other uses, such as the preparation of dried and salted fish and the manufacture of fish-oil, fish-meal and even fish-manure. In the past, the bulk of the fish guano that is prepared in the Province of Madras is exported, through Ceylon, to other countries and particularly to Japan; the value of this export rose, under the fostering care of the Madras Fishery Department, from 188 tons, valued at Rs. 13,648, in 1910-11, to 32,000 tons, valued at Rs. 24,40,000 in 1922-23, and in 1927-28 it had risen even further to 100,000 tons. If the Japanese trawling in the Bay of Bengal proves to be a success, it is highly probable that in the very near future there will be a marked falling off in the sales to Japan of these Indian fishery products, to the great detriment of the Madras fishermen.

THE present Japanese invasion of Indian waters appears to have commenced in 1935; but its origin can probably be traced back to several years earlier. In 1929-30 the Japanese commenced a surreptitious exploitation of the *Trochus*-shell beds of the Andaman and Nicobar Islands by divers working from motor-boats that were based on Singapore, and this increased to such an extent that the Government of India appointed a fishery research officer in 1931. Unfortunately, owing to lack of proper supervision, undersized shells were fished and, in the absence of any patrolling vessel, grounds that were supposed to be closed were poached, while considerable poaching on the authorized grounds was carried out by unlicensed vessels: in consequence, the shell-beds were rapidly decimated and will take many years to recover. Some of these motor-boats brought with them their fishing nets, and an experiment carried out off Port Blair showed that these nets could be used in these waters with very considerable success, one boat after an absence of two days returning with a catch of about 1½ tons of fish. The natural resources of the ocean are everywhere open to all nations outside the three-mile territorial limit, but unless adequate patrolling of these Indian coastal waters by fishery-protection vessels is carried out—and in view of the great length of coast-line involved this would seem to be impossible—Japanese trawlers will certainly exploit the inshore waters, should experience prove that they are profitable trawling-grounds. A comparison of the various species of fish brought to market by the local fishermen of Akyab in Burma and Puri in Orissa, on opposite sides of the Bay of Bengal, with those taken by the *Golden Crown*, reveals that a large percentage are identical. These local inshore fishing-grounds extend out from the coast for distances varying from about five miles up to as much as 10-15 miles; thus, even were the territorial limit of three miles strictly enforced for these trawlers, there can be little doubt that such trawling by Japanese vessels will affect adversely, and perhaps seriously, the Indian coastal fishing industry.

National Institute of Sciences of India

PROF. M. N. SAHA informs us that the Government of India has decided to make a grant-in-aid of Rs. 6,000 per annum to the National Institute of Sciences of India, Calcutta, with effect from 1937-38. The grant will be subject to the following conditions: (1) Provision should be made for a nominee of the Government of India on the Council of the Institute. (2) An annual report of the working of the Institute, together with a duly audited statement of accounts, should be furnished regularly to the Government of India. (3) The Institute should tender advice on any scientific problems which may be referred to it by the Government of India and discharge any other functions which may be assigned to it by the Government of India. No provision exists in the current year's budget of the Central Government for this grant. It is proposed, however, to include a sum of Rs. 12,000 in the budget estimates for 1938-39.

on account of the grant for the year 1937-38 and 1938-39 and, subject to the vote of the Legislative Assembly, steps will be taken to pay this amount early in the year 1938-39.

Devices for Fighting Fires

In the High Tension Conference held in Paris in June interesting discussions took place as to the relative merits of fire-fighting equipment. In Part 2 of an article by T. Rich in the *Electrician* of July 16, the latest opinions of French engineers on the devices used in practice are given. For protecting transformers and alternators of large output, alarm indicators are used as well as extinguishing appliances. They are of the fixed type which operate automatically when the station has no attendants and when the generators are very large. The movable apparatus generally used consists of extinguishers, boxes of sand, blankets and water jets directly connected to the mains or to a foam generator. Gas masks, smoke fans and emergency lamps are auxiliary apparatus. Portable extinguishers are only used for very small fires. It is important that the material used should be a bad conductor of electricity, as small fires make a close approach necessary and the jet may give a dangerous shock. Carbon tetrachloride has high extinguishing powers and it is not a good conductor. But at high temperatures it decomposes into a gas that is corrosive and poisonous, so that a gas mask is desirable although it entails a loss of time. Methyl bromide is generally thought to give out less poisonous fumes but it is expensive. Saline solutions with a base of potash have a high extinguishing capacity but they are dangerous to use as the jet is a conductor. Carbonic acid snow is not such a good extinguisher but its use entails no danger to personnel. It can be used without cutting off the current, and so is useful in the case of small fires, but the risk of re-ignition is serious. Fire-resisting blankets are used to put out burning clothes on persons. They should be kept in metallic cases with anti-moth material and a window should be put in the case to ensure that the contents have not been borrowed for other purposes. 'Atomized' jets which work under a high pressure have been found useful both in putting out oil fires and cable fires. For hoses rubber is better than woven material. Each 'fire' point at an electric station should have a sand box with wood shovels, a gas mask and a lantern.

Annual Report of the Ministry of Health

THE eighteenth annual report of the Ministry of Health, 1936-37, has been recently issued (H.M. Stationery Office. 5s. net). It consists of an introduction and seven chapters, and includes the work of the Welsh Board of Health. The death-rate was 9.2 per thousand, the death-rate of infants below one year 59, and the maternal mortality rate 3.81, per 1,000 live births. Tuberculosis mortality was the lowest on record, being a rate per million living of 583 for pulmonary, and of 109 for non-pulmonary, tuberculosis. Notifications of diphtheria were 7,290 less than for 1935, but still considerably in excess of

those for 1933. Of enteric fever, 2,493 cases were notified, compared with 1,750 in 1935, the increase being mainly due to the epidemic last summer at Bournemouth, Poole and Christchurch. Public analysts examined 146,438 samples of food and drugs—a record number—of which 7,802 were reported against. Of this total, 80,082 were samples of milk and 7,588 those of butter. Under slum clearance and rehousing, up to the end of last year 100,355 houses had been demolished and 127,553 houses built to replace them, this being the fourth year of the five years' plan. This year, general progress in town and country planning, especially in preserving the countryside, has markedly increased. No less a sum than £65,000,000 of Exchequer money was spent in 1936 on services administered by the Ministry, but only £2,200,000 of this was expended on central administration.

Apparatus for Testing Petroleum and Related Products

A CATALOGUE of scientific apparatus is necessarily a classified list of separate items and to repay reading must be clearly printed, attractively set out, adequately illustrated and up to date. Messrs. Gallenkamp and Co.'s catalogue (No. 96A, 1937 Edition) listing apparatus for testing petroleum, tar, asphalt and their products, fulfils all these requirements and will be of definite interest to those engaged in the examination of these substances. The listed apparatus includes types standardized for routine tests by the Institution of Petroleum Technologists, the Standardisation of Tar Products Test Committee, the British Standards Institution and the American Society for Testing Materials, as well as many other special forms which for one reason or another have not been so standardized. The drawings, in general, have been executed with due attention to detail, although on p. 35, an unsuitable type of ring burner has been included in the diagram of the apparatus for the determination of water in asphaltic substances; on p. 43, the position of the thermometer in the R and B softening point apparatus is incorrect and on the same page, the K and S softening point apparatus depicted is not the standard type specified by the S.T.P.T.C. The arrangement of the subdivisions is at present somewhat haphazard, necessitating frequent reference to the index; it could be improved by the substitution of an alphabetic order on the lines of the Institution of Petroleum Technologists' hand-book. Despite these defects, the catalogue will be appreciated by technologists specializing in the fields indicated in the title.

Natural Colour Eclipse Photography

WE have received from Mr. Edward R. Hewitt, of 127 East 21st Street, New York, a correction of the statement, quoted in NATURE of March 13, that the *National Geographic Magazine* of February contained the first natural colour photograph of a total solar eclipse ever reproduced. Mr. Hewitt informs us that the *Scientific American* of April 1925 reproduced a colour photograph, made by him, of the total eclipse of January 24, 1925, and has sent

us a copy of the reproduction. Mr. Hewitt, in 1925, used Autochrome plates specially sensitized by himself, and his camera had a focal length of 8 ft. Dr. Gardner, in 1936, used Dufay colour plates and a camera of 19-ft. focal length. Owing to the greatly differing circumstances, any detailed comparison of the two pictures would be invidious. The picture Mr. Hewitt has sent us is about a tenfold enlargement of the original, and shows a yellow coronal image extending to about a fifth of a solar radius from the limb, so that on the original plate the coronal image can only have been about 0.6 mm. across, whereas Dr. Gardner's picture was reproduced at about actual size and showed a corona extending to about a solar radius or about 20 mm. on the original plate. In view of the low resolving power of colour plates, it would be absurd to expect much recognizable detail on the 1925 plates, and indeed there is only a suggestion of coronal form, and the colour is presumably in error, but the photographs had the value of demonstrating that colour plates could be made sensitive enough to photograph a total eclipse.

Plant Diseases and Pests of India

Science and Culture contains an interesting review of "Some Plant Diseases and Pests of India and their Control" by Amil Mitra (2, Nos. 8 and 9, Feb. and March 1937). The paper should serve the useful purpose of directing attention to the serious nature of plant disease, for it includes succinct references to the monetary or percentage losses occasioned by many fungi and insect pests. These are sufficiently convincing. The world's loss through the activities of various rust diseases of wheat is estimated at about £60,000,000, and India bears about £4,000,000 of this. A smut disease of the Jowar crop, caused by the fungus *Sphacelotheca sorghi*, causes a loss of 20-25 per cent, and in the Bombay Presidency alone, this means a cost of two crores of rupees (about £2,000,000). Sugar cane mosaic, caused by a virus, often lowers the yield of sugar by 30-35 per cent, whilst a wilt of the pea crop caused by the fungus *Fusarium Vasinfectum* seems to cause the highest percentage damage, for more than half the crop is often lost as a result of its depredations. The review mentions the particular methods of control for each disease or pest, which have been found most effective in practice. A few insect and eelworm enemies are mentioned, but the main emphasis of the paper is that of a mycologist.

Journal of Parapsychology

AN introduction by Prof. Wm. McDougall gives reasons for the publication of a new journal, the *Journal of Parapsychology*, and making clear its object. Throughout the ages, people have asked: Are mental processes always and everywhere dependent upon material and physical organizations? What are the relations of mind and matter? Do the volitions and beliefs of men make any difference to the historical course of the events of the world? Is the physical co-extensive with the mental and the powers and potentialities of mind to be defined by

the laws of the physical sciences? For the most part, the psychology studied in the universities has not concerned itself experimentally with these problems, and such work as has been undertaken has generally been the leisure-time pursuit of interested amateurs. Prof. McDougall thinks that all those phenomena vaguely denoted by the phrase, 'psychical research', ought to be the study of trained scientific workers in the universities, both in the interests of the development of knowledge and of the public. A beginning was made at Duke University in 1930 to study what the researchers called 'extra-sensory' perception. In order that the experiments made in one laboratory may be repeated by other workers, it seemed desirable that there should be a journal. The need for multiple repetitions by different observers of all experiments purporting to give positive results is greater in this field than in others. The word parapsychology is chosen to denote the more strictly experimental part of psychical research. The journal is published quarterly, and the first number is dated March 1937 (Durham, N.C.: Duke University Press. Subscription 3 dollars a year).

Cist Burial at Blaydon-on-Tyne

AN interesting example of a cist burial is reported from Blaydon-on-Tyne (*The Times*, Aug. 6). The discovery was made by workmen digging in a sand-pit, who uncovered the broken upper slab of the chamber. The dimensions of the cist were 3 ft. 8 in. in length, 2 ft. 3 in. wide and about two feet in depth. The interior was filled with sand, but among the contents were found a human skull and bones of the skeleton. With them was a flint knife about two inches in length. The site was visited and the cist examined by Miss G. M. Scott, assistant curator of the Hancock Museum, Newcastle, Mr. W. Bulmer, of the Corbridge Museum, and other authorities of the locality, in whose opinion the find belongs to the Bronze Age and is to be assigned, notwithstanding the absence of the beaker which might be expected, to a date at about 1500 B.C. A burial with skeletal remains of a somewhat earlier date was found on Summerhill, not far away, seven years ago and is on view as reconstructed in the Hancock Museum.

National Museums of Natural History

FREQUENT visits from, and even interchange of, the staffs of the larger museums of the British commonwealth of nations, as referred to in an article in *NATURE* of January 9, has evidently the strong approval of Mr. Frederick Chapman, the well-known authority on the Foraminifera, who has written to us from Melbourne on the subject. The 'Australian Museum' is situated at Sydney and there is the 'Melbourne National Museum', which from the wealth of its collections, especially palaeontological, must be regarded as also of the highest rank. It is immaterial that one museum may be richer than the other in some sides of biology, for such must always be the case. The important matter is that tightening of the bonds between all the museums in question, which has the approval of the Museum Association

Australia. Further, we understand that a representative of this Association was deputed to discuss this with the trustees of the British Museum this summer. When can we expect to hear the result of this discussion?

Research at Armstrong College

FROM Armstrong College, Newcastle-upon-Tyne, we have received a report for 1935-36, somewhat elaborated, by the Standing Committee for Research. The importance of some of the work accomplished with the help of the Committee's small subventions (twenty-six grants amounting in the aggregate to 846) is well brought out in an eighteen-page summary prefixed to the individual reports of the recipients and list of publications. An obvious advantage of a fund such as that administered by the Committee, appropriated in advance to specified fields, is that its administration compels representatives of different departments to take an interest in research in each other's fields, and this promotes inter-departmental collaboration in research, instances of which are cited in the report. Of the role of philosophy in the University, the Committee takes a liberal view, for it refers to works emanating from the College's Department of Philosophy as "original contributions towards the formation of that background of knowledge which forms, or should form, the background of university education".

American Documentation Institute

THE American Documentation Institute was incorporated at a meeting in Washington on March 13 as a corporation "not for profit" but for educational, literary and scientific purposes. The first objective of the new organization is to develop and apply the new technique of microphotography to library, scientific and other material. This national organization was foreseen as an outline of the documentation activities of Science Service when they commenced in July 1935. Bibliofilm Service has been conducted by Science Service in co-operation with the Library of the U.S. Department of Agriculture as a service to research workers, and in auxiliary publication through microfilm, leading academic and scientific journals have co-operated.

Cytological Technique

A SHORT but useful pamphlet giving an "Outline of Cytological Technique for Plant Breeders" is issued by the Imperial Bureau of Plant Genetics (1s. 6d.). Genetics and cytology have become so intimately interwoven in their results that every plant breeder needs to have some knowledge not only of chromosome investigations but also of the methods of cytology. The various techniques involved are sufficiently exacting if satisfactory results are to be obtained. This pamphlet gives an account of the paraffin method, the smear method and a short statement containing the essentials of technique in the use of the microscope, the methods being based mainly on the schedules in use at the John Innes Horticultural Institution, Merton.

Microscopy: the Quekett Microscopical Club

WATSON'S *Microscope Record* of May (No. 41), among other matter, contains an account by Mr. J. F. Stirling of the microscope used by John Dalton, now in the possession of the Manchester Literary and Philosophical Society, and an article by the editor on the appropriate eyepiece to use with certain objectives. Two new species of Bdelloid Rotatoria are described by Mr. W. E. Garner in the *Journal of the Quekett Microscopical Club* of April (Ser. 3, 1, No. 7, p. 280). Mr. W. E. Watson Baker is the new president of the Quekett Club, which is holding its annual conversazione on October 12 in the rooms of the Royal Society at Burlington House.

Conference on Protection against Natural Disasters

THE first "Conférence internationale pour la protection contre les calamités naturelles" is to be held at the Paris Exhibition on September 13-17. The following titles of sections of the Conference indicate its scope: vulcanology and seismology, meteorology, zoology and epidemiology, economic and social crises (fires, famines), assurances. The organizers of the Conference are the Commission Française d'études des calamités, one of a dozen such national commissions which owe their existence to the initiative of the editorial board of the scientific periodical, *Matériaux pour l'étude des calamités*, established in 1924 by M. Raoul Montandon. In that year the Italian commission was formed. Its president is Giovanni Ciralo, who is also president of the Union internationale de secours founded by the League of Nations in 1927, when the French commission was formed. Later, similar bodies were established in Austria, Belgium, Bulgaria, Chile, Czechoslovakia, Greece, Hungary, Italy and Switzerland. Others are in course of formation in Russia and Yugoslavia. The opening session will be presided over by the Under-Secretary of State for Scientific Researches and the closing session (to be followed by a reception at the Hôtel de Ville and a banquet) by the Minister for the Colonies. Admission to membership of the Conference involves payment of a fee of 100 francs, exclusive of the charge of 40 francs for participation in the banquet. Membership will carry the right of free entry to the Exhibition during the Conference. The address of the secretariat is: Laboratory of Applied Entomology, 45 bis, rue de Buffon, Paris, 5^e. The secretariat will, if desired, reserve bedrooms for members.

Comet Finlér

PREDICTION for the place of Finlér's Comet for the next three weeks is given in Announcement Card No. 421 issued by Harvard College Observatory. The ephemeris is based on a parabolic orbit computed by Dr. A. D. Maxwell of the University of Michigan. The time of deduced perihelion passage is August 15.76946 U.T. This comet was discovered on July 4 last by Finlér at Zurich; it was then of the 7th magnitude. It is now possible to locate the comet with the naked eye. The following predicted positions at 0^h U.T. show that the comet will pass 3° or 4°

west of the bright star, Arcturus, between August 22 and 23. In the latitude of London, Arcturus sets in the north-west about an hour after midnight (Summer Time) in the middle of the month.

Date	R.A.	Dec.	Date	R.A.	Dec.
Aug. 14	13h. 30.6m. + 45° 04'		Aug. 26	14h. 02.5m. + 13° 10'	
" 16	13 40.6 + 37 54		" 28	14 04.4 + 10 11	
" 18	13 47.8 + 31 31		" 30	14 06.9 + 7 23	
" 20	13 53.1 + 25 57		Sept. 1	14 07.2 + 5 02	
" 22	13 57.0 + 21 07		" 3	14 08.2 + 2 54	
" 24	14 00.1 + 16 56				

Announcements

THE following research fellowships in tropical medicine have recently been awarded by the Medical Research Council: *Senior fellowship* to Dr. Frank Hawking, assistant lecturer in pharmacology, Welsh National School of Medicine, Cardiff; this is tenable for three years, for investigations to be made mainly in the tropics. Dr. Hawking will work in Africa on the chemotherapeutic treatment of sleeping sickness. *Junior fellowships*: D. A. Cannon; J. L. Dales, assistant pathologist, Royal Hospital, Sheffield; I. W. MacKichan, house surgeon, London Hospital.

ON the recommendation of the Agricultural Research Council the following awards of agricultural research scholarships, studentships for research in animal health and veterinary scholarships have been made by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland: P. J. Faulks (plant physiology), R. S. Russell (plant physiology), F. H. Malpress (nutritional chemistry), J. Wilson (plant genetics), G. H. L. Dickier (entomology), J. W. Whittick (animal pathology), F. D. Asplin (poultry diseases), Miss K. M. Massey (poultry diseases).

THE following awards for 1937-38 have recently been made by the Salters' Institute for Industrial Chemistry and approved by the Court of the Salters' Company: a fellowship has been renewed to L. M. Baxt, Imperial College; fellowships have been awarded to R. H. Freak, University of Oxford, A. J. Shorter, University of Birmingham, J. L. Tuck, University of Manchester, and S. H. Wade, Imperial College of Science and Technology; the Salters' Institute has also awarded forty grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

DR. J. ANDERSON has been appointed representative of the Scottish Beekeepers' Association on the Bee Research Committee that advises it in regard to investigations on bees carried out at Rothamsted. Dr. Anderson is well known for his special knowledge of bee problems and for his admirable work in Scotland in applying science to the solution of the beekeepers' difficulties.

EIGHT honorary memberships of the Engineering Institute of Canada were conferred at the semi-centennial meeting of the Society held in Montreal recently. The engineers honoured include Sir Alex-

ander Gibb, president of the Institution of Civil Engineers; the Hon. C. D. Howe, Minister of Transport, Ottawa; the Hon. Grote Stirling, former Minister of National Defence, Kelowna; Prof. R. W. Angus, professor of mechanical engineering at the University of Toronto; Dr. George Harriek Duggar, a past-president of the Engineering Institute of Canada and chairman of the Dominion Bridge Company, Montreal; and Mr. S. J. Hungerford, chairman and president of the Canadian National Railways, Montreal.

DR. JOHN K. SMALL, chief research curator of the New York Botanical Garden, who has described the proposed Everglades National Park on p. 26 of this issue, has sent us sixty papers, of diverse botanical interest, published in the *Journal of the New York Botanical Garden*, and extending over a period of twenty years. The papers demonstrate great field activity on the part of the author, especially in plant morphology and ecology. It is interesting to note that Dr. Small has published about a hundred reports on explorations and fourteen descriptive floras concerned chiefly with the south-eastern United States. Copies of these publications can be obtained from the Science Press Printing Co., Lime and Green Streets, Lancaster, Pasadena.

DR. ADOLF BUTENANDT, director of the Kaiser Wilhelm Institute for Biochemistry, has been awarded the Scheele Medal of the Chemical Society of Stockholm.

GEHEIMRAT PROF. CARL BOSCH has been elected president of the Kaiser Wilhelm Society for the Advancement of Science in succession to Prof. Max Planck.

THE Gluge Prize of physiology of the Belgian Royal Academy of Sciences has been awarded to Prof. J. J. Bouckaert of the University of Ghent.

DR. VICTOR G. HUBER has been awarded the Medal for Distinguished Service of the Pennsylvanian Society of New York in recognition of his medical research work under the auspices of the Rockefeller Foundation.

THE sixteenth American Congress of Physical Therapy will be held in Cincinnati, Ohio, on September 20-24 at the Netherlands Plaza Hotel, under the presidency of Dr. William Bierman of New York. Further information can be obtained from the editorial and executive offices of the Congress, 30 North Michigan Avenue, Chicago.

AN International Congress of the Scientific Press organized by the Professional Syndicate of the Scientific Press will be held in Paris on October 7-9. Further information can be obtained from M. Toutain, 25 rue du Four, Paris.

ERRATUM. In NATURE of August 7, p. 229, the date of the erection of the Roman bath at Leicester should be, obviously, A.D. and not B.C. as stated.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 283.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Lecithinæmia following the Administration of Fat

ABOUT two hours after the administration of a meal containing fat, the fat content of the blood begins to rise. Bloor¹ found that when olive oil is administered to a dog, besides an increase in the neutral fat content of the blood an increase in its lecithin content also takes place. The average increase was found to be about 20 per cent. A maximum is reached after four hours. Bloor was inclined to ascribe the lecithin formed after the administration and resorption of the neutral fat to a synthesis occurring inside the red blood corpuscles. Other explanations might, however, be suggested as well, namely: (1) The lecithin is synthesized in the intestinal mucosa and absorbed into the blood. (2) The synthesis takes place, after the resorption of neutral fat, in the liver, or somewhere else outside the intestinal tract. (3) The increase in the lecithin content of the blood is due to mobilization of preformed lecithin after the resorption of the neutral fat.

To decide which of these suggestions is to be accepted we repeated Bloor's experiment, but administered simultaneously with the oil-labelled (radioactive) phosphorus in the form of sodium phosphate. In the case denoted by (1) the additional blood lecithin should contain chiefly labelled phosphorus; in case (2) the additional lecithin should contain only small amounts of labelled phosphorus; in case (3) the additional lecithin should contain ordinary phosphorus only.

We determined the normal P present in the blood lecithin, which was extracted by the usual procedure, by the method of Fiske and Subbarow, and the labelled P by means of a Geiger counter. While, as seen in the table, the lecithin phosphorus content of 100 c.c. of blood increased by 2 mgm. four hours after administering the oil, that of labelled P only increased by 0.028 mgm. We must, furthermore, take into account the fact that half the labelled phosphorus administered two hours before the oil produced 0.028 mgm. labelled lecithin P during that time. We must therefore deduct 2×0.028 mgm. from the 'oil effect' of 0.096 mgm., obtaining 0.04 mgm. per 100 c.c. of blood for the maximum value of the 'oil effect'.

An important objection can, however, be raised to our conclusion; it may be argued that the intestinal tract might contain large amounts of phosphorus other than the labelled phosphate administered by us, the presence of which must be accounted for when carrying out the above calculation. To investigate this point and to ascertain to what extent the labelled phosphorus was resorbed, we killed the dog after the last experiment, the results of which are seen in the table. We washed the intestinal tract with water and determined both its total P content and its labelled P content. We

found by activity measurements 39.6 mgm. labelled P and by chemical determination 175 mgm. normal P. Within six hours as much as 260.4 mgm. of the 800 mgm. administered to the dog was thus resorbed. The 135 mgm. non-labelled phosphorus got into the intestine, presumably along with the digestive fluids, so that the 40 mgm. labelled P were 'diluted' to 175 mgm. We determined also the total acid-soluble phosphorus content of the intestinal mucosa; it was found to amount to about 40 mgm., bringing the above figures up to 215 mgm. But even if we make the assumption that this dilution was present during the whole of the resorption process we should get the result $5.2 \times 0.064 = 0.21$ mgm. per cent lecithin P, while an increase of 2 mgm. per cent was found in the blood lecithin P.

Time in hours	Labelled P given in mgm.	Lecithin phosphorus found in 100 c.c. blood		Labelled total P found	
		Total	Labelled	In 100 c.c. blood	In the total blood of the dog
0	150	—	—	—	—
2	150 (+50 gm. oil)	16.0 mgm.	0.028 mgm.	1.03 mgm.	6.18 mgm.
4	—	15.5 "	0.048 "	2.03 "	12.18 "
6	— (250.4 mgm. resorbed)	18.0 "	0.066 "	2.00 "	12.00 "

It is of interest to compare the labelled P content resorbed with that actually found in the blood stream of the dog. Six hours after the beginning of the experiment, as is seen in the table, only 4.6 per cent of the amount resorbed was found. This result illustrates beautifully the great rapidity of the phosphorus exchange in the body. As observed by us in numerous cases, the individual phosphorus atoms present in the blood stream exchange their places rapidly with others present in the different organs. For this reason we can conclude with certainty that during our experiments the ratio labelled phosphorus to ordinary phosphorus must have been appreciably higher in the intestinal mucosa than in the blood.

The only moderate increase in labelled phosphorus in the blood lecithin after administration of oil, an increase which nevertheless in all our experiments exceeds the increase observed after the radioactive phosphorus was administered alone, leads to the conclusion that during the absorption of neutral fat, lecithin is formed outside the intestinal tract. A comparatively rapid formation of labelled lecithin in several organs in the course of normal metabolism has in fact recently been observed².

Some of the labelled phosphorus used in our experiments was prepared by us from sulphur under the action of neutrons emitted by a radium-beryllium

mixture most kindly put to our disposal by Prof. Niels Bohr, and some of it was a generous gift from Prof. Lawrence, of the University of California. We should also like to express our best thanks to Mr. A. H. W. Aten, jun., and Miss Hilde Levi for their assistance in this work.

G. HEVESY.
E. LUNDGAARD.

Institute for Theoretical Physics
and
Institute for Medical Physiology,
University of Copenhagen.

¹ Bloor, W. B., *J. Biol. Chem.*, **23**, 317 (1915); **24**, 448 (1916).
² Artom, C., Barana, G., Santagelo, M., and Segre, H., *NATURE*, **139**, 836 (1937). Comp. also Hahn, L., and Hevesy, G., *Scand. Arch. f. Fys.*, Aug. 1937).

A New Source of Vitamin A

IN the course of a study of the mode of occurrence and distribution of vitamin A, we have found that the viscera (excluding the livers) of halibut yield abnormally rich oils (see table).

VITAMIN A IN HALIBUT

Weight of fish (kgm.)	Weight of liver (kgm.)	Weight of 'viscera'* (kgm.)	Weight of liver oil (gm.)	Weight of 'visceral' oil (gm.)	Weight of vitamin A		Percentage† vitamin A	
					In liver (gm.)	In viscera (gm.)	In liver oil	In visceral oil
45.4	1.03	1.67	203	36	3.84	2.88	c. 2.0	8.0
45.4	0.54	1.47	70	27	1.53	1.61	2.2	5.6
28.6	0.40	0.76	34	15	2.1	1.05	6.3	7.0
23.6	0.34	0.85	—	15	—	0.9	c. 4.5	6.0
26.9	0.51	1.04	—	17	—	0.48	0.33	2.8
36.3	0.91	1.05	205	20	0.22	0.32	0.11	1.6

* In this table the term 'viscera' refers only to stomach, mesentery and intestines.

† Percentage is calculated on the basis
for vitamin A, so that for an
8 per cent oil we have —

1%	620 mμ	5,000
1cm	583 mμ	2,600
1cm	328 mμ	1,600

The fish were caught in Shetland waters in May this year and their stomachs were free from food.

The viscera are normally thrown into the sea although they may contain, as in these cases, as much vitamin as the liver, and may yield more potent oils.

In the eye, Wald has shown that vitamin A forms a complex with protein. In order to test whether a similar complex occurs in liver, we have attempted to extract liver oils without denaturing proteins. In a number of instances the oil obtained by the use of non-polar solvents contains much less vitamin A than the oil obtained in other ways from the same liver. The phenomenon is best shown with livers poor in vitamin, but even in halibut, part at least of the vitamin A is not present in oil solution.

This work is being carried out under the auspices of the Medical Research Council and the Food Investigation Board.

J. A. LOVERN.

Torry Research Station,
Aberdeen.

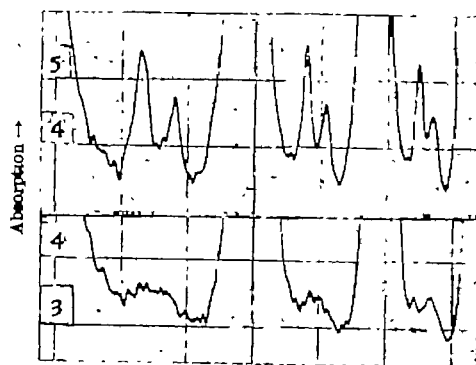
J. R. EDISBURY.
R. A. MORTON.

University of Liverpool.
July 6.

Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium

IN view of conflicting evidence as to the sign of the nuclear spin of potassium 39, it was decided to make a quantitative investigation of the intensities of the hyperfine structure components of the resonance lines. The method used was similar to that used by the authors for the hyperfine structure of the resonance lines of silver¹. The absorption produced by an atomic beam of potassium in the resonance line given by a potassium lamp similar to that previously described was observed by means of an etalon of 5 cm. plate separation, with heavily silvered plates. Under these conditions, the adjacent orders of the emitted lines are well separated from each other, and the hyperfine structure can be observed as a narrow absorption doublet. In order to measure intensities, a photograph is made first of the emitted light without absorption, and then with absorption; the reduction in the logarithmic intensities by the absorption line give their respective absorption coefficients, and the ratio of these the required intensity ratio.

The collimation of the atomic beam was 1:8; the absorption of the hyperfine structure was observed best when the temperature of the potassium was about 150° C. (v.p. = 5×10^{-4} mm. mercury) the absorption in the weaker component of the line $4S_{1/2} - 4^2P_{1/2}$ being about 60 per cent. Seven determinations of the intensity ratio were made for this line; the values were 1.44, 1.44, 1.44, 1.38, 1.43, 1.48 and 1.45, the mean being 1.44; the component of longer wave-length being the stronger. For the line $4S_{1/2} - 4^2P_{3/2}$, four determinations of the intensity ratio were made, the values being 1.52, 1.42, 1.40 and 1.45, mean 1.45; the component of longer wave-length was the stronger. A photometer trace of this line is shown in Fig. 1, three orders being shown.



← Wave-length

Fig. 1.

a, LIGHT SOURCE ONLY; b, ABSORPTION OF ATOMIC BEAM.

It was observed that when the density of the atomic beam was increased twenty times by raising the temperature of the potassium to 200° C.

(r.p. = 7×10^{-8} mm.) the short wave-length component in both resonance lines became considerably broadened, its width being about 0.012 cm^{-1} , that of the other component being about 0.008 cm^{-1} .

According to Millman and Fox and Rabi² the nuclear moment of K39 is $3/2$. The observed intensity ratio is in agreement with this if it is assumed that both the hyperfine structure components of K41 lie on the weaker component of K39; in this case the observed intensity ratio should be $1.67 / (1 + \frac{2.67}{14}) = 1.40$, the total intensity of K41 being $1/14$ of that of K39. This is in good agreement with the observed value 1.44. The broadening of the weaker component at very high densities is strong evidence in favour of this interpretation, as the separation of the two high-frequency components of K41 is 0.00853 cm^{-1} according to Manley³. The spreading out by this structure of the absorption of K41 could reduce its influence on the intensity by about one third, the calculated intensity ratio becoming 1.46, and thus in even better agreement with the observed. No trace of absorption due to K41 outside that due to K39 was found with 5 cm. and 2 cm. etalons when the atomic beam was twenty times as dense as that needed to give 50 per cent absorption by K39; and the intensity of the background was varied by giving exposures up to 20 times normal.

On the above view the centre of gravity of the components of K41 overlaps the weaker component of K39; this indicates a violet isotope shift of K41 equal to about 0.009 cm^{-1} ; the normal centre of gravity shift is theoretically 0.009 cm^{-1} .

It is thus shown that the spectroscopic determination of the nuclear moment of K39 is in complete agreement with those made by Rabi and others; the sign of the magnetic moment is positive⁴, and the value of the spin $3/2$.

In a previous note⁵, we stated that the short wave-length hyperfine structure component of $4S_{1/2} - 4^3P_{1/2}$ appeared stronger; this discrepancy can be explained; for the photometer traces of the absorption in which this was observed were made from photographs (intended for measurement of distance of high-frequency components and not for intensity measurements) made with an etalon of 10 cm. plate separation; under these conditions the emitted lines in adjacent orders overlap each other, so that in the position where the absorption was observed there is unabsorbable light from the wing of the emitted line in the adjacent order. The density of the atomic beam was very high (temperature of potassium $220^\circ \text{ C}.$) so that the absorption was almost complete, and the light transmitted was due to the overlapping wing, and had no significance as to the intensity ratio of the high-frequency components.

The observation of Fisher⁶ that the short-wave components appear stronger in an excited atomic beam can perhaps be explained by self-absorption; moreover, it has been observed by K. W. Meisner⁷ that the long wave component is the stronger in an excited atomic beam.

Clarendon Laboratory,
Oxford. July 16.

D. A. JACKSON.
H. KUHN.

Expulsion of Neutrons from Lead by Cosmic Rays

A NEUTRON counter was made of a brass tube 10 cm. long and 1 cm. in diameter, the inner surface being coated with a thin film of borate a few microns thick. The axial collector of the ionization chamber was directly connected to a set of the improved linear amplifier system, which was so carefully mounted that the counting system was perfectly free from the mechanical and electrical disturbances of the surroundings, and gave only two to four clear, natural kicks in an hour. By a series of control experiments with neutrons from a radium-beryllium source (of 10 mgm. radium), it was found very reliable for observing slight variations in the number of kicks under various experimental conditions.

Now when the counter was placed inside a lead chamber 50 cm. long and 10 cm. thick (the dimensions are shown in Fig. 1) the number of kicks was found to increase to about 7 per hour, while it amounted to about 15 per hour when the space around the chamber was filled with paraffin.

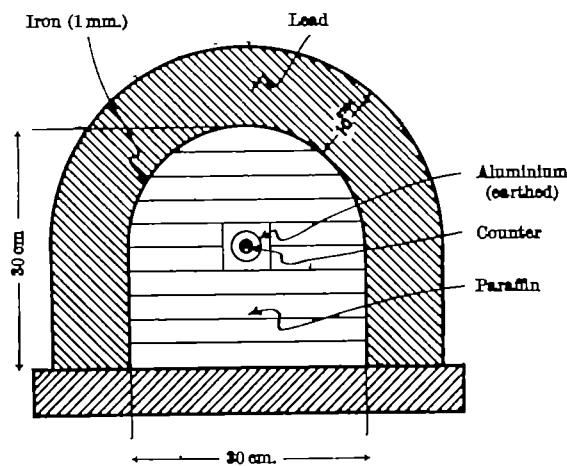


Fig. 1.

These observations were carefully done intermittently for half a year. Though it was difficult to maintain the constant reliability of the counting system for a long duration of time (the results for different dates were sometimes markedly different) most of the results obtained in good conditions were found to lie within the following extreme values:

	Natural kicks outside the chamber	Kicks inside the lead chamber without paraffin	Kicks inside the lead chamber filled with paraffin	Kicks outside the chamber but within paraffin
Min.	2 per hour	4-6	9-13	Less than those counted in the lead chamber without paraffin
Max.	4	7-9	18-20	

(Boron-surface: 10 cm. in length and 1 cm. in diameter.)

This result shows that a number of fast and slow neutrons are produced by the action of cosmic rays in lead (or less probably in iron or in paraffin).

At first it was suspected that they were liberated at the instant of the production of a 'shower' in lead. But the remarkable Wilson chamber photograph taken by Blackett⁸ showing the disintegration of an atomic nucleus into heavy particles by cosmic

¹ Jackson, D. A., and Kuhn, H., *Proc. Roy. Soc. A*, **155**, 372 (1937).

² Millman, S., *Phys. Rev.*, **47**, 739 (1935). Fox, M., and Rabi, F., *Phys. Rev.*, **48**, 745 (1935).

³ Manley, J. H., *Phys. Rev.*, **48**, 921 (1935).

⁴ Torrey, H. G., *Phys. Rev.*, **51**, 501 (1937).

⁵ Jackson, D. A., and Kuhn, H., *NATURE*, **137**, 106 (1936).

⁶ Fisher, R. A., *Phys. Rev.*, **51**, 887 (1937).

⁷ Private communication from Prof. Meisner.

⁸ Blackett, P. M. S., *NATURE*, **146**, 866 (1940).

rays, and the interesting research on the general nuclear photo-effect reported by Bothe and Gentner², suggest to us that a neutron or neutrons may be liberated from a lead nucleus by a cosmic ray photon, presumably accompanying a kind of disintegration into heavy particles (general Chadwick and Goldhaber's effect).

A recent report by Fünfer³ on the existence of slow neutrons in the atmosphere corresponds probably with the existence of the natural kicks in our experiment, which is, however, not sufficiently sensitive to decide the matter.

Institute of Physics,
Kyoto Imperial University,
Kyoto.
June 6.

B. ARAKATSU.
K. KIMURA.
Y. UEMURA.

¹ "Kernphysik" edited by E. Bräucher, p. 108 (H. J. Williams) (Berlin: Julius Springer, 1936).

² Bothe, W., and Gentner, W., *Naturwiss.*, **25**, 90 and 125 (1937).

³ Fünfer, H., *Naturwiss.*, **25**, 235 (1937).

Electron Diffraction Studies of Oxides formed on Iron

THAT iron oxidized at high temperatures forms a scale composed of three layers, namely, ferrous oxide (below 575° C., does not form), magnetic oxide and ferric oxide is generally known. I have examined oxide films formed on a clean surface of iron exposed to air at various pressures and temperatures, using the electron diffraction reflection method, and have been able to ascertain the condition for the formation of these oxides.

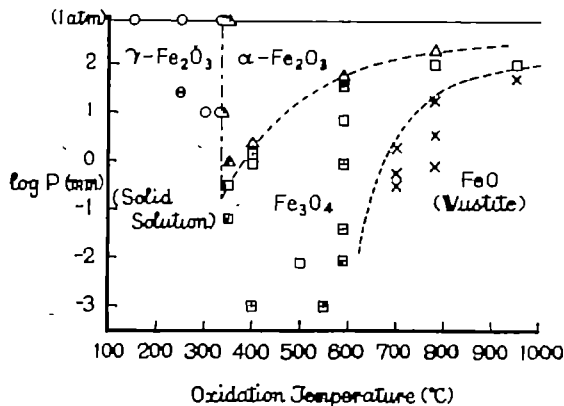


Fig. 1.

The iron specimens, after being etched to remove any polishing effects, were heated to definite temperatures in a highly evacuated tube and then oxidized by introducing air at definite pressures. After an appropriate period of oxidation, the tube was again evacuated as quickly as possible and in the meanwhile cooled in two or three minutes to room temperature. The space lattices of oxides were determined by electron diffraction photographs. The regions where the various oxides are formed are shown in Fig. 1. The duration of exposure has no effect on the resulting oxide except in a few cases.

The facts that lower oxides are formed at higher temperatures under reduced pressures and that prolonged exposure does not elevate the degree of oxidation but is manifested only in the increase of scale thickness are interesting phenomena indeed. These

phenomena lead us to the suggestion that iron atoms migrate more vigorously towards the surface with rising temperature and check any further oxidation of the lower oxides.

Only the oxide of the structure of Fe_3O_4 type is obtainable below 340° C., and considering other parts of the diagram this oxide was concluded to be $\gamma\text{-Fe}_2\text{O}_3$. The invisible films¹ of passive iron and of the iron polished in air and the oxide film² formed in air below 200° C. were recently concluded to be $\gamma\text{-Fe}_2\text{O}_3$. These two cases are included within the $\gamma\text{-Fe}_2\text{O}_3$ region of the diagram.

In other investigations³, the transition point between $\gamma\text{-Fe}_2\text{O}_3$ and $\alpha\text{-Fe}_2\text{O}_3$ was indistinct; but in this work it was ascertained that the point lies almost at 340° C., and in the immediate vicinity of this temperature both oxides are formed in almost amorphous state. The ordinarily impossible transition from $\alpha\text{-Fe}_2\text{O}_3$ to $\gamma\text{-Fe}_2\text{O}_3$ was verified to be possible by maintaining the temperature of this nearly amorphous $\alpha\text{-Fe}_2\text{O}_3$ at 330° C.

Specimens heated at 200° C. and 250° C. for a short while produced an extra ring corresponding to 3.4 Å., besides the diffused $\gamma\text{-Fe}_2\text{O}_3$ pattern, which disappeared on further heating. It is hoped that better identification may be arrived at for this unknown primary oxide from a different angle.

Experimental details and technique will be reported in the *Scientific Papers* of this Institute.

I wish to express my thanks to Dr. I. Iitaka and Mr. S. Miyake for their kind guidance.

TAKESHI IIMORI.
Institute of Physical and Chemical Research,
Tokyo. July 5.

¹ Iitaka, I., Miyake, S., and Iimori, T., *NATURE*, **139**, 156 (1937).

² Milley, H. A., *Iron and Steel Inst., Carnegie Schol. Mem.*, **25**, 200 (1936).

³ Fricks, R., and Zerkow, W., *Z. Elektrochem.*, **43**, 54 (1937). Miyake, S., *Sci. Pap. I.P.C.R.*, **31**, 166 (1937).

β -Decay as due to a Neutrino Shower

ACCORDING to the Fermi theory of β -decay, the β -curve representing the number of electrons with a given energy lying in the interval of the transition energy of the nucleus, is governed by a statistical factor which may, however, be deduced in a simple manner as shown by Uhlenbeck and Goudsmit. Experimental curves indicate the existence of a marked asymmetry about half the transition energy of the nucleus, while the statistical factor in the Fermi theory is practically symmetrical.

If we imagine the final process to consist of a shower of neutrinos (the number in the shower depending on the transition energy of the nucleus), with intermediate stages, the asymmetry can receive a simple explanation. Indeed, following the basic transformation pictured by Fermi and assuming the Jordan formulation that a high-energy electron makes a transition to a lower energy state with the emission of two neutrinos the total energy of which is equal to the transition energy of the electron, we can follow the shower production in a way analogous to Heisenberg's theory. The transformations in the β -decay would be

$$N \rightarrow P + e + n, \quad (\text{Fermi})$$

$$\left. \begin{aligned} e &\rightarrow e^I + n^I + n^{II}, \\ e^I &\rightarrow e^{II} + n^{III} + n^{IV} \end{aligned} \right\} \quad (\text{Jordan})$$

resulting in

$$N \rightarrow P + e^{II} + n + n^I + n^{II} + n^{III} + n^{IV},$$

where N , P , e and $\bar{n}$ stand for neutron, proton, electron and neutrino. The electron e may further undergo a Jordan transformation depending on its energy in the field of the nucleus. The number of electrons with less than half the transition energy of the nucleus would be greater than that of those with energy greater than half the transition energy as there would be the tendency for the higher energy electron to undergo the Jordan transformation, thus resulting in an asymmetrical curve representing the number of electrons with a given energy.

N. S. NAGENDRA NATH.

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July 11.

An Inexpensive Low-Temperature Thermostat

SINCE the low-temperature thermostats on the market involving an electric refrigerator and temperature regulator are very expensive, it is possible that the following easily constructed apparatus (Fig. 1) may prove of value to many research workers. It was designed for the purpose of subjecting small aquatic animals to a constant temperature over a range of 4° – 10° C. Our present apparatus will maintain a constant temperature $\pm 0.1^{\circ}$ C. Working at 5° C. it will consume approximately $\frac{1}{4}$ cwt. of ice in 100 hours.

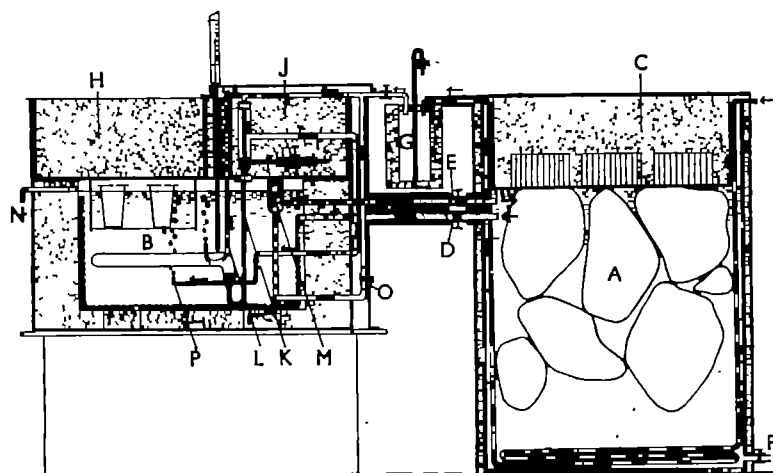


Fig. 1.

It consists of two tanks, A a large reservoir containing ice and water, and a small thermostat bath B , both of which are well insulated with powdered cork. A constant temperature in the bath B is maintained by a controlled circulation of water between it and the ice tank through the insulated tubes D and H . This flow is induced by a stream of air bubbles entering via O and streaming up the tube into the cup M , thus raising the level of the water in the latter and causing a flow via H into the ice tank. This is compensated by a back flow of cold water into the bath through D . The air is first cooled by passage through a coil at the bottom of the ice tank in order to prevent subsequent condensation in the thermo-regulator. Any water condensed in the coil is forced up and retained in the trap G . The air can then pass (1) through O to the circulator already described; (2) via the toluol-mercury gas regulator K to the bubbler P ; or (3) direct to the bubbler L . When the

bath temperature falls lower than that required, the air passage through the regulator is open and the tube diameters and taps are so adjusted that all the air is passing into the bath through the bubbler P , thus keeping the water stirred. When the temperature rises as a result of inevitable heat leakage from the air, the bubbler P is stopped by the rise of the mercury in the regulator and the air passes through the circulator and the bubbler L . The result is that the bath temperature is lowered by inflow of cold water while stirring is still maintained. The well-insulated lid of the thermostat bath is in two halves, one, J , into which are inset the thermometer, thermo-regulator and connexions, and the other, H , which is removable in order to give access to the experimental vessels resting on a wire tray. The lid O of the ice tank is weighted and so arranged that it touches the surface of the water at the required level. This prevents alteration in level due to melting of floating ice; that due to specific gravity changes is not sufficient to affect the apparatus and is readjusted when the ice is renewed. Preparatory to addition of more ice, the tubes D and H must be shut while the water is run off through F . An overflow N from the thermostat bath must be provided.

It is, of course, essential that the insulation should be protected against damp from the air or from possible leakage over the edges of the tanks, and that the tube connexions are thoroughly firm and watertight. There is no doubt that the efficiency and sensitivity of our present apparatus could be increased by improvement of certain details, particularly in insulation and in the form of the thermo-regulator. In the absence of a compressed air supply, we have found a Grafton electric aquarium aerator to be thoroughly satisfactory.

The apparatus could be used as a cold aquarium for larger animals if the bath B were made of glass or porcelain and the water circulated between this and a vessel suspended in A and surrounded by the ice and water. It might also be adapted for use at temperatures below 0° C. if brine were used, cooling

being done by the suspension of a vessel in A containing a block of solid carbon dioxide.

L. C. BEADLE.

F. A. BOOTH.

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Production of Thin Gold Films

IN view of the interest attached to the investigation of the physical properties of thin metallic films, a new and easy method for producing such films of pure gold would seem to have special significance.

Certain organo-gold compounds or their derivatives and, particularly the simplest of such compounds, namely, diethylmonobromogold¹, $[\text{Au}(\text{C}_2\text{H}_5)_2\text{Br}]$, when dissolved in a suitable solvent such as ethanol to which alkali is added, undergo an interesting

decomposition even at the ordinary temperature; the solutions become deeply coloured like those of colloidal gold and in a short time (seven to nine minutes at the ordinary temperatures) gold is deposited as a coherent film.

Brilliant films have been deposited on suitably prepared glass and other surfaces. By reflected light they appear as massive gold and by transmitted light they show the characteristic colours of thin gold films. The films are capable of being polished, but they can be produced in such a manner as to render this unnecessary. The thickness of the films can be varied by altering the conditions of the reaction and the quantities of the reactants.

The necessary starting material being available, the pure gold films are actually more easily produced than those of silver and are much more chemically inert. In spite of their opulent appearance as mirrors, the films of pure gold produced so readily and deposited on glass, etc., may have considerable scientific application.

CHARLES S. GIBSON.

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July 21.

¹ Gibson and co-workers, *J. Chem. Soc.*, 2531 (1930); 2407 (1931); 860 (1934); 1024 (1935); 324 (1936). Gibson, Provisional Patent Specification, 17251/1937.

Spontaneous Electrical Charge of Fine Coal Dust

In the last paragraph of their letter on "Some New Characteristic Properties of Certain Industrial Dusts" in *NATURE* of May 1, Prof. H. V. A. Briscoe and colleagues state: "On several occasions we have found that fine dusts which have become aggregated by settlement or have been for some time exposed to air appear to be much less reactive than when freshly formed. . . ." In this connexion I have obtained interesting evidence which has specific reference to the varying liability of fine dusts to spontaneous electrical charging also dependent upon pre-treatment.

Two samples of the same coal dust were respectively maintained at 80° C. in an oven for 24 hours and 36 hours, the latter being periodically stirred and turned. Representative results of the voltages generated on circulating these dusts were:

	Voltage of generated charge at same capacity	Weight
24-hour sample	344.0	3 gm.
" "	747.5	5 gm.
36-hour sample	270.0	3 gm.
" "	590.0	5 gm.

The ratio of charge generation is approximately 1.25:1 for 24 hour to 36 hour samples.

The residue of the 24-hour sample was then retained in the desiccator at *n.t.p.*, whilst the 36-hour sample residue was further heated in the oven, and the charge divergences were confirmed as follows:

	Voltage of generated charge at same capacity	Weight
Desiccator sample	224.0	3 gm.
Oven sample	64.5	3 gm.

Fresh samples of the same coal dust were then used, and after varying treatments of sub-divided

samples (2 gm. each), were found to generate charge as follows:

Treatment	Voltage of generated charge at same capacity
1. In desiccator overnight	256.9
2. In oven 1 hour	205.4
3. No. 2, after 2½ hours in desiccator	240.8
4. Several days in oven	112.0
5. As No. 4, but turned over many times	87.8

The continuing loss of electrical activity with age of dust is shown.

From 1 and 2, drying with heat produces a lower charge than drying at normal temperature, hence charge variation is probably due to a heating effect, for example, either oxidation or gaseous adsorption on particle surfaces, or both. From 2 and 3, as the regeneration of activity on cooling in desiccator is not likely to be due to reversal of oxidation, it is likely to be due to gas re-adsorbed on cooling in desiccator to replace gas driven off by heating in oven. From 3, 4 and 5, as heating and agitation continue, electrical charge progressively decreases. The decrease, therefore, is probably due to continuing de-adsorption.

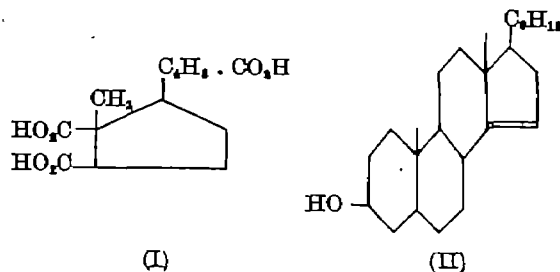
It seems, therefore, that the tendency to spontaneous electrical activity of a coal dust decreases with age of dust and with probable decrease of adsorbed films or molecules on the dust particles, and increases, despite age, with increase of such adsorption.

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June 10.

Stereochemistry of the Sterols and the Bile Acids

ALTHOUGH the stereochemistry of the *A* and *B* rings of the sterols and allied substances has been very fully developed, the evidence for the stereochemical configurations of the other rings rests on less secure grounds. The evidence for the *trans* fusion of the *B* and *C* rings rests solely on the requirements of a flat molecule as adduced from X-ray data, while that for the *trans* fusion of rings *C* and *D* is based on



the isolation of the tricarboxylic acid (I) by the step-wise degradation of 12-ketocholanic acid¹ and desoxycholic acid². This acid on pyrolysis gave an anhydride which on hydrolysis furnished an isomeric tricarboxylic acid. It was, therefore, deduced that the former acid had a *trans* configuration, from which it was assumed that the fusion of rings *C* and *D* was originally in the *trans* position. This conclusion would seem to be sound provided that no inversion occurred in the degradation, a loop-hole which cannot be excluded.

Recent work on the relative stabilities of *cis* and *trans* hydrindane derivatives leads to a different

expectation and, in fact, the result of the catalytic hydrogenation of β -ergosterol (II) strongly suggests that rings *C* and *D* are in *cis* relation. Laucht³ has shown quite conclusively that the double bond in this substance occupies the $C_{14:15}$ position. The original stereochemical configuration of the *C* and *D* rings has, therefore, been destroyed, yet, on catalytic hydrogenation in neutral solution⁴ and even in acetic acid⁵ (a solvent known to favour the formation of a *cis* configuration), β -ergosterol yields the same ergosterol as that obtained by the complete reduction of ergosterol. Ergosterol must, therefore, include a *cis* fusion of the *C* and *D* rings. As ergosterol is known to possess the *allo*-cholanolic configuration, it would appear from this line of evidence that the *C* and *D* rings in the sterols and the bile acids are in *cis* relation also.

This result also supplies confirmatory evidence of the *trans* fusion of rings *B* and *C*, since, in the wandering of the double bond from ring *B* to ring *D*, the former two rings would be expected from known analogies to adopt their more stable configuration. This is further supported by the fact that inversions of 7-keto derivatives analogous to the facile isomerization of dehydrohydroxycholeic acid to 8:6-diketo*allo*-cholanolic acid have never been observed.

D. A. PEAK.

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University, Oxford.
July 8.

¹ Wieland and Dano, *Z. physiol. Chem.*, **218**, 91 (1933).

² Wieland and Schlichling, *Z. physiol. Chem.*, **134**, 276 (1924).

³ Laucht, *Z. physiol. Chem.*, **237**, 236 (1935).

⁴ Betndel and Walter, *Ann.*, **453**, 45 (1927). Hallbrun and Wilkin-son, *J. Chem. Soc.*, 1708 (1933).

⁵ Hart and Emerson, *J. Amer. Chem. Soc.*, **54**, 1073 (1932).

The *Cis*-form of Azobenzene

DURING determinations of the solubility of azobenzene, in which a photometric method of analysis was used, an apparent lack of reproducibility was traced to an increase both in the light absorption of standard solutions and in the concentration of saturated solutions, on exposure to light. The increases reached steady values after several days' exposure in a thermostat tank in a north-lit room. The increase of adsorption was shown to be nearly independent of light intensity, solvent and concentration, but was reached much more rapidly in bright sunlight—a few minutes sufficing for a *M*/2000 solution in a glass bottle. The phenomenon, persisting after repeated recrystallization of the azobenzene, seemed consistent only with a reversible formation of a polymer or isomer, both forward and backward reactions being activated by light and the thermal reaction being very slow at ordinary temperatures.

The second form was found to be distributed between immiscible solvents much more in favour of the more polar one than is ordinary azobenzene and a method of separation based on this property was devised. 5 gm. of azobenzene were dissolved in 250 c.c. of acetone and the solution exposed to sunlight for several hours. The following operations were then carried out in dim light. 350 c.c. of water were added, the mixture cooled, filtered and extracted with 40 c.c. of light petroleum. The azobenzene left in the aqueous layer would have been extremely small if the acetone solution had not been exposed to light. That actually remaining was

extracted by chloroform. The procedure was several times repeated and the chloroform extracts united, dried and evaporated down *in vacuo*. The product was crystallized from light petroleum between 25° and -15° C.

Solutions of successive crystal fractions were made up in acetone. The first few fractions had a constant absorption coefficient for the blue light used (that transmitted through a Kodak 'Wratten No. 47' gelatin filter) and this was 2.17 times that of ordinary azobenzene. On exposure to sunlight, the absorption of these solutions fell to a constant fraction, 0.61, of the original value. That of ordinary azobenzene rises on exposure to 1.32 of the original, the exposed solutions thus having identical absorption. It was assumed that the first crystal fractions were the pure second form. The equilibrium mixture would contain, therefore, about 27 per cent of the second form.

The melting point of the second form is at least one or two degrees higher than that of the normal form (88° C.). Successive determinations on the same sample gave melting points progressively lower at first, passing through a minimum at about 35°, and then rising to 88° C. Some thermal reversion may have occurred before the first determination, and the exact melting point is therefore in doubt. Thermal reversion is undoubtedly quicker in the liquid than the solid state, but some reversion had occurred in crystals that had been exposed to strong sunlight. In a sealed tube, with a mercury manometer attached, in which the azobenzene occupied about 1/10 of the enclosed air space, thermal reversion took place at 100° C. without change of pressure.

The polar character of the second form, which proves almost conclusively that it is the *cis*-isomer, a suggestion first due to Prof. S. Sugden, is indicated by its greater solubility, despite the higher melting point, in polar solvents, and smaller solubility in petroleum. Determinations of the dipole moment in benzene solutions, made by Dr. R. J. W. Le Fèvre, give a value of 3.0 Debye units. The apparent moment of the ordinary *trans*-form increased on exposure of a solution to light from zero to 1.4–1.5 while that of the *cis*-form decreased to the same value. The change indicates that the equilibrium solution contains between 20 and 25 per cent of the *cis*-form, in good agreement with an approximate estimate of 21 per cent by the photometric method, this value, in a c. 1 per cent solution in benzene, being somewhat lower than that, 27 per cent, found in much more dilute solution in acetone.

G. S. HARTLEY.

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Transformation of Hydrate Cellulose into Native Cellulose

If cellulose is precipitated from solution or liberated from its compounds with sodium hydroxide, the space lattice ($a=8.14$ A., $b=10.3$ A., $c=9.14$ A., $\beta=62^\circ$) differs from that of native cellulose ($a=8.35$ A., $b=10.3$ A., $c=7.9$ A., $\beta=84^\circ$). In this form it is known as hydrate cellulose, although it is in fact of the same analytical composition as the native form, and is free from water. Hitherto it has not been possible to convert one modification directly into the other; it was possible to pass from native cellulose via alkali cellulose to hydrate cellulose, and from this

(as Barry, Peterson and King¹ showed recently) by way of the ammonia compound back to native cellulose. Moreover, Hess and Gundermann² have described the appearance of native cellulose along with hydrate cellulose during the washing out of alkali cellulose at 100° C. We find, however, that it is possible to convert hydrate cellulose directly into native cellulose.

When strongly stretched hydrate cellulose in the form of viscose silk 'Lilienfeld silk' is heated for half an hour in water at 200° C., the X-ray diagram shows interferences characteristic of native cellulose as well as those of hydrate cellulose. The same diagram is obtained after treating viscose with boiling formamide (200° C. for half an hour). If the fibres are heated in formamide to 140° C., less native cellulose is formed than at 200° C.; after half an hour in glycerine at 250° C. the hydrate cellulose is converted almost completely into the native form. If the fibres are left for eight days in water at 200° C., very little more native cellulose is formed than after half an hour.

The same experiments were made with hydrate cellulose obtained by the mercerization of ramie. It was found that under the same conditions less native cellulose was formed from this material than from Lilienfeld silk.

Dry viscose heated for twenty minutes in a high vacuum at 200° C. remains unchanged; but after ten minutes at 300° C. a little native cellulose is formed. Water and other dipole-containing liquids appear to increase the rate of transformation very considerably.

Native cellulose (ramie) after heating for five days in water at 150° C. remains unchanged. We conclude that at least over the range of temperature covered by these experiments *native cellulose is the stable form, and hydrate cellulose the non-stable*.

As already indicated, Hess and Gundermann obtained native cellulose by the action of water at 100° C. on alkali cellulose. We have been able to detect native cellulose in preparations which were washed out at 60° C. If decomposition and washing out take place at 20° C. and the preparation is afterwards heated, no native cellulose is formed even at 100° C. On dipping fibres of alkali cellulose into formamide at 140° C. the product obtained is almost entirely native cellulose. In all these cases, therefore, the temperature necessary for the formation of native cellulose is considerably lower than that required for the transformation of hydrate cellulose as such into the native form.

KURT H. MEYER.

Chemistry Department, N. P. BADENHUISSEN, jun.
University,
Geneva.
July 14.

¹ J. Amer. Chem. Soc., 58, 333 (1936).

² Ber. deutsch. chem. Ges., 70, 527 (1937); see also Hess and collaborators in Z. phys. Chem., B, 7, 7 (1930).

Isolation of Ascorbic Acid from Urine

HINSHBERG and Ammon¹ have been unsuccessful in an attempt to isolate ascorbic acid from urine. Recently E. C. Noyons² has described a method for the isolation of ascorbic acid from tomato juice involving chromatographic adsorption, and has announced his intention of applying a similar procedure to the isolation of ascorbic acid from urine.

We have been engaged for a considerable time on this problem and have finally isolated from urine a small amount of a crystalline dinitro-phenyl hydrazine derivative which appears to be that of ascorbic acid. Its melting point (269–271 uncorr.) agrees with that of the similar derivative prepared from pure ascorbic acid (m.p. 270–272) and the crystalline forms appear identical. A mixed m.p. with the dinitro-phenyl hydrazine derivative of the pure vitamin shows no depression (m.p. 271–272). The reliability of the m.p. determinations has been checked by taking a mixed m.p. of the 2:4 dinitro-phenyl hydrazine derivative of ascorbic acid and salicylaldehyde (m.p. 249). A very marked depression was observed, both in this case and in another where a mixed melting point of two different hydrazones with very similar melting points was taken.

This work is being continued, and we hope shortly to be in a position to give a more complete account of this investigation.

C. P. STEWART.

Bio-chemical Laboratory, HAROLD SCARBOROUGH.
Royal Infirmary, P. J. DRUMM.
Edinburgh.
July 21.

¹ Hinshberg, K., and Ammon, R., Biochem. J., 298, 102 (1936).

² Noyons, E. C., Acta. Soc. Neerlandica, 7, 70 (1937).

A Diene Synthesis applicable to the Sterol Group

This method is regarded as the most promising yet adumbrated in that it reduces the problem of the synthesis of cholesterol or its stereoisomerides and analogous substances to the much simpler one of preparing a monocyclic and a bicyclic intermediate. It seems to be especially important that the double bond of cholesterol is placed by this synthetic process in the correct position and that unlike many other diene syntheses the method can be used to introduce the angle-methyl groups.

1-Methyl-2-vinylcyclohexene (I), obtained from the known 2-methylcyclohexenylethyl alcohol by an application of the xanthogenate reaction, condenses with maleic anhydride in benzene solution with the formation of the anhydride (II), m.p. 111.5°. This and the related dibasic acid, m.p. 171°, afforded analytical values tallying with theoretical anticipations.

With crotonaldehyde the diene furnishes an adduct the dinitrophenylhydrazone of which has m.p. 192° and analysis of which agrees with the formula C₁₈H₂₄O₄N₄. The 2:4-dinitrophenylhydrazone of the adduct (III) from the diene and cyclohexanone has m.p. 164° and gives satisfactory figures on analysis.

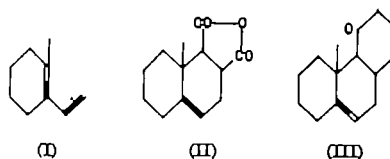


Fig. 1.

The constitutions of the intermediates now required for the synthesis of substances containing the cholane skeleton are obvious on inspection, and attempts to make some of them are in progress.

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July 20.

A. B. MEGGAY.
R. ROBINSON.

Antimicrobial Action of Some Aromatic Compounds

NUMEROUS recent researches have directed our attention to the antimicrobial action of various aromatic amino or nitro compounds containing the following functional groups: sulphamide, $R-SO_2NH_2$; thio, $R-S-R'$; dithio, $R-S-S-R'$; sulphone, $R-SO_2-R'$; thiophenol, $R-SH$; sulphinic acid, $R-SO_2H$. By chemical analogy with the arsenic compounds in which the arsenoxide group shows *in vitro* a very high parasitocidal activity, we have been led to a study of the *para*-substituted aromatic sulphoxides.

Experiments on mice have proved that 4:4'-

diacetylaminodiphenyl sulphoxide (m.p. $292^\circ C$. uncorr.) and also other sulphoxides, symmetrical or asymmetrical, containing the groups OH, NH, or NO, in the *para*-position, administered by mouth, show an extremely high curative activity not only against *Streptococcus*, but also against experimental gonococcal infection.

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ANDRÉ RAY.

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Points from Foregoing Letters

By feeding a dog with oil and with radioactive phosphorus (as sodium phosphate) and then determining the proportion of 'labelled' phosphorus in the lecithin of the blood and of the intestine, Prof. G. Hevesy and E. Lundgaard find that the additional lecithin found in the blood contains only a small amount of the active phosphorus, and conclude that during the absorption of neutral fats lecithin is formed outside the intestinal tract.

Drs. J. R. Edisbury, J. A. Lovern and R. A. Morton state that fish viscera other than liver contain vitamin A, and that halibut viscera constitute a very rich and hitherto neglected source of the vitamin. Evidence is adduced that vitamin A in liver is, at least in part, associated with protein.

From the intensity of the components of the hyperfine structure of the resonance line of potassium, Dr. D. Jackson and H. Kuhn deduce that the magnetic moment of K39 is positive, and that the nuclear spin has a value of $3/2$, in agreement with the findings of Millman, Fox and Rabi. The centre of gravity of the components of K41 overlaps the weaker component of K39.

An increase in the number of kicks in a 'neutron' counter when placed inside a lead chamber leads B. Arakatsu, K. Kimura and Y. Uemura to assume that neutrons are liberated from lead by cosmic ray photons. When the lead chamber is filled with paraffin, a further increase in the number of kicks of the counter is observed.

Investigations of oxide films on iron by means of electron diffraction throws further light on the three oxide layers (composed of ferrous, magnetic and ferric oxide). T. Iimori gives a diagram showing the regions of stability of the various forms of iron oxide and concludes that, with rising temperature, iron atoms migrate more vigorously towards the surface and check any further oxidation of the lower oxides.

N. S. Nagendra Nath states that the asymmetry in the curve showing the energy distribution of the electrons emitted by radioactive substances (β -decay) is explainable on the assumption that the final process consists of a shower of neutrinos, the number in the shower depending on the transition energy of the nucleus.

An inexpensive low-temperature thermostat, useful

also as a cold aquarium, is described by L. C. Beadle and F. A. Booth. A constant temperature is maintained by means of a controlled circulation of water from an ice tank, the flow being induced by a stream of air bubbles in a connecting tube.

Prof. C. S. Gibson directs attention to the production of thin gold films or mirrors on glass and other surfaces by deposition from organic gold compounds such as diethylmonobromogold.

Dr. S. C. Blacktin describes experiments indicating that, with a fine coal dust, its spontaneous electrical activity varies with the treatment to which the dust is submitted, and that such activity seems to increase with the increase of adsorbed material on the particles and to decrease with decrease of such adsorbed material.

D. A. Peak discusses the evidence concerning certain aspects of the structure of sterols and bile acids and suggests that the fusion of the *C* and *D* rings is in the *cis* and not in *trans* position as hitherto believed.

The separation of the *cis* form of azobenzene by extracting an acetone solution exposed to light with water and then further extracting the aqueous solution with chloroform is described by G. S. Hartley. The *cis* and *trans* forms come to equilibrium under usual conditions, the change being activated by light. The *cis* form has a greater absorption coefficient for blue light and its melting point is somewhat higher than that of normal azobenzene. In benzene solution it has a dipole moment of 3.0 Debye units.

By heating strongly stretched hydrated cellulose (viscose silk) for half an hour at $200^\circ C$. in water or in formamide, Prof. K. H. Meyer and N. P. Badenhuizen, jun., find that it is changed into native cellulose, as shown by X-ray diffraction patterns. The authors consider that at 200° – $300^\circ C$. native cellulose is the stable form and hydrate cellulose is the non-stable.

A small amount of a crystalline dinitro-phenyl hydrazine derivative which appears to be that of ascorbic acid has been separated from urine by Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm.

A diene synthesis which may help towards the synthesis of cholesterol and similar substances is described by A. B. Meggy and Prof. R. Robinson.

Research Items

'Woman Marriage' in Dahomey

THE institution of a form of marriage in which one woman takes another to wife has been recorded in Africa among peoples so far distant from one another as in northern and southern Nigeria, the Anglo-Egyptian Sudan and the Union of South Africa. It was observed by Dr. Melville J. Herakovits in Dahomey in 1931 (*Africa*, 10, 3). Dahomean marriages take thirteen different forms, falling into two general classes, in one of which, 'woman-with-money' are comprised all forms in which the marriage dues are paid by the spouse to the bride's father, while in the form 'friend-custody' no such payment is made. A woman may marry another woman, paying the dues and performing all the duties required in the first class; but nevertheless her marriage is spoken of as if it belonged to the second. In the first class of marriage the resultant offspring are under the control of the father; but in the second the mother retains control of her children. Woman marriage is rare among commoners, but frequent in upper-class families, particularly among royalty. It is based on the fact that women frequently become wealthy. They may then wish, especially if barren, to build up a compound of their own. To effect this a wife is married to whom the 'husband' admits a male friend or member of her household, the children who may result being regarded as her own, and competent to inherit the property of the house she has built up on this basis. The marriage does not necessarily imply homosexual relations. The motivating force, the desire for prestige and economic power, reflects the dominant Dahomean patterns of thought and the fundamental forces that underlie their behaviour. No stigma is attached to the parties contracting such marriages, and in fact the woman 'husband' is respected on account of her wealth and the number of persons she controls in her compound.

Prontosil in Puerperal Infections

IN the Section of Obstetrics and Gynaecology of the British Medical Association during its recent meeting in Belfast, Mr. G. F. Gibberd opened a discussion on the use of prontosil and similar compounds in the treatment of puerperal infections caused by haemolytic streptococci. After a preliminary reference to dosage, he compared a series of 167 cases of puerperal infection treated at Queen Charlotte's Hospital with a control series treated in this hospital during the last two years before the introduction of the new drug. The death-rate was much reduced, and the time spent in hospital was much shorter in prontosil-treated cases. Dr. Doris Brown reported on the use of prontosil in the Royal Maternity Hospital, Belfast. For the three years before the introduction of prontosil the death-rate for cases of septicaemia was 87.5 per cent, and the mortality for all cases due to infection by the haemolytic streptococcus was 23.5 per cent. Since the use of the drug the death-rate in cases of septicaemia was 28.57 per cent, and for all cases of puerperal infection 6.6 per cent. Prof. Chaasar Moir referred to the remarkable effect prontosil had in combating *B. coli* infections of the urinary tract.

Factors of Vocational Guidance

IN an article in the *Human Factor* (11, Nos. 7-8), Dr. Oesser discusses the problem of vocational guidance. He believes that while most people acknowledge its importance, few recognize its complexities. He analyses some of the psychological aspects affecting individual cases, and points out the interrelation between these and social and economic factors. He considers the problem for those who leave school at the age of fourteen years. Economic and social factors, he says, limit the individual's sphere of choice. The child of poor parents must earn an immediate living; an individual may have both the ability and the inclination to enter a certain trade, but may be forced by the condition of the labour market into another for which he has the ability but not the inclination; opportunities of employment vary in different neighbourhoods; the social status accompanying each occupation varies; the tradition of the family circle will give arbitrary value to certain kinds of work. The psychological factors fall into two parts: those that determine technical ability, and that depend on physical, temperamental and intellectual endowments; and those that determine personal choice and preference. Physical and intellectual endowments are measurable; but temperamental fitness is more difficult to assess, and together with the factors determining personal choice has its source in unconscious mental processes. Thus the data that are required for adequate vocational guidance range from the more general psycho-biological through social and economic to the deeply individual.

Sexual Periodicity

IN a paper (*Proc. Roy. Soc., B*, 123, 413; 1937) which is really a supplement to the Croonian Lecture given by him in 1936, Dr. F. H. A. Marshall summarizes evidence of the factors controlling the sexual seasons of various animals. Ruminants breed when the days are getting shorter, whether they live in the northern or the southern hemisphere. Individual ruminants which have been transported across the equator have been known to adapt themselves at once, and have two rutting seasons in one year. Ruminants on the equator usually have no sexual season. Most other mammals breed in the spring, and species transferred from the northern to the southern hemisphere conform to the seasonal conditions of the south. The same is generally true of birds. Rowan showed that, in some birds in any event, the lengthening of daylight was the important factor causing the onset of the sexual season. Similar experiments have been done with various other animals, and although it has frequently been found that light increases sexual activity, this is not always so.

Biology of Plankton Animals

MUCH information of interest is given on the biology of three important plankton organisms, *Calanus finmarchicus*, *Sagitta setosa* and *Sagitta elegans*, in the North Sea by R. S. Wimpenny (*Min. Agric. Fish., Fishery Invest., Ser. II*, 15, No. 3, 1936, pp. 1-53, 1937). The seasonal observations have been

based mainly on a line of stations between Flam-borough Head and the south-west patch of the Dogger Bank. Detailed observations were made on the breeding, growth and feeding of the three species, and have afforded a welcome extension to somewhat similar knowledge gained at Plymouth and Millport. All three species tended to be smaller than at Plymouth; this was thought to be connected with the shallow conditions of the southern North Sea, there being, for example, a decrease in size of *S. setosa* in the North Sea from north to south. The breeding periods of *Sagitta* also appeared to be fewer than at Plymouth. It appears that *S. setosa* is characteristic of mixed North Sea or 'Bank' waters, while the other two species occur in water of more oceanic origin. Additional information is given on the relation between zooplankton and phytoplankton, and the suggestion is put forward that phytoplankton concentrations may play the part of breeding and nursery grounds for zooplankton species.

Bacteriosis of Cherry Trees

THE serious damage caused by bacterial 'die-back' of sweet cherries in many English orchards is described in a recent paper by H. Wormald (*J. Pom. and Hort. Sci.*, 16, 1, 35; 1937). The symptoms consist of stem, crotch and branch cankers, shoot wilt, bud and spur blight, leaf spots and occasionally fruit spots. Certain varieties have proved to be commonly attacked, and some varieties seem to suffer less than others. Two organisms, *Pseudomonas prunicola* and *P. mors-prunorum*, have been isolated from a number of infected trees and are regarded as responsible for bacteriosis of sweet cherries in Great Britain. The latter, which also causes bacterial canker in plums, is more widespread. Control is difficult, but infection may be reduced by avoiding mechanical injury, such as pruning, in autumn, winter and early spring. Infected parts may be excised early in the year and the wounds covered with an antiseptic dressing. Mercury-glycerine or zinc chloride is suggested. Some control has been achieved by spraying with Bordeaux mixture in autumn, but several varieties suffer foliage damage with this treatment. There is no evidence that application of lime to the soil induces resistance to bacteriosis. Stocks as well as varieties vary in susceptibility, and it is possible that suitable resistant stocks may be found on which to graft susceptible varieties. Some interesting observations on the susceptibility of different varieties at East Malling are described (*ibid.*, p. 25) by N. H. Grubb, and certain questions of nomenclature and the effect of local conditions are discussed.

Crosses between Radish and Turnip

RECIPROCAL crosses were made between radish ($n = 9$) and turnip ($n = 10$) by Messrs. L. E. Morris and R. H. Richharia (*J. Genet.*, 34, No. 2). With turnip as female parent, 428 flowers yielded 23 seeds, 19 of which germinated. Their characters indicated that they were diploid hybrids. In the reciprocal cross, from particular parent plants 128 flowers yielded 5 seeds. Two of the resulting plants were like radishes (accidental selfs?), one was like the reciprocal hybrids and one was triploid, having $2n = 28$ chromosomes. It probably came from the fertilization of a diploid radish egg-cell. This triploid hybrid open-pollinated gave a varied progeny, including two hexaploids with $2n = 56$ which resembled the triploid but were almost sterile. The

functional eggs of the triploid plant were chiefly triploid, but some had 9 chromosomes and were genetically like the radish. The pollen of this plant also showed a range from 9 probably up to $3n$, but when used on radish the functioning grains had mostly 9 but some had 10 chromosomes. Triploid pollen grains apparently did not function on the radish stigma.

Roaring Sands of the Kalahari Desert

MR. A. D. LEWIS has recently given an interesting account of these sands (*S. African Geog. J.*, 19, 33-49; 1936). They lie at the south end of an elongated patch of whitish sand dunes near the south-east corner of the Kalahari desert, and the roars are heard most intensely along the southern face, which rises nearly 100 ft. at a slope of about 1 in 2. Compared with the rest of the desert sands, the grains are perhaps more rounded and of a more uniform size and shape. Mr. Lewis describes two types of noise, a roar caused by pushing the sands forward in a heaped-up manner and a hum by keeping the sand moving slowly down the slope. A very loud roar is produced by sitting on the slope and sliding down it in slow jerks. In the still of the early evening or morning, such a noise is easily heard, like the rumbling of distant thunder, at a distance of 600 yd. Merely moving the fingers up and down the sand produces a roar, the upward motion giving a higher note than the downward. Samples of the sand were taken in bags to Pretoria, and it was found that a roar was obtained by tilting the bag over sharply when half empty. If the bags were left open, the roar was lost after a few weeks, though it could be restored for a short time by heating the sand in an oven.

Mineral Position of the British Empire

A REMARKABLY comprehensive and instructive publication on the mineral industries of the British Empire has recently been issued under the above title, by the Mineral Resources Department of the Imperial Institute (pp. 166, price 4s.). Commencing with a comparison between world and Empire outputs of all the more important minerals used in 1929 and 1935, the work goes on to survey the many changes bearing on production that have occurred during this period. Graphical illustrations of the variations in annual outputs of twelve essential commodities are given. It appears that the Empire as a whole is largely dependent on foreign sources of supply for eight mineral products only—antimony, borates, molybdenum, petroleum, potash, pyrites, mercury and sulphur. Many interesting facts are brought to light by the authoritative statistical data presented. Thus, in 1935 the Empire produced 86.6 per cent of the world's nickel and 68.2 per cent of the world's asbestos, but both these percentages are considerably lower than in 1929. Also, in spite of a greatly increased output of gold, the Empire proportion fell from 72.7 per cent in 1929 to 58.3 per cent in 1935. There have also been decreases in the Empire percentages of chrome ore, manganese ore and diamonds. On the other hand, there have been decided increases in the Empire percentages of copper and lead ores. The total value of the Empire's mineral output during 1935 was about £400,000,000, of which the United Kingdom contributed nearly 42 per cent, South Africa a little more than 21 per cent and Canada 16 per cent. It is a striking fact that the value of the coal output of the United Kingdom represents about 37 per cent of the total value of the whole of the

Empire output of all minerals. All who are concerned with mineral industries or with Empire problems in relation to world affairs will find this volume indispensable.

Cyclone Series in the Caribbean Sea

At a meeting of the Royal Meteorological Society on May 26, a paper was read by E. Kidson entitled "The Cyclone Series in the Caribbean Sea, October 17-24, 1935". The author mentioned the view held by some who have attempted to apply frontal methods of analysis to tropical cyclones that air which has passed across the equator acts as the cold air. He referred to fronts found by K. R. Ramanathan and K. P. Ramakrishnan in Indian depressions of July and August, in which old monsoon air heated over India performed the role of the warm air-mass and fresh monsoon air the role of the cold air-mass; but stated that in the south-western Pacific the colder air of tropical cyclones undoubtedly came from higher southern latitudes and not from the far side of the equator. The paper is concerned with cyclonic developments encountered by the author on two occasions when he was crossing the Caribbean Sea after passing through the Panama Canal, and is illustrated by a series of synoptic charts with frontal analysis. In these he found more than one case where the warm air-mass clearly arrived from the south or south-west after having crossed the equator, in contradiction to the theory mentioned above, but in support of the observations in the south-west Pacific. It was noted, however, that air entering the Caribbean Sea from the south-west has first to cross the cold waters south of Panama and that such air will tend to be chilled in its lowest layers in consequence. This may easily lead to the warmth of the current as a whole being overlooked and thence to its being mistakenly regarded as the cold supply in any frontal development on account of its relatively low surface temperature.

Cyclol Theory of the Structure of Insulin

UNTIL recently the only comprehensive theory of protein structure was the polypeptide chain theory put forward by Emil Fischer. This is somewhat difficult to reconcile with the globular character of the soluble protein molecules first indicated by Svedberg's ultra-centrifuge measurements and later also supported by X-ray measurements on pepsin and insulin, and it is evidently of the greatest importance that other theoretically possible arrangements of amino-acids should be considered. One such has been examined in detail by Dr. D. M. Wrinn, who has shown that it might be possible to unite amino-acid residues through imino links in a laminar pattern—the cyclol structure. This laminar structure may then be folded into a restricted number of geometrically plausible space enclosing networks. For insulin, Dr. Wrinn proposes a cyclol structure built out of 288 residues united in a network of this kind which covers the surface of a truncated tetrahedron (*Science*, 85, 566; 1937). This polyhedral configuration would give the molecule the globular character required by Svedberg's data, and also the trigonal symmetry suggested by the X-ray evidence, provided that the actual amino-acid residues are symmetrically distributed over its surface. Along the trigonal axis the dimensions of the cyclol molecule would fit it fairly closely into the crystal unit cell, but at right angles to this there is very much more space, and it is suggested that this is filled by tyrosine residues held together by zinc or

other cations. Very much more experimental evidence is, of course, necessary before such a structure could be considered established, but in any event the construction of the models proposed is of great interest.

Projection Television

At a convention of the Institute of Radio Engineers held on May 10-12, several papers were presented dealing with recent developments in television. Two of these, by Dr. V. K. Zworykin, Mr. W. H. Painter and Dr. R. R. Law, described the development of a new electron tube by means of which an enlarged, projected image may be obtained of the picture normally seen on the fluorescent screen of a cathode ray tube. Some brief details, with an illustration of the device, are given in the June issue of *Electronics*. The tube illustrated contains an electron gun capable of delivering about 1.5 milliamperes at the cathode, of which about 0.4 milliamperes is actually delivered to the beam itself. The beam is accelerated by a potential of 10,000 volts on the last anode, and the resulting picture on the fluorescent screen itself, although only 2 in. $\times$ 1½ in. in size, is of exceptionally high brilliance. The tube is intended for use with a lens of $f/1.5$ aperture, and the standard size for the projected picture is 18 in. by 24 in., for which the illumination compares favourably with that of the ordinary 16 mm. home cinema picture. The screen material used in this tube is principally zinc orthosilicate of carefully controlled crystalline structure, which gives a brilliant yellow-green light and which is very stable under prolonged heavy bombardment. At the meeting referred to above, a demonstration of the operation of this projection tube was given by the engineers of the Radio Corporation of America. A video signal was obtained from a still picture using 30 frames a second and 343 lines without interlacing. A special screen, about three by four feet in size, was employed, and the picture obtained was of high brilliance and quality. As an additional demonstration, the small screen was removed and the image projected on to the standard screen used for lantern slides. In this case, the picture was 8 ft. $\times$ 11 ft. in size and was stated to be readily visible to all those present in the room, which was about fifty feet long.

Masses and Parallaxes of Binary Stars

DR. O. BARNES has published a paper on the statistical determination of masses and parallaxes of binary stars (*Mon. Not. Roy. Astro. Soc.*, 97, 6; April 1937), in which he submits the mean values of $\rho\omega^3$ and $(\rho\omega^3)^{1/2}$ for orbits of given eccentricity, these quantities appearing in the equations used for determining the combined mass and the parallax respectively. In addition, he gives the mean values for $(\rho\omega^3)^{1/3}$ and $(\rho\omega^3)^{1/4}$ which are required for the estimation of the probable errors. From 124 orbits as computed by Prof. R. K. Young, it is found that with the mean value of e between 0 and 1, $\bar{\epsilon}^2 = 0.322$ and $\bar{\epsilon}^4 = 0.14$; from which $\rho\omega^3 = 16.9(a^3/P^3)$ and also $(\rho\omega^3)^{1/2} = 2.38(a^3/P^3)^{1/2}$. In the first case, the probable error in a single determination is 49 per cent, and in the second case it is 21 per cent. If a somewhat different mean value of e be taken, the numerical results are essentially unchanged. For example, if $\bar{\epsilon}^2 = 0.263$, $\bar{\epsilon}^4 = 0.11$, the coefficients given in the above equations become 17.3 and 2.42 respectively, very small changes for a considerable change in e .

Royal Society of Canada

ANNUAL MEETING AT TORONTO

THE annual meeting of the Royal Society of Canada was held at the University of Toronto on May 25-28, under the presidency of Mr. Lawrence J. Burpee of Ottawa, who took as the subject of his presidential address "The Discovery of Canada". The Flavelle Medal for 1937 was awarded to Dr. F. D. Adams, the Lorne Pierce Medal to Prof. Stephen Leacock, and the Tyrrell Medal to Mr. Aegidius Fauteux. Prof. A. G. Huntman, consulting director of the Biological Board of Canada and editor of its publications, and professor of marine biology in the University of Toronto, was elected president for the year 1937-38.

In Section 1 (French, Literature, History, etc.) fifteen papers were read, and in Section 2 (English Literature, History, etc.) twenty-one papers.

In Section 3 (Chemical, Mathematical and Physical Sciences) 142 papers were presented, 47 by title only. One third were presented to the whole Section, the remainder to four subsections (Astronomy, Chemistry, Mathematics, Physics). Three new fellows were elected to the Section: Prof. A. R. Gordon, of the University of Toronto; R. L. Jeffery, of Acadia University, and W. H. Watson, of McGill University.

The feature of the meetings of Section 3 was its presidential address by John Patterson, director of the Meteorological Service of Canada, in which he outlined recent advances made in this service. The necessity of a continuous forecasting service for the recent expansion in aviation has given a new impetus to research, has led to increase in the number of observation centres, and has increased the personnel. The address was followed by a symposium by A. Thomson and various members of the meteorological staff, in which the results of temperature, water vapour content, and pressure distribution in the upper atmosphere at various Canadian stations were given. Observations at the National Research Laboratory, communicated by D. C. Rose, showed that the advance of polar front is the cause of variations in potential gradient.

Prof. L. Gilchrist presented a paper on resistivity measurements at the Chickamauga Dam site, Tennessee, where underground caverns were located by the proper use of 'Megger' instruments. A survey of methods used to determine overburden above magnetic deposits by magnetic methods with field examples was given by Prof. D. A. Keys. Dr. W. H. Martin dealt with the Raman spectra of some oximes, and pointed out the shift of one Raman line due to addition of hydrochloric acid to certain amines and to mercuric chloride in solution. Prof. J. A. Gray gave the results of the scattering of X-rays at small angles by charcoal, and presented further evidence that some β -rays lose energy when scattered through large angles by nuclei.

The Rev. A. Vachon presented an interesting account of the salinity of the water at different points in the estuary of the St. Lawrence River; from these measurements, arctic currents can be traced, especially along the north shore, and also the course of the water from the Saguenay after it enters the St. Lawrence. Prof. E. H. Boomer, speaking on

phase equilibria in hydrocarbon systems, showed that the behaviour of the systems relative to one another can be predicted qualitatively from the chemical and physical properties of the liquid hydrocarbons used. Results of experiments by Prof. C. C. Coffin on the effect of molecular structure on the rate of unimolecular gas reactions show that the replacement of hydrogen by chlorine atoms produces a slight decrease in rate, while introduction of a double bond gives a fourfold increase. Prof. W. Lash Miller presented a group of papers on Wilders' bios and yeasts. Of fourteen papers presented by Prof. O. Maass and his students, one on the measurement of the specific heat of propylene in the critical pressure - critical temperature region contained an account of a new type of adiabatic calorimeter, and it was shown that the liquid state of aggregation persists above the critical temperature. Prof. H. Hibbert (with F. B. Pickett and G. F. Wright) reported on the relative acidity of carbohydrate hydroxyl groups; they find that the hydroxyl group attached to the C_4 atom in glucose is more acid than those attached to the C_1 , C_2 and C_3 atoms.

Prof. W. H. Watson presented a paper on the electron and the limits to the precision of electromagnetic field specifications, in which the uncertainty relations of the electromagnetic field are applied to determine the corresponding uncertainties in the motion of an electron in the field. Prof. J. L. Synge presented several papers by his associates, of which one on the problems of the beam and the plate in the theory of elasticity, by J. N. Goodier, was of particular interest, as it proved that the engineering theories of beams and plates are good to a high order of approximation under the conditions of use. Prof. A. F. Stevenson gave a paper on a generalization of Oseen's equations for steady flow past a fixed obstacle, with application to the sphere, and Prof. R. L. Jeffery another on sequence integration and non-absolutely convergent integrals for functions of two or more variables. A paper by Prof. W. L. G. Williams and M. S. MacPhail on functions of the complex variable $z = x + jy$, where $j^2 = -1$, was of particular interest, and mention may also be made of a paper by Prof. S. Beatty and D. C. Murdoch on routine for determining the numbers e, m associated with a cycle $f = \alpha(p)$ of an algebraic equation $F = 0$.

Prof. H. A. McTaggart demonstrated the ellipticity of the light reflected at the surface of films of oriented molecules. Prof. A. L. Clark gave the result of the experimental determination of the probability of a steel ball falling through one of a number of holes in a plate. Prof. E. F. Burton presented a number of papers describing work done in the McLennan laboratories. The specific heat of tributyrin at low temperatures has been measured by J. O. Wilhelm and A. H. Woodcock, who find that it varies from 0.4 cal./gm. at room temperature to 0.012 at 16° K. H. E. Johns and J. O. Wilhelm have determined the refractive indices for λ 5461 Å. of liquid oxygen (1.2242), liquid nitrogen (1.1990) and liquid hydrogen (1.1120). J. M. Anderson has determined the half

lives of several lines in the spectrum of argon II by a modified canal-ray method; all so far measured have a half life of less than 10^{-8} second.

In the Geological Section (4) eighteen papers were presented. Three new fellows were elected: Dr. G. W. H. Norman, of the Geological Survey of Canada; Prof. F. F. Osborne, of McGill University, and Dr. J. F. Walker, provincial mineralogist of British Columbia. Among the interesting papers presented the following may be mentioned.

Prof. G. H. Handerson (of Section 3) described two new types of pleochroic haloes in biotite, and showed that they are invariably associated with minute fissures through the mineral. He indicated that they originated from certain members of the radium family of very short life-period, and suggested that precipitation of minute grains of radium-bearing minerals from the fissure-filling solutions probably accounts for the localization of the haloes.

The last paper of the late Dr. W. H. Collins, formerly director of the Geological Survey of Canada, was presented by H. C. Horwood, who had assisted him with much of his field work. Results of several years of detailed study of the Sudbury district strongly confirm the original conclusions of Dr. A. P. Coleman as to the magmatic origin of the ores, and indicate that secondary processes play a relatively minor part in ore deposition. Dr. Coleman, now eighty-five years of age, was present at the meeting to hear this vindication of his conclusions.

H. C. Cooke presented new data on the age of the Dore series of Michipicoten district, Ontario, based on determinations of the structure of the Keewatin lavas, and concluded that the Dore series is probably of Temiskaming age, and is not interbanded with the Keewatin as previously supposed. W. C. Gussow presented the results of his work during tenure of one of the Carnegie fellowships administered by the Society. These indicate that the gold deposits of the Rouyn area, Quebec, are not primarily related to the granitic stocks, but were deposited from soda-bearing solutions introduced along fissures at some later date. The solutions albited the intrusives and caused profound petrographic changes in them.

In Section 5 (Biological Sciences) sixty papers were presented, in part before the whole section, and in part to two subsections (Zoology and Botany, and the Medical Sciences). Profs. D. L. Bailey and G. F. Marrian of the University of Toronto and Dr. J. H. McDunnough, of the Division of Systematic Entomology of the Dominion Department of Agriculture, were elected fellows of the Section.

Prof. E. M. Walker gave the sectional presidential address on "*Grylloblatta*, a Living Fossil", and showed a very interesting cinematograph film of this prehistoric beetle from the Canadian Rockies, proving, *inter alia*, that the heat of the hand rapidly causes its complete prostration, while contact with ice leads to slow recovery. Prof. A. G. Huntsman traced the cause of the scarcity of salmon which occurs periodically in the Atlantic provinces every nine or ten years, as due to a succession of dry summers (also occurring periodically) which result in such lowering of the water of salmon streams that the young salmon parr are clearly exposed to kingfishers and mergansers, which take an unusually large toll. He also communicated an account of W. H. Johnson's study of the effect of light on the marine copepod *Acartia clausi*, which shows that movement is brought about by changes in intensity

of light (upwards with diminution, downwards with increase of intensity), rather than by the degree of intensity itself; under static light conditions, the animals gradually become uniformly distributed.

Dr. J. W. MacArthur reported from his studies of finger and palm prints that left and right hands are as different in identical as in fraternal twins while hands of the same side are quite similar in identical twins, but show large and increasing differences in the series: fraternal or sib pairs parents and children, and unrelated persons. By such comparisons, the twin type can be correctly diagnosed in about half the pairs from their own prints alone, and in nearly all when prints of their parents and sibs are also available.

Prof. G. W. Searth presented a paper by D. Siminovitch showing that the cells of plant tissues frozen internally with intra-cellular ice formation always die, while those dehydrated by external (inter-cellular) ice will survive, even after extreme dehydration of the protoplasm. Prof. Marie-Victorin and the Rev. J. Rousseau gave a paper extending the former's theory of the development of the flora of the St. Lawrence valley. R. B. Thomson described comparative studies of the 'inverted' bundles of male and female cone scales in a series of conifers, confirming the view that these are homologous structures which during growth come to assume different positions in association with the function of the scales as sex organs. Prof. W. P. Thompson presented several papers by himself and co-workers dealing with genetic problems in wheat and other cereals. Prof. A. H. R. Buller reviewed the life-history of the wheat rust, and reported new discoveries concerning the fusion in pustules on the barberry leaf of pycnia with a hypha of opposite sign.

Prof. J. W. MacArthur presented a paper by C. K. Gunn giving an account of a strain of rats which has, as a monofactorial autosomal recessive mutant character, acholuric jaundice resembling that in man in its chief clinical and genetic features. A paper by A. E. Allin (presented by Prof. D. T. Fraser) showed that, in general, skin sensitivity to diphtheria toxoid develops within three weeks during an attack of diphtheria in those who are initially non-sensitive, and increases at this time in those initially sensitive in some degree.

Prof. G. F. Marrian (with G. C. Butler) showed that an ether-soluble fraction from two women with adrenal tumours contained unusual amounts of pregnandiol, and also a triol, $C_{21}H_{36}O_3$, melting at $243-244^\circ$ C. R. G. Sinclair adduced evidence that the red blood cells of the dog and the cat do not take part in fatty acid transport. E. G. Young gave an interesting account of prolonged study of purine metabolism in the Dalmatian coach hound from early age to adolescence.

Prof. C. C. MacKlin described the detailed histology of the pulmonary alveolar walls of the adult cat, illustrating his paper by beautiful slides from photomicrographs, and stressed the presence of many 'bare areas' devoid of nuclei.

Prof. F. G. Banting presented a number of papers from workers in the Banting Institute of the University of Toronto. W. R. Franks and H. J. Creech have succeeded in forming chemo-antigens by coupling 1:2:5:6-dibenzanthracene and similar compounds to proteins, and injecting the products into rabbits, guinea pigs, and rats; formation of haptene specific antisera was demonstrated by precipitin reactions and by specific inhibition with

the prosthetic substances. H. F. Richardson showed that death from intra-venous air embolism in dogs depends on the rate of injection; at very slow rates surprisingly large amounts of air can be injected before death ensues (through failure of the pulmonary circulation). B. C. Coles showed that the type of oath in cases of criminal abortion, commonly ascribed to small amounts of air found in the heart post-mortem, may be due rather to lethal amounts

of toxic substances (such as potassium soaps) in the douche solution having entered the blood stream from the uterine cavity. According to D. Irwin, the tissue response to different samples of quartz is practically identical. W. R. Franks, L. D. Proctor and A. Duncan described a photo-electric dust estimator, designed to measure accurately and rapidly dust retainable by the lungs and therefore to estimate the dust hazard.

Recent Aeronautical Research

THE report of the Aeronautical Research Committee, issued recently*, deals with a period of nearly two years, from April 1935 until December 1936. This is to cover a change of procedure, future reports being issued for the calendar year. The report opens with a well-merited tribute to the memory of Sir Richard Glazebrook and Sir Joseph Stetavel, who died during the period under review. They were both original members of the Advisory Committee for Aeronautics, appointed in 1909, and all who have had any connexion with aeronautics will appreciate how much the development of the science owes to them.

The outstanding feature of the period under review has been the increase in, and the still further demands for, high performance of aircraft. The major part of the Committee's activities are obviously directed towards this object. It is emphasized that the more recent equipment at the National Physical Laboratory and the Royal Aircraft Establishment, although elaborate and expensive, have made possible advances in the fundamentals of aircraft aerodynamical design to an extent that could never have been accomplished by the trial-and-error methods of full-scale experimental flight alone. The compressed air tunnel and the one-foot high-speed tunnel at the former, and the 24-ft. wind tunnel at the latter, are cases in point.

The 24-ft. tunnel at the R.A.E. has been used principally for the investigation of engine-cooling problems. At high translational speeds, theory shows that it should be possible to provide enough cooling without adding at all to the drag of the complete aeroplane, and this prediction has been supported by experimental results. As the induced drag at high speeds is very small, it follows that a well-designed aircraft travelling at high speed need have a drag very little higher than that due to the friction between its exposed surfaces and the air.

Aeroplane speeds are now almost approaching the range in which compressibility becomes important, and the Committee, by undertaking research on compressibility effects, is taking steps to have information available by the time it is required. The apparatus used for this work is a one-foot high-speed tunnel, run from the exhaust of the compressed air tunnel. Tests on thick aerofoils have been done, and suggest that it may be necessary to take account of compressibility drag when speeds of flight exceed four hundred miles per hour.

Much of the time of the compressed air tunnel has

been devoted to investigations of surface friction. At the Reynolds numbers of flight a surface roughness corresponding to excrescences of the order of one-thousandth of an inch in height may be enough to increase the friction substantially. This measure of roughness is inappreciable at Reynolds numbers corresponding to those in ordinary atmospheric tunnels, so that although roughness may produce a difference in the behaviour of an actual aeroplane, the cause was not appreciated until this problem had been worked out.

Drag measurements have also been made in flight by means of a comb of small pitot tubes which determine the difference in relative velocity between the air in the wake of the wing and the free air. It can also be applied in the compressed air tunnel, which will enable profile drag to be determined at Reynolds numbers of the order of those reached by fast modern aeroplanes.

Another problem has been to determine where on aeroplane wings the change from laminar to turbulent flow in the boundary layer takes place. As the drag associated with the turbulent boundary layer is considerably greater than that of the laminar layer, it is important to keep the transition point on the wing as far back as possible. It is suspected that protuberances in the surface of a wing near its leading edge may promote an early transition point and so increase the drag.

Modern high-speed machines have introduced other problems, particularly of stability. For example, directional stability is often unexpectedly good, although longitudinal stability is not so satisfactory. Further, increasing speed inevitably implies higher wing loading and thus introduces landing problems. The properties of flaps and other aids to stability, particularly when landing and taking off, have been studied, and work on gusts in the atmosphere is continuing.

Structural problems following upon the recent development of 'stressed skin' bodies and wings have shown that stabilizing members for flat, or slightly curved, sides of bodies need to be carefully studied for optimum efficiency. Tubular members are stronger for a given amount of material, but their use presents practical difficulties.

In aero-engine work, attention has been paid to the development of bi-fuel systems, which at the moment appear to be necessary with the use of 100 octane fuel. Direct fuel injection, supercharging, high boiling point liquids for cooling, spark ignition, and the compression ignition engine have been subjected to investigation in various details, but nothing revolutionary is proposed.

* Aeronautical Research Committee. Report for the years 1935-36. p. 60+7 plates. (London: H.M. Stationery Office.) 4s. net.

The question of the size of sea-going aircraft has been studied in a general way, and the Committee expresses the opinion that no new scientific problem seems probable with flying boats of up to a hundred tons in weight.

The technical supplement to the report is sub-

divided into sections dealing with: aerodynamics, fluid motion, stability and control, oscillation, spinning structures, elasticity and fatigue, alloys, engines, aircraft noise, seaplanes, meteorology, accidents, administration including (a) list of publications and (b) membership of sub-committees and panels.

"Discovery" Investigations*

DURING the years 1935 and 1936 three volumes have been published containing reports on material collected by the "Discovery" expeditions, on many subjects by various workers. Vol. 11 is devoted entirely to plankton, and forms an introduction to the study of the plankton of the Antarctic, embodying as it does, a detailed discussion of methods and their value, besides extensive accounts of the distribution and migrations of plant and animal plankton, pre-eminently important for the understanding of the natural history of the Blue, Fin, Sei and Humpback whales. It is noteworthy that the first instance of vertical migration of phytoplankton is here shown in certain species of *Oscinodiscus* which ascend during the daytime, the reverse of the usual animal migration. It is constantly seen in the "Discovery" reports that *Euphausia superba* appears to be a key animal with regard to the distribution of Antarctic plankton, forming directly the food of the Blue and the Fin whales, and indirectly influencing the plankton in a variety of ways. A consideration of the relationship between the distribution of the whales and that of the plankton, and between the zooplankton and the phytoplankton, has led to the recognition of certain general principles of pelagic ecology.

The remarkable patchiness in distribution of many of the plankton animals is emphasized, and Prof. Hardy's hypothesis of animal exclusion, showing that the more important plankton animals avoid the areas of dense phytoplankton, is dwelt upon at length. In this connexion, the phosphate values are shown to be of extreme importance, and relative reduction in phosphate content appears to be a better index in studying the zooplankton relationship than the phytoplankton itself, giving a measurement of phytoplankton over a little time in the past. The appearance of exclusion from regions of low phosphate (high phytoplankton) applies to animals belonging to widely different groups, and it is considered that if the distribution of the animals is being modified by the phytoplankton, this modification must be brought

about by variations in the vertical migration in conjunction with differing water movements at different levels. All the animals which show the exclusion effects have marked vertical migrations. This first report is intended to form an introduction to pelagic ecology of the Antarctic seas. The plankton community is considered in relation to its hydrological background, and to the distribution of the Blue and Fin whales which feed upon the plankton and form the object of such an important fishery in these seas.

The second plankton report deals with the continuous plankton recorder invented by Prof. Hardy. This has now been much improved, and a full account is given of its construction, method of working and the advantages and limitations of the results obtained in its use. The third paper deals with observations on the uneven distribution of oceanic plankton, and describes records of plankton taken in the open ocean during the voyages of the R.R.S. *Discovery* and R.R.S. *William Scoresby* in the years 1925-27, with the original form of continuous plankton recorder. They were made with the view of studying the main fluctuations in the planktonic density along uninterrupted lines of observation. These lines varied from 23 miles to more than 100 miles in length, and were made in different oceanic regions from the tropical to the antarctic zone. The records demonstrate marked fluctuations in the distribution of the main planktonic groups of animals, no less marked in the tropics than in the antarctic zone. The existence of a rhythm in the distributional fluctuations is tentatively suggested, a rhythm which varies on different occasions.

Vol. 12 embodies a variety of subjects, the first being the coast fishes from the South Atlantic by J. R. Norman. The term 'coast fishes' includes not only the littoral forms, but also fishes that may occur at no great distance from the coasts in water down to two or three hundred fathoms deep, and that are not pelagic or bathypelagic. C. C. A. Munro continues his description of the polychaete worms (2), Dr. Th. Mortensen reports on the Echinoidea and Ophiuroidea, R. A. B. Ardley on the birds of the South Orkney Islands and Dr. R. Gurney begins his study of the decapod larvae (Stenopidea, Amphionidea and Phyllosoma).

In Vol. 13 A. Earland continues the Foraminifera (4), R. A. B. Ardley describes the R.R.S. *Discovery II*, its construction and design, accommodation for research, scientific equipment and laboratory methods, E. R. Gunther writes on oceanographical investigations in the Peru coastal current, and Dr. F. D. Ommanney contributes an extensive paper on the copepod *Rhincalanus gigas* (Brady) which is very important in Antarctic waters and is reported on fully in every aspect as a representative plankton animal in these regions.

* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 11. The Plankton of the South Georgia Whaling Grounds and Adjacent Waters, 1935-1937. By A. O. Hardy and H. B. Gunther. Pp. iv+456. 50s. net. The Continuous Plankton Recorder. By A. O. Hardy. Pp. 457-510+4 plates. 9s. net. Observations on the Uneven Distribution of Oceanic Plankton. By A. O. Hardy. Pp. 511-538. 4s. net. Vol. 12. Coast Fishes, Part I: The South Atlantic. By J. R. Norman. Pp. 58. 5s. net. Polychaete Worms, II. By C. C. A. Munro. Pp. 59-108. 18s. net. Echinoidea and Ophiuroidea. By Th. Mortensen. Pp. 109-348+9 plates. 37s. 6d. net. The Birds of the South Orkney Islands. By R. A. B. Ardley. Pp. 349-376+plates 10-12. 6s. net. Larvae of Decapod Crustacea. By Dr. Robert Gurney. Pp. 377-440. 9s. net. Vol. 13. Foraminifera, Part 4: Additional Records from the Weddell Sea Sector from Material obtained by the B.Y. Scotia. By Arthur Earland. Pp. 76+8 plates. 12s. net. The Royal Research Ship *Discovery II*. By R. A. B. Ardley and Dr. N. A. MacIntosh. Pp. 77-106+plates 3-13. 6s. net. A Report on Oceanographical Investigations in the Peru Coastal Current. By E. R. Gunther. Pp. 107-376+plates 14-16. 20s. net. *Rhincalanus gigas* (Brady), a Copepod of the Southern Macropod. By Dr. F. D. Ommanney. Pp. 377-384. 15s. net. (Cambridge: At the University Press, 1935-1936.)

Science News a Century Ago

A Pigmy Cemetery

THE issue of the *Gentleman's Magazine* of August 1837 contains the following information: "A short distance from Cochocton, Ohio, U.S., a singular ancient burying-ground has lately been discovered. It is situated, says a writer in *Silliman's Journal*, on one of those elevated, gravelly alluvions, so common on the rivers of the West. From some remains of wood, still apparent in the earth around the bones, the bodies seem all to have been deposited in coffins; and what is still more curious, is the fact that the bodies buried here were generally not more than from three to four and a half feet in length. They are very numerous, and must have been tenants of a considerable city, or their numbers could not have been so great. A large number of graves have been opened, the inmates of which are all of this pigmy race. No metallic articles or utensils have yet been found to throw light on the period or the nation to which they belonged."

Monument to Gutenberg

THREE hundred and sixty-nine years after his death, a large statue in bronze of Gutenberg, the inventor of printing from movable type, was unveiled at his birthplace, Mainz, the inaugural proceedings extending over the three days, August 14-16, 1837. The statue was by the Danish sculptor Thorwaldsen, and it bears the inscription "Joannem Gensfleisch de Gutenberg Patricium Moguntinum, ere per totam Europam collato posuerunt cives 1837".

Hare and the Oxy-hydrogen Blow-pipe

ON August 14, 1837, Prof. Robert Hare (1781-1858) wrote from Philadelphia to Dalton, saying: "I beg leave, through you, to communicate to the British Association for the Advancement of Science, the fact that by an improvement in the method of constructing and supplying the hydro-oxygen blow-pipe, originally contrived by me in 1801, I have succeeded in fusing into a malleable mass, more than three-fourths of a pound of platina. In all, I fused more than two pounds fourteen ounces into four masses averaging, of course, nearly the weight above-mentioned." After further notes on the application of the blow-pipe, he said: "I need not say how much I regret that the Atlantic rolls now between myself and those respected and esteemed brethren in science, whom, this time last year, I had the honour and pleasure to meet and to greet at Bristol, and to whom I shall ever be grateful for their kind reception. How much would it gratify me, could I exhibit to them, and their enlightened visitors, that splendid concentration of heat and light which I have lately employed, by which a metal infusible in the air-furnace or forge is made as fluid as mercury, so as to be blown off in globules."

Gossage and the Alkali Industry

ON August 17, 1837, William Gossage secured a patent for "certain improvements in the processes of operation connected with the manufacture of alkalis from common salt"; a patent which anticipated the later and successful processes of Weldon, Mond and Chance for the recovery of manganese and sulphur. Gossage, who was born in 1799, had begun

life in a chemist's shop at the age of twelve years; but by 1830 was a partner in a salt and alkali works at Stoke Prior, Worcestershire, and it was there that in 1836 he invented the 'Gossage' condensing tower for preventing the escape of hydrochloric acid gas, a "simple contrivance which saved from extinction a trade, the growth of which has contributed largely to the nation's prosperity". From Stoke Prior Gossage removed to Birmingham, establishing there a white lead works, and then to South Wales, where he engaged in copper smelting. In 1850 he settled at Widnes and became the largest soap manufacturer in the country. In 1861 he contributed a paper on "The History of Alkali Manufacture" to the Manchester meeting of the British Association. He died at Bowden, Cheshire, on April 9, 1877 (see "Some Founders of the Chemical Industry" by J. F. Allen).

The Magazine of Zoology and Botany

THE *Athenaeum* in its issue of August 19, 1837, referring to the above journal, which was conducted by Sir William Jardine (1800-1874), P. J. Selby (1788-1867) and Dr. G. Johnson, said: "To the naturalist this periodical affords a most valuable repository of the current facts and opinions of writers upon all points relating to zoology and botany; and it quite answers to our notion of what such a production should be, if it be of great general utility. There are excellent original papers by Swainson, Henslow, Westwood and other men of high scientific reputation, independently of the authors whose names stand upon the title page; there is a brief and very honest indication of the most interesting matters treated of in other periodical works on natural history, well brought down to the period of publication; and to these are added well-written sensible critiques on many of the more important works upon this branch of knowledge. Moreover, and this is not to be overlooked—the botanical department is conducted with reference to modern views and with a commendable disregard of prejudices."

University Events

CAMBRIDGE.—Dr. J. H. Schulman, of Trinity Hall, has been appointed assistant director of research in colloid science.

D. J. Bauer, of Trinity College, has been elected to the Michael Foster studentship in physiology; the E. G. Fearnside scholarship is awarded to A. M. Barry, of Pembroke College; the Wrenbury scholarship is awarded to P. T. Bauer, of Gonville and Caius College; the John Winbolt prize is awarded to D. W. Ginns, of Emmanuel College, for a dissertation on "The Mechanical Properties of some Metals and Alloys broken at Ultra High Speeds".

G. H. A. Wilson, master of Clare College, vice-chancellor of the University, has been appointed, in succession to the late Sir E. C. Hoskyns, to represent the University on Sept. 27-28 at the four-hundredth anniversary of the foundation of St. Mary's College in the University of St. Andrews. Dr. F. W. Aston and Dr. J. D. Cockcroft have been appointed to represent the University in Bologna on October 18 at the celebration of the bicentenary of the birth of Galvani. Prof. R. G. W. Norrish and Dr. J. D. Cockcroft have been appointed delegates from the University to a congress to be held at the Palais de la Découverte, Paris, on September 30-October 7.

Societies and Academies

Dublin

Royal Irish Academy, June 14

JOSEPH ALGAR and ISABELLA P. CARRY: The synthesis of flavonols: oxidation of flavindogenides. The oxidation in acetone solution of the flavindogenide 3-benzylidene flavanone by means of acidified potassium permanganate appears to give 3-hydroxy-3-benzoyl flavanone (I). The latter forms a monoxine and a monoacetate. Gentle hydrolysis of (I) gives flavonol and benzoic acid. Products similar in constitution to (I) are obtained by the oxidation of the following flavindogenides: 3-anisylidene flavanone; 3-piperonylidene flavanone; 3-benzylidene-3',4'-methylenedioxy flavanone.

H. S. W. MASSEY: Creation of electron pairs by nuclear capture of neutrons. The probability of creation of electron pairs by the materialization of the energy freed in the capture of a neutron by a nucleus is calculated by a method not involving explicit introduction of light quanta.

C. B. MORRAT: The mammals of Ireland. A catalogue is given of the species supposed to have any claim to inclusion in the fauna, with notes on the distribution and status of each. The list differs from Thompson's in including a much larger number of marine (chiefly oceanic) animals. Novelty among terrestrial mammals are few. They include, however, the Irish stoat (*Mustela hibernica*) and the Irish hare (*Lepus hibernicus*), both now marked as practically endemic. Three bats have been added to Thompson's list. There are also five new species of Rodentia. The pine-marten (*Martes martes*), is still known from ten counties; and the red deer (*Cervus elaphus scoticus*), though now confined as a strictly native species to a protected area in Kerry, has recently been shown to be living a perfectly wild life in a new home to which it has found its way among the Wicklow Mountains. The question of the admissibility of the wild cat (*Felis silvestris*) to a historic place in the Irish fauna is regarded as having been lately placed by Major Barrett-Hamilton in a new light.

Edinburgh

Royal Society, Edinburgh, July 5.

C. FORSTER-COOPER: The Middle Devonian fish fauna of Achanarras. This is the first section of a report on five seasons work in the flagstone quarry of Achanarras in Caithness and deals with the fishes of the genus *Dipterus*. Hitherto two forms, *Dipterus valencianesi* and *D. platycephalus* have been considered as separate species differing in the structure of the scales and in the extent to which the skull is ossified. It is now shown that the difference is due to seasonal changes, as described by Westoll for the contemporary Crossopterygians, and that the two conditions alternate during the life of the fish, so that there is only one species represented and not two. The abundance of material has rendered possible a full restoration of the fish.

FLORA COCHRAN: A histological analysis of eye pigment development in *Drosophila pseudo-obscura*. A detailed examination of unstained histological sections of the eyes of wild type and various mutants of *D. pseudo-obscura* at various stages of development was made. This revealed that pigment in the form of granules appears in two types of pigment cells at two definite times during development

and that genes which alter the colour of the eyes do so by affecting these granules in three distinct ways: (1) by suppressing the formation of all or part of the granules laid down in one or both types of pigment cells during either or both phases of development; (2) by altering the rate of granule development; (3) by causing a qualitative change in the granules.

A. R. WATERSON and H. E. QUICK: *Geonemertes dandyi* Dakin, a land nemertean in Wales. Since 1935, a land nemertean had been known from several localities near Swansea. The external and internal characters are described. Details are given of the habits, mode of feeding, and reproduction. The habitats are all damp places near streams or trees, and the nemerteans occur under stones and fallen branches. The sites seem to be free from contamination from exotic sources. Land nemerteans have not previously been found living under natural conditions in Europe.

R. S. BROWN: The anatomy of *Ophelia cluthensis* McGuire. An account of a polychaete worm which seems to be fairly common in the sand just below high water neap tide, not only in the Clyde estuary, from where it was originally described, but also in other parts of Great Britain and northern Europe. The species was created by McGuire in 1935, but her description was very incomplete, and the present account gives much fuller details of its specific characters and also a discussion of its affinities with other members of the genus. The description of the anatomy includes an account of the lymphatic corpuscles, which in this genus consist of two types of cells: (i) small disk-shaped cells 15–20 μ in diameter, with radiating processes; and (ii) larger irregular cells, 40–150 μ in diameter, containing a dense central body usually in the form of a club. Reproductive cells are also found in the coelomic fluid.

Paris

Academy of Sciences, June 14 (C.R., 204, 1769–1848).

ANDRÉ BLONDEL: The search for short light signals by navigators. Discussion of the effects of the duration of the light signals from the physiological point of view.

GEORGES CHARPY: The definition of the *nuance* of steels.

JACQUES DE LAPPARENT: The mineralogical nature of the clays of El Golea (Sahara).

OTOKAR BOBŮVKA: Multiplicative systems.

MICHEL GHERMANESCU: A problem of Laguerre.

RICHARD BRAUER: The multiplication of the characteristics of continued and semi-simple groups.

KUNTSMANN: Multiform operations. Hypergroups.

M. KELDYCH and MICHEL LAVRENTIEFF: The problem of Dirichlet.

P. DUPUIS, H. GUILLEMET and ANDRÉ MARTINOT-LAGARDE: The determination of the trajectories of the water particles in the flow through a centrifugal pump.

JACQUES VALENSI: A new method for the measurement of the delivery through a tube placed in a current of air of uniform velocity.

RENÉ HIRSCH: The automatic stabilization of aeroplanes.

PIERRE AUGER, PAUL EHRENFEST, JUN., ANDRÉ FÉRON and MICHEL THÉRÈSE GRIVET: The mechanism of the production of cosmic bundles. The experimental results described support the mechanism of production indicated by Bhabha and Heitler for the soft cosmic rays, that is, the group of electrons and photons present in the lower atmosphere.

NICOLAS PERAKIS and LÉANDRE CAPATOS: The thermomagnetic study of the complex compounds $(Ag_2Cd_4(C_6H_5N)_8)_2O_8$.

MAROUS BRUTZOUS: The heat of formation of hydrocarbons.

J. TIMMERHANS and H. BODSON: The surface tension of water and that of heavy water. The variation of the surface tension of water with temperature shows an anomaly at 13° C.; with heavy water this appears at 17° C. This anomaly has not been detected by other workers on this subject.

G. DUCH: The variations of the mechanochemical constants of the benzene hydrocarbons along the vaporization curve with origin at 74.5 cm. mercury.

PAUL BARY and JEAN HERBERT: The transformation points of glasses.

ALBERT TIAN and EDOUARD GAND: The ionic dissociation of the alkyl halides. Experimental evidence that, contrary to the view usually accepted, alcoholic iodides in aqueous solution behave as weak electrolytes.

CARSTEN HOLTHERRMANN and PAUL LAFFITTE: A new oxide of lead. The existence of Pb_7O_{11} has been proved from a study of the composition of the oxide as a function of the temperature under a pressure of 200 atmospheres. The only other oxides indicated on the curve are PbO_2 and the red Pb_3O_4 .

VICTOR AUGER and Mlle. NINA IVANOFF: The molybdenum blues. Amorphous colloidal molybdenum blue. The only molybdenum blue appears to be that described by Guichard with a formula $Mo_3O_{11} \cdot 7H_2O$. This blue is amorphous and colloidal.

MME. NATHALIE DEMASSIEUX and LOUIS ROGER: A complex compound formed by lead iodide and lithium iodide in aqueous solution. This has the constitution $PbI_2LiI \cdot 4H_2O$.

LOUIS HACKSPILL and GEORGES WOLF: The thermal decomposition of the barium carbonates.

MICHEL LESBRE: Some halogen organic derivatives of lead.

ANDRÉ MEYER and HENRI DEUTEL: Salts and complex compounds of 6-methyl- and 8-methyl-4-hydroxyquinolines.

GUSTAVE VAVON and JEAN BOLLE: The condensation of the benzene hydrocarbons with chlormethyl ether. Method of alkylation of aromatic nuclei.

ANDRÉ DEMAY: The role of static and dynamic phenomena in the genesis of the Cristallophyllian.

JAQUES FLANDRIN: The attribution to the Oligocene of a part of the Nummulitic strata of the Kabylie of Djurdjura and its western prolongation (Algiers).

JEAN CUVILLIER: The presence of the marine Carboniferous in the ouadi Abou Darag (Arabian desert).

EDMOND ROTHÉ and MME. ARLETTE HÉE: Prospecting by the penetrating radiations in the trap and granite quarries of Raon-l'Étape.

LOUIS BOUNOURS: The fate of the germinal line in the russet frog after the action of ultra-violet rays on the lower pole of the egg.

TCHOU-SU and CHEN-CHAO-HSI: The spontaneous activation of the egg of the russet frog (*Uraeus muratus*) in contact with fresh water.

MAURICE LEMOIGNE, PIERRE MONGUILLON and ROBERT DESVRAUX: The reduction of nitric acid to hydroxylamine by the higher plants. The role of ascorbic acid. The juice of lilac reduces nitrites to hydroxylamine and under the same experimental

conditions ascorbic acid behaves similarly. Ascorbic acid is always present in the leaves and hence is probably the cause of the reduction of nitrite by the juice.

MICHEL A. MACHEBOEUF, MMES. GHOZZET LÉVY and MARGUERITE FAURE: Researches on the chemical nature of the lipid-fixing haptene of tubercle bacilli. Chemical study of the purified active fraction.

PIERRE LÉPINE, PIERRE MOLLARET and BORIS KREIS: The receptivity of man to the murin virus of lymphocytary choriomeningitis. The experimental reproduction of benign lymphocytary meningitis.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 251-294, May 15).

F. ZWICKY: A new cluster of nebulae in Pisces. During September and October last year, more than a hundred photographs with exposures of ten to thirty minutes were obtained at Mount Palomar with the new 18-inch Schmidt telescope of the Carnegie Institution of Washington; characteristic features of the instrument are effective aperture 18 inches, focal ratio $F/2$, diameter of field used about 9.5°, limiting magnitude about 17.5. A large swarm of nebulae in Pisces of large extension and asymmetrical shape suggesting rotation of the whole was observed.

R. A. GORTNER and H. B. BULL: Electro-kinetics. (19) Interfacial energy and the molecular structure of organic compounds. (v) The electric moment of Al_2O_3 : benzene-nitrobenzene interface.

JENNY E. ROSENTHAL and LLOYD MOTZ: Application of a new mathematical method to vibration-rotation interaction.

K. G. SCOTT and S. F. COOK: Effect of radioactive phosphorus upon the blood of growing chicks. Growing White Leghorn chicks were given substantial doses of radioactive phosphorus (prepared by irradiation of red phosphorus) in the form of phosphoric acid. It gave rise to effects not obtained with X-rays. Lymphocytes, which are sensitive to X-radiation, were little affected; polymorphonuclear leucocytes, which are not much affected by X-rays, were much decreased in number. These effects are attributed to deposition of the radioactive phosphorus in the bones, which allows bombardment with radiation of the bone marrow, the source of the polymorphonuclear leucocytes, whereas X-rays only reach the marrow with difficulty.

J. VAN OVERBEEK: Effect of the roots on the production of auxin by the coleoptile. If the root systems of *Avena* seedlings are removed, after 15-20 hours the auxin production is much reduced, causing decreased growth. When both roots and seed are removed, the plants do not 'regenerate' and their curvatures increase steadily. It is suggested that auxin itself and a precursor are present in the seed; the latter is transported independently of the root system, and the former in the transpiration or root-pressure stream.

F. D. MURNAGHAN: The irreducible representations of the symmetric group.

G. A. MILLER: Groups of order less than 2^m having $m-1$ or $m-2$ independent generators.

H. WHITNEY: Products in a complex.

A. GLEYZAL: Linear orders.

C. H. DOWKER: Hopf's theorem for non-compact spaces.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

STRUCTURAL ENGINEERING ASSISTANTS in the Directorate of Fortifications and Works of the War Office—The Under-Secretary of State (C.5), War Office, S.W.1 (August 16).

ASSISTANT LECTURER IN PHARMACY in the Technical College, Bradford—The Principal (August 28).

TECHNICAL OFFICER in the Signals Experimental Establishment, at Woolwich—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (August 27).

LECTURER IN PHYSICAL CHEMISTRY in the Battersea Polytechnic, London, S.W.11—The Principal (September 6).

LECTURER IN PATHOLOGICAL BIOCHEMISTRY in the University of Glasgow—The Secretary of the Court (September 11).

DIRECTOR OF RESEARCH of the Institute of Brewing—The Secretary of the Institute, Brewers' Hall, Addle Street, London, E.C.2 (October 15).

CIVIL ENGINEER in the Public Works Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Report on the Phenological Observations in the British Isles from December 1935 to November 1936. (No. 46.) By Ivan D. Margary. (Quarterly Journal of the Royal Meteorological Society, No. 270, Vol. 63.) Pp. 219-275. (London: Royal Meteorological Society.) 1s. [197]

Experimental Researches and Reports published by the Department of Glass Technology, the University, Sheffield. Vol. 19, 1936. Pp. iii+218+16 plates. (Sheffield: The University.) 7s. 6d. [197]

Department of Scientific and Industrial Research. Forest Products Research Records, No. 18 (Myology Series, No. 2): The Causes of Stain and Decay in Imported Timber. By K. St. G. Cartwright. Pp. i+15+7 plates. (London: H.M. Stationery Office.) 6d. net. [197]

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, Ministry of Agriculture for Northern Ireland and Agricultural Research Council. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1934-1936. Pp. v+288. (London: H.M. Stationery Office.) 4s. net. [197]

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1937. Pp. 68. (Aberdeen: North of Scotland College of Agriculture.) [197]

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Chesham. Twenty-second Annual Report, 1936. Pp. 104. (Chesham: Nursery and Market Garden Industries' Development Society, Ltd.) [197]

Make the Lake District a National Park. Pp. 16. (Ambleside: Friends of the Lake District.) [197]

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Vol. 140

Milk Supply and National Health

A FEATURE of the present-day interest in nutrition is the number of unofficial organizations which have sprung up with the object, by propaganda and other means, of directing attention to what is naturally and properly considered to be a matter of immediate public concern, and of stimulating the Government to take action on recommendations regarding nutritional needs which have been made by expert committees of the League of Nations, the Ministry of Health and other authoritative bodies.

Active among these organizations is the Children's Minimum Council—a non-party body the aim of which is to secure that no child shall, by reason of the poverty of its parents, be deprived of at least the minimum of food and other requirements necessary for full health. Undeniably, widespread damage is caused to our national health by malnutrition during pregnancy and lactation and in the early years of childhood. Undeniably, also, inadequate family means among a large section of our population is the chief contributory factor to the existence of this state of affairs. Such is proved by the recent surveys of Orr, M'Gonigle, Rowntree and others.

There is much that is still controversial regarding the right nutrition of our people ; but for those who seek an early improvement in existing conditions there is one guiding principle which may be followed without fear of contradiction or misdirection. It is the indisputable value of milk for nursing mothers and children.

In a recent memorandum on "Milk for Mothers and Children under Five", the Children's Minimum Council stresses the case for cheap milk. Expert Government committees have now unanimously declared that the desirable daily amount of milk

for children is from one to two pints, for expectant and nursing mothers about two pints, and for other adult members of the community half a pint. At the present average prices, a family in which there are three children taking, say, one and a half pints a day each, an expectant mother taking two pints, and a father taking half a pint, would have an average milk bill of 13s. 3d. a week. Such an expenditure is, of course, quite beyond the means of working-class families with dependent children.

Consumption of milk in working-class households is far below the amounts regarded as desirable. Statistics from all over the country show how consumption drops with falling income and with an increasing number of children in the household. Many children get little or no fresh milk. For example, a survey of more than thirteen thousand school children in the Glasgow area showed that 57·7 per cent did not drink milk at all.

The proposal of the Children's Minimum Council is that milk should be made available at 1½d. a pint for expectant and nursing mothers and children under school age in families covered by National Health Insurance or of equivalent economic status. Both producers and distributors should be asked to make some concession in their prices for milk supplied under the scheme, and whatever subsidy is thereafter needed to bring the price down to 1½d. a pint should be paid by the national Exchequer. It is estimated that there are in Great Britain about three and a half million expectant and nursing mothers and children under five. The Council argues that a yearly Government subsidy of just over one and a half million pounds would suffice to provide for an annual distribution of eighty million gallons of cheap milk among that number. This is

on the assumption that their orders for the milk would average half a pint per head per day.

Any scheme which attempts to break down the price barrier preventing an adequate consumption of milk by those who most stand in need of it deserves our attention. Nevertheless, however laudable in itself, this new scheme is but another expedient (of which there are already three in existence) to remedy an evil the root cause of which lies much deeper than the mere inability of people to pay for milk. Various State-aided schemes for the provision of cheap milk to mothers and children are already in operation under the Public Health Act of 1936, the Education Act of 1921 and the Milk Act of 1934. Admittedly there are defects and anomalies in these schemes; but another will only bring confusion to an already

complicated position and further increase the administrative difficulties of our already overburdened public health services.

The case requires more drastic handling, and demands a fundamental change in the whole statutory position which at present governs the production and marketing of milk. In the past, the Government has tended to serve the economic interests of producers at the expense of the health interests of consumers. While no one will deny a fair return to the producer, it is out of all proportion that the interests of 175,000 producers should come before those of the ten million children on whose health the future of the country depends. The time has come when the Government must take a comprehensive view, and, without fear or favour, design a unified milk policy to meet the needs of the whole community.

Genetics and Plant Breeding in the U.S.S.R.

THE fourth session of the Lenin Academy of Agricultural Sciences, held in Moscow at the end of 1936, witnessed a determined campaign against genetics as the main basis of scientific plant breeding¹. It is only now, however, that detailed reports of some of the speeches made at the session are available, while further light is thrown upon the controversy by recent Soviet publications.

The attack was opened by a group of plant-breeding experts headed by T. D. Lysenko, a member of the Odessa Institute for Selection and Genetics. The main ideas of Lysenko do not appear to have been published in a scientific form, but they are expressed in a popular pamphlet² and in his speech at the session of the Academy of Agricultural Sciences³. They are based on no lesser, and no later, authority than that of Charles Darwin, whose teachings according to Lysenko "were unable to blossom out properly in bourgeois countries. The best Darwinists in capitalist countries, as for example Burbank in America, as well as our revolutionaries-biologists K. A. Timiriazev and I. V. Michurin in the Czar's Russia, were lone fighters." The works and theories of de Vries, Johannsen, Bateson, Morgan, are dismissed on the strength of a few quotations from their writings, suggesting their critical attitude to some of Darwin's ideas, all of which are held by Lysenko to be the last word in biology.

The actual controversy is centred around two points of practical plant breeding. One concerns the problem of crossing and selection of self-fertilizing pure line plants. According to Lysenko, pure lines if cultivated for a long time are liable to degeneration. This can be prevented, and the line even improved, by artificial cross-fertilization within the variety. "Small field experiments" made at Odessa with some varieties of wheat have shown an increase in the yield from cross-fertilized seeds, and this was taken to be sufficient to consider the method ready for immediate introduction into practice. About 10,000 farmers on 2,000 collective farms were instructed to sterilize wheat plants by cutting stamens to prevent self-fertilization. As a result, 500-1,000 gm. of cross-fertilized seeds were obtained on each farm. "If it happens that the seeds from intra-varietal crossing should be of higher quality, should produce plants with greater yield . . . , there will be no obstacle to a rapid transformation of a kilogram of seeds on each farm into tens of tons". Since Lysenko is also practically certain (although without apparent data) that the improved plants will be more resistant to winter frosts, he urged the Academy to pay serious attention to the question of the immediate necessity of introducing the method of cross-fertilization on "at least 50-70 thousands of collective farms".

It does not appear to be safe to criticize such enthusiastic plans, containing a promise of enormous and immediate progress towards the fulfilment of Stalin's recent order for increased agricultural production. N. I. Vavilov¹, in his reply to Lysenko, merely pointed out that many pure varieties of wheat, barley, etc., have existed without any "degeneration" for centuries, and there is no need to seek to improve them by intra-varietal cross-fertilization. Even if such crossing should produce an improvement (due to heterosis), it remains to be shown that the improvement will be lasting, since usually heterosis disappears in a few generations. G. Meister², who summed up the discussion, very cautiously suggested that it would be premature to develop extensive practical programmes while the method is still being studied experimentally.

While this first point of the discussion was mainly concerned with a practical problem, the second presented a clash between two almost diametrically opposed fundamental conceptions of biology. The discussion developed round Lysenko's forceful statements that the external conditions under which a plant develops have a profound effect not only on the somatic, but also on the sex cells. Therefore, responses of the constitution of an individual plant to its environmental conditions are inheritable, contrary to the views of "bourgeois" geneticists. This theory is based on three incomplete years of experiments with the vernalization of winter wheat and rye; none of these experiments was carried beyond the fourth generation and the results do not appear fully conclusive³. Nevertheless, Lysenko claims that the possibility of "changing the nature of plants" has been definitely proved, and promises in the near future to develop new varieties of winter wheat with increased cold-hardiness, of cotton requiring less heat for its growth, etc.

On the face of it, Lysenko's theory is nothing but Lamarckism in its simplest form, and this was pointed out by several speakers. Such accusations of being unfaithful to Darwinism appear, under Soviet conditions, to be tantamount to charges of high treason. Lysenko, therefore, had to insist that his theory is nothing but a development of most orthodox Darwinian views. His defence is worth quoting, since it provides a typical example of methods of discussion adopted by some Soviet scientific investigators: ". . . no work can possibly produce positive results if it starts on the

basis of Lamarckism. If, by suitable breeding of plants, we have already succeeded in altering their hereditary nature in the desired direction, this alone proved that we are not Lamarckists. . . ." Lysenko insists further that he is not against the science of genetics, but "genetics as one of the most important sections of agro-biological science must be . . . remade in our Soviet way, without accepting many anti-Darwinian tendencies of fundamental genetic conceptions".

The problem of the inheritance of acquired characters has such an extensive literature and is still so far from its solution, that recent Russian work on vernalization and allied phenomena should be regarded merely as providing additional experimental data on the subject. Some of the results may be suggestive, but they certainly do not in any way justify Lysenko's assertions that the secret of "changing the nature of plants" is now discovered. These assertions would not be worth recording, were it not for the fact that they led, not to a healthy discussion, but to unscrupulous attacks on the large Russian school of geneticists deservedly appreciated by biologists in other countries. It is true that Lysenko and his colleagues veiled their attacks, for example, on Vavilov, by professing profound respect for his work; but at the same time they lost no opportunity for stressing what they consider to be anti-Darwinian tendencies in his ideas. In a country where Darwinism—as interpreted by Engels and Lenin—constitutes the ideological basis of official philosophy, arguments of this kind savour of denouncing an enemy of the State. Some practical effects of these accusations were pointed out by Meister⁴, who said that certain Soviet editors already refuse to publish articles dealing with genetics, which appear to them bordering on counter-revolution. It is also perhaps not a mere coincidence that the International Genetical Congress, which should have been held in Moscow this summer, has been postponed.

On the whole, the discussions, which must have stirred very deeply all biological workers in the Soviet Union, appear to be of very limited theoretical interest. They are, however, of outstanding significance in revealing the atmosphere in which scientific investigators in totalitarian countries have to live and work.

¹ NATURE, 139, 185 (Jan. 30, 1937).

² "Changing the Nature of Plants" (in Russian). Pp. 46+10 figs. (Moscow, 1937).

³ *Pod znamenem marksizma*, 2, 96-118 (1937).

⁴ *Front Nauki i Tekhniki*, 2, 54-61 (1937).

⁵ *Front Nauki i Tekhniki*, 2, (2-20) (1937).

Willard Gibbs and his Work

A Commentary on the Scientific Writings of J. Willard Gibbs, Ph.D., LL.D., formerly Professor of Mathematical Physics in Yale University.

Vol. I: Thermodynamics; dealing with the Contents of Volume One of the Collected Works. Edited by Prof. F. G. Donnan and Prof. Arthur Haas. Pp. xxiii+742. Vol. 2: Theoretical Physics; dealing with the Contents of Volume Two of the Collected Works. Edited by Prof. Arthur Haas. Pp. xx+605. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1936.) 45s. net.

IT is now sixty-four years since Willard Gibbs published in the *Transactions of the Connecticut Academy* the first of his classical papers on thermodynamic theory, and thirty-five since the publication of his "Elementary Principles in Statistical Mechanics".

Almost contemporaneous with the last-mentioned event was the introduction by Planck of the 'quantum of action', which was destined to revolutionize atomic and molecular physics. It is not inappropriate, now that the new theories have largely taken shape, that Gibbs's work should be rediscussed with the view of examining how much of it retains its validity in the light of modern physics.

The two volumes under review have been prepared under the auspices of Yale University, where Willard Gibbs was professor. They consist of a symposium, to which a number of distinguished workers have contributed, with the double object, first of doing honour to the memory of Willard Gibbs, secondly of providing a commentary to guide the reader of his collected works. This last indeed is very necessary, for Gibbs's own treatment is frequently far from easy to follow and, apart from this, both nomenclature and methods differ appreciably from modern practice.

In view of the above intention, Gibbs's notation has been adhered to, and the commentary begins with a very brief but very valuable note on symbols and nomenclature by Prof. F. G. Donnan, for which anyone who has lost himself in the maze of 'free energies', 'available energies' and 'thermodynamic potentials', as envisaged by various authors, will be indeed thankful.

The first volume, which is under the general editorship of Prof. Donnan and Prof. Arthur Haas, deals with the subject-matter of vol. 1 of Gibbs's Collected Works, that is, mainly with his first three classical papers.

The general theory of thermodynamics as expounded by Gibbs forms the theme of quite a number of the contributions, in particular articles (D) "The General Thermodynamic System of Gibbs", by J. A. V. Butler, (G) "The Phase Rule and Heterogeneous Equilibrium" by G. W. Morey, and (J) "The Fundamental Equations of Ideal Gases and Gas Mixtures" by F. G. Keyes. Prof. E. A. Milne contributes an article on the thermodynamic functions and criteria of equilibrium, and Prof. Schreinemakers one on graphical methods using the free energy function. To the same group belongs the leading article (N) of the second volume, "The Thermodynamic Principles as Extended and Perfected by Gibbs" by Prof. Arthur Haas.

Special subjects such as osmotic equilibrium (E. A. Guggenheim), the thermodynamics of elasticity and interface phenomena and capillarity (James Rice) are dealt with in separate articles.

There is naturally a good deal of overlap; thus Gibbs's paradox in connexion with the diffusion of two gases into one another is described and discussed by both Dr. Butler and Prof. Haas, and this is not an isolated case. On the whole, this overlapping is rather an advantage than otherwise; the differences of presentation are often complementary and illuminating.

It is, however, to be regretted that, although Gibbs's famous criteria for equilibrium are explained at least three times, namely, by Butler and by Milne in vol. 1 and by Haas in vol. 2, there appears to be nowhere an adequate discussion of their validity, at any rate in the most difficult case, that of unstable equilibrium. Butler alone attempts to deal with this case, and he follows Gibbs's own lines; but unfortunately Gibbs is here entirely unconvincing. In view of the importance of these criteria a careful and critical examination would not have been out of place.

The second volume, which deals nominally with vol. 2 of the Collected Works, contains two articles, (N) and (O), devoted to classical thermodynamics. The first has already been mentioned above. The other, by Prof. Epstein, deals with the subsequent continuation by Nernst and others of Gibbs's purely thermodynamical work.

Other articles by Leigh Page, E. B. Wilson and Arthur Haas concern Gibbs's contributions to the theory of light, to vector analysis and multiple algebra and to dynamics respectively.

The bulk of this volume is devoted to Gibbs's work on statistical mechanics, most of it being from the pen of Prof. Haas; but the last two

articles but one, by Epstein, contain a very instructive criticism and appreciation of Gibbs's work in the light of recent theories. Haas himself, at the end of article (R), has dealt with the derivation of the ideas of wave-mechanics from Gibbs's conception of phase-space, and the whole of this section is highly suggestive and deserves the most attentive reading.

Admirable as the "commentary" is in general, one cannot help feeling occasionally that it is itself at times in need of a commentator to clear away obscurities.

This is noticeable, for example, in the treatment of elastic solids in vol. 1 (art. K), which is far more difficult to follow than the usual expositions of the analysis of stress and strain in treatises on elastic theory. In one place (p. 445) the writer of the article uses as "more convenient" a set of strain-variables which do not form a tensor and which, for that reason, would be highly inconvenient for use in an isotropic solid.

Another example may be taken from vol. 2, pp. 192-203, where a number of difficulties occur. Thus (a) on p. 192, the reader is not told why

the vanishing of $\int Dv_n df$ must involve $\frac{\partial D}{\partial t} = 0$;

(b) on pp. 196-97, the vital assumption by Gibbs of the form $\exp \{(\psi - \epsilon)/\theta\}$ for P is described as "plausible"; but there are an infinity of forms for P which will ensure the convergence of the integral $\int \dots \int P dq_1 \dots dp_n$, and the reader might well expect to be told why one "plausible" form is preferred above all others; (c) on p. 198, the statement that $\int \dots \int dq_1 \dots dq_n = f(V)$ is not true unless the q 's are Cartesian co-ordinates, in which case f can only be a power, as correctly stated on p. 200; (d) on p. 202, no explanation is given of the absence of a term in $d\theta$ in equations (56) and (60), although ϵ as defined by (55) appears to be a function of θ .

Taken as a whole, however, the commentary forms a most welcome addition to the literature of a difficult subject, and will be not only a worthy monument to one of the greatest mathematical physicists of the nineteenth century but also an excellent exposition of his ideas by some of the greatest experts in the subject at the present time. The work involved has clearly been enormous, and the editors and their collaborators have well deserved the congratulations which they undoubtedly will receive.

It is perhaps still too early, in the present fluid condition of physical science, to estimate Willard Gibbs's position in the development of theoretical physics and chemistry. Those who hope for such an estimate from these two volumes are likely to be disappointed. We are given a very full and very instructive paraphrase of Gibbs's work, and deductions from it. We are shown its connexions with contemporary and subsequent developments; but no real attempt is made to apply critical analysis to the work itself and to discriminate between the best and (at any rate) the second-best. Yet that in such a mass of new methods and results weaknesses or indeed failures must have occurred seems inevitable; even Newton was not exempt. A commentary written in a more critical spirit would certainly have done Gibbs's memory no harm and would undoubtedly have helped towards a better understanding of his work.

Even on the question of the relative value and permanence of the thermodynamics and the statistical mechanics—which represent widely different scientific philosophies—we are left in doubt. Possibly this is the unavoidable result of the symposium method, and of a natural diffidence on the part of individual contributors. But the reader puts down the book with the feeling that the final summing-up about Gibbs has yet to be written.

L. N. G. F.

The Peasant Farmers of Ireland

The Irish Countryman:

an Anthropological Study. By Dr. Conrad M. Arensberg. Pp. xi+216. (London: Macmillan and Co., Ltd., 1937.) 10s. 6d. net.

DR. ARENSBERG'S anthropological study of the peasant-farmer population of western Ireland will be held to confirm their views by those who believe that much of the primitive survives in the modern Irishman. It is this element in his make-up, they would maintain,

which has persisted, certainly from pre-conquest, and possibly from prehistoric, days, and lies at the root of a misunderstanding between governors and governed, dating back so far as the twelfth century and distorting, as it would appear to the Irish, the vision of Giraldus Cambrensis.

As a social anthropologist, Dr. Arensberg's approach to the culture of the west is that of the analyst of patterns of behaviour. He shows how the whole social nexus of the peasant-farmer class, with which he is dealing, nucleates in the land,

that is, in the farm holding, not merely as a matter of the internal economy of a single unitary organization, but also as one among a number of similar organizations, with mutual accommodations, perhaps even obligations, in co-operation at times of pressure in their agricultural functions, and a conditioned relation to the traders of the nearest or central town. The all-pervading influence of the land, and the character of the social economy to which it gives rise, can be discerned most clearly, perhaps, in such diverse matters as the system of passing the control of the farm to one of the sons at the oncoming of age—though not necessarily of senility—match-making, the late age for marriage, and the system of retail purchase and credit, which are not a question of finance simply, but depend on kinship, social relation, or other economically extraneous considerations, rather than price and quality.

It is interesting to translate Dr. Arensberg's study of patterns and nuclei of behaviour into the more formal and familiar terminology of traditional methods of observation. The primitive character of this community, with which he is

concerned, immediately becomes more clearly apparent. It is then evident that in the peasant-farmer population we are dealing with a community in which the unit is the family, supplemented by the extended family and the kinship organization. It has its age classes, each with its club-house, and headed by an assembly of elders, who regulate the affairs of the community and are the repository of tradition. Marriage follows on or accompanies initiation into manhood, which goes with the accession of responsibility on the farm. Hence the late age of marriage. It follows also from this peculiar economy that the town is literally the market town, a meeting place for the exchange of produce, which functionally has no independent existence. There is also a place for primitive religious belief, as over and above the orthodox creed, there is an all-pervading animism, the belief in "they", the fairies, or *sidhe*.

It is perhaps not remarkable that a mentality in which these elements of behaviour are so deeply engrained as to have survived for centuries should have been incompatible with a system of landlordism.

Chemistry for Everyman

Chemistry, Matter and Life

By Dr. Stephen Miall and Laurence Mackenzie Miall. Pp. x+296+8 plates. (London: Edward Arnold and Co., 1937.) 7s. 6d. net.

THE popularization of chemical science is a notable feature of the twentieth century, and the appearance of the volume under consideration is welcome evidence that the demand for books which give a readable and accurate account of the achievements of scientific chemists still continues. In looking back over the past thirty years or so, it is of interest to note how the methods have altered by which authors have sought to capture the interest of their readers. Formerly, it seems to have been considered necessary to emphasize in the titles chosen the wonder, the romance or the mystery of chemistry, and in the text the reader was constantly being aroused to amazement and wonder. Each sentence, almost, ended in an exclamation mark, and it was sought to hold the attention of the reader by means of slogans and the devices of the advertising agent.

Nowadays, these methods of exposition have fortunately almost disappeared, and the intelligent and educated public is now supplied with books, such as the one before us, in which the facts and

theories of chemistry are presented clearly and soberly and left to make their own impression. One cannot but welcome the present work, in which the authors "have tried to describe in language that any educated person can understand some of the main principles of chemistry, the nature of matter, and some of the chemical changes that take place in living plants and animals". The qualifications of the senior author, at least, are a sufficient guarantee that the attempt has not been made in vain.

Within the compass of less than three hundred pages, and in a succession of twenty-seven chapters, the authors have considered briefly, sometimes too briefly, the general aspects of much of present-day chemistry. In the first eighteen chapters we have presented to us an account of modern views regarding the constitution of matter of the arrangement of atoms and molecules in crystals, of the spontaneous transformations which atoms are undergoing in radioactive substances and of the similar transmutations which can now be brought about artificially. The discussion of these and other topics leads on to the consideration of some of the substances which are formed in the bodies of plants and animals and of the chemical processes which take place in the living

organism. These closing chapters are necessarily less easy to read and understand than the earlier ones, yet the authors have succeeded in giving to the general reader an idea of the truly extraordinary work which has been achieved by chemists in unravelling the molecular constitution of the complex compounds which build up the structure of plants and animals, which control the health of the animal organism and which give to plants their marvellous colours.

The book can be recommended to all who wish to obtain some knowledge of what the science of chemistry means. It is readable and reliable, and is well illustrated by diagrams and plates; but why, one may ask, should there be given on the jacket a picture of an alchemist in his laboratory rather than a picture of, say, Ramsay or of Robinson? Is it thought that the fading glamour of alchemy, of which there is no mention in the text, may act as a lure?

ALAN. FINDLAY.

Technological History

The Collected Papers of Rhys Jenkins, M.I.Mech.E.

comprising Articles in the Professional and Technical Press mainly prior to 1920 and a Catalogue of other Published Work. (Links in the History of Engineering and Technology from Tudor Times.) Pp. x+247+8 plates. (London: Newcomen Society, 1936.) 21s.

TWO things strike one at the first glance into this handsome volume: first, the wide range of Mr. Jenkins's researches and his large output; secondly, the reflected glory which shines on the Newcomen Society through having published the volume, apart from the fact that it is "a token of the affectionate regard in which he is held by members of the Society".

Closer examination of the work reveals that it is nearly all based on hitherto unpublished material obtained from the most out-of-the-way sources, indicative not only of keen research, but also of a flair for knowing where to look. Not only so, but also Mr. Jenkins has visited the localities where the industries he describes have been carried out; he has in some cases located their sites and he has exhausted the traditional sources of information locally. What is so refreshing about the author is that he brings to the sifting of the evidence and the weighing of facts a critical inquirer's mind. He examines the stories which have hitherto served as history, and extracts from them whatever modicum of truth they may contain. His papers may be studied as models of historical research, and he himself is rightly regarded as the doyen of students in the field of engineering and industrial history.

The papers have been gathered from many sources, but are reprinted substantially as they appeared; where new matter has come to light after the publication of any particular paper, this matter has been dealt with by Mr. Jenkins in an appendix.

In general, the papers represent Mr. Jenkins's activities prior to the founding of the Newcomen Society by himself and others in 1920; since that date, most of his contributions have found their way into the *Transactions* of that Society. Taken together, they thus form a corpus of all his work up to date.

Turning to the subject-matter in detail, it may be conveniently classified under these headings: mechanical technology; steam engineering and foundry work; hydraulic and sanitary engineering; industrial and economic history. In the space at disposal, attention may be directed to a few of the papers. Foremost among them are those which elucidate the history of the steam engine and the work of Sir Samuel Morland, Thomas Savery, Thomas Newcomen and Henry Beighton. It may be said without hesitation that Mr. Jenkins's researches in this direction have added more to our knowledge than the whole of that available previous to his time. Another subject treated in a masterly manner is the history of paper-making in England in 1495-1788; even the site of the mill of John Tate, the first English paper maker, had been lost. The history of an industry—that of tin-plates—that has been associated with Mr. Jenkins's native county—is the subject of what will undoubtedly remain a classic memoir.

Sufficient perhaps has been said to indicate the interest of these "Collected Papers". To conclude the volume there are complete lists of the published works of Mr. Jenkins, authorities quoted, and a really good index. This is, we believe, the first time that such a volume has been published by an engineering society in Great Britain, and the Society, the editor, Mr. E. W. Hulme, and the printers are to be congratulated on the results of their combined efforts. No student of industrial history can afford to overlook this remarkable volume.

Vitamins in Theory and Practice

By Dr. Leslie H. Harris. Pp. xix+242. (Cambridge: At the University Press, 1937.) 8s. 6d. net.

THE first edition of Dr. Harris's book was published at the end of 1935 and reviewed in *NATURE* in the spring of 1936 (137, 868). Its deserved success is doubtless one reason why a new edition has been needed so soon; another is the speed with which advances in vitamin chemistry have been made during the last eighteen months, a speed unusual even in this exceptionally fast-moving branch of biochemistry.

During that period the exact structures of aneurin chloride (vitamin B₁) and of lactoflavin (part of the 'vitamin B₂ complex') have been made known, and both have been completely synthesized. The detailed structures of two antirachitic vitamins, calciferol (vitamin D₂) and the 'natural' vitamin of halibut and tunny liver oils (vitamin D₃) have been worked out and a generally accepted formula has been proposed for each; the latter has been prepared from inactive substances, both 'natural' and of laboratory origin, and it has also been obtained crystalline, though too recently for the fact to be recorded by Dr. Harris. The claim by Evans to have isolated vitamin E, which he calls "tocopherol", is accepted by Dr. Harris, but he would not find that all workers in this field agree with him on the matter.

Apart from expanding his book to include these items of new discovery, the author has made few additions. He might, perhaps, with advantage have included reference to the more recent work on the treatment of habitual abortion with wheat-germ oil or extracts made from it (Shute, Watson, Currie), especially as this work confirms the original observations of Vogt-Möller, recorded in this edition in words identical with those used in the first. But Dr. Harris is perhaps wise in a book of this nature, intended for lay consumption, to err on the side of caution.

A. L. BACHARACH.

Thirty Years of Nature Photography:

a Personal Record of Two Observers. By Seton Gordon. Pp. xi+100+108. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1936.) 21s. net.

THE author has been photographing birds and their nests since 1903, inspired originally by the books of Richard Kearton. His wife had also observed and photographed sea and moorland birds, and after marriage the two enthusiasts helped each other in this fascinating pursuit. The beautiful plates of this book are the result of their collaboration, the letter-press explaining the methods used, with particular emphasis on the necessity for a 'hide', and for two observers to use it.

There are photographs of sea birds, moorland birds, a few of seal and deer, and two remarkable pictures of crested tits. The account of the taking of these photographs shows that considerable physical fortitude, besides infinite skill and patience, went to the making of a book which admits the reader to the intimate family life of these untamed creatures.

Most of the photography was done with a large camera from a hide, a hand camera being used for sea birds only. The photography of the latter is comparatively simple as they are not very shy, the main difficulty being the inaccessibility of their haunts. But photographs such as those of the golden eagles caressing each other above their eaglet, feeding and sheltering the eaglet, and of the hooded crow with her nestling are wonderful achievements, alike in photographic skill and bird study. Regarded pictorially, the 'close-ups' are better than such pictures as "Stags Crossing a River", where the lens is too good for the picture, the deep focus giving no sense of recession.

The author comments on the difficulties found in enforcing the Wild Birds Protection Act. Books such as this must, we hope, turn a reader's thoughts to study of a bird as a lovely sentient being, rather than as a stuffed corpse or a blown egg.

Flora of Jamaica:

containing Descriptions of the Flowering Plants known from the Island. By William Fawcett and Dr. Alfred Barton Rendle. Vol. 7: Dicotyledons—Families Rubiaceae to Compositae. By the late Spencer Le Marchant Moore and A. B. Rendle. Pp. ix+303. (London: British Museum (Natural History), 1936.) 15s.

THE continuation of this valuable work is very welcome, and we note with pleasure that there is every hope of its speedy completion. The present volume is filled almost entirely by the accounts of the Rubiaceae and Compositae, which were prepared by the late Mr. Spencer Moore and have been completed by Dr A. B. Rendle. The latter author has also worked out the Campanulaceae, and has successfully unravelled the difficulties which obscured the identity of some of the ten species of *Lobelia* occurring in Jamaica. All students of tropical American plants will be grateful for the attention to nomenclature and synonymy, the care in examining historic types, and the general finish which have from the first been marks of this distinguished production.

Einführung in die Vektor- und Tensor-rechnung: unter besonderer Berücksichtigung ihrer physikalischen Bedeutung. Von Prof. Dr. Harry Schmidt. Pp. vi+126. (Leipzig: Max Jänecke, 1935.) 5.80 gold marks.

THIS is an excellent account of vector analysis, starting at the beginning, based on sound mathematical principles, and clearly explained. The vector theorems are well illustrated by hydrodynamical applications; the tensor of the second order (the work is carried no further) is exemplified by the theory of elasticity. The author believes that an exact treatment need not be more difficult, and is certainly easier to understand, than a popular exposition lacking in rigour and based on intuition. With this we entirely agree, and can recommend this book to all who wish to learn vector methods and their application.

The Search for the Isotopes of Hydrogen and Helium of Mass 3

By The Right Hon. Lord Rutherford, O.M., F.R.S.

AFTER the discovery by Urey of the isotope of hydrogen of mass 2 (deuterium) and its concentration by electrolysis, it was natural to examine whether any other stable isotopes of hydrogen, and particularly ^3H (tritium, symbol T), are present in ordinary hydrogen. In this article an account will be given of the chequered history of the many investigations to throw light on this question, and incidentally also of attempts made to detect the presence of the helium isotope of mass 3, which is believed to be produced in certain transmutations.

It was natural to suppose that the concentration of deuterium by electrolysis of water should lead also to a concentration of tritium to a considerable extent. Using a direct spectroscopic method, Lewis and Spedding¹ in 1933 looked for the presence of a spectrum line corresponding to ^3H in hydrogen released from a rich sample of heavy water, but with negative results. They concluded that if tritium were present at all its concentration was less than 1 in 6×10^4 , compared with ordinary hydrogen.

Experiments with a similar object were carried out in Princeton University in 1934 by Lozier, Smith and Bleakney². A sensitive form of mass-spectrograph designed and operated by Bleakney was used to detect the presence of charged molecules TD of mass 5. They estimated that the concentration of T was about 5 in 10^4 after the initial volume of ordinary water had been reduced to 1 part in 225,000. The experiments were continued by Prof. H. S. Taylor and his collaborators³ until the volume was reduced to 1 part in 150 million. In these experiments about 75 tons of ordinary water were electrolysed down to 0.5 c.c. The concentration of T/D using Bleakney's method was found to be about 1 in 10^4 , and they concluded that the abundance of T in ordinary water was about 7 in 10^{11} .

In the meantime Oliphant and Harteck⁴ in Cambridge had found definite evidence that the bombardment of a deuterium preparation by fast deuterons led to two types of transformation, in one of which an isotope of hydrogen of mass 3 was liberated, and in the other an isotope of helium of mass 3. From the energies released in these reactions, it was deduced that the masses of these two isotopes are nearly the same, namely, 3.0171 when the mass of a hydrogen atom is taken as 1.0081. The general evidence suggests that

both these new isotopes are stable under normal conditions.

It was clear that it was matter of much scientific importance to obtain sufficient quantities of these new isotopes not only to determine their masses with precision but also to investigate the interesting transformations which might be expected to occur when the ions of these isotopes were used for bombarding purposes. An account will be given later of attempts to obtain detectable quantities of these gases by direct transmutation, but I will first deal with experiments to obtain detectable quantities of tritium by continued electrolysis of heavy water. Before the completion of the Princeton experiments, the feasibility of large-scale electrolysis was discussed by Prof. Urey with Prof. Tronstad and Engineer J. Brun of the Norsk Hydro-Elektrisk Kvoelstofaktieselskab of Oslo, Norway, which was producing heavy water in quantity by the electrolytic method. The most suitable methods to employ for the concentration of tritium were discussed by Dr. Farkas and Dr. Oliphant of Cambridge with the representatives of the Norwegian company, which very kindly agreed to carry out the elaborate research programme required. A brief statement of the methods employed, given by the Company, is as follows:

"If ordinary heavy water containing a small quantity of tritium oxide is electrolysed to a small volume, it is to be expected that, in all probability, it will become rich in T_2O . The object of the experiments was to try to accomplish this by electrolytic means.

"The basis used was 43.4 kilos of heavy water produced electrolytically and having an average D_2O content of 99.2 per cent. During the course of nine months and a half, this heavy water was electrolysed to a volume of 11 c.c.

"The electrolysis was carried out under conditions that ought to be considered favourable for the concentration of any tritium oxide that might happen to be present in the heavy water. During the first part of the electrolysis nickel cells provided with iron cathodes were used, but during the last part of the process glass cells with electrodes made of platinum were employed. The cells were constructed in such a manner that there was excellent communication between the anolyte and catholyte. In addition to this, provision was made for efficient reflux condensation of the water

vapour, so as to ensure the purity of the gases developed by the electrolysis.

"The electrolyte used consisted of heavy potassium hydroxide—KOD. In order that the concentration of the electrolyte should not increase too much during the electrolysis, the potassium hydroxide was gradually eliminated from the electrolyte by distilling off the water. The D₂O content of the dry potassium hydroxide obtained by this process was regenerated by being first treated with dry CO₂, the water liberated thereby being then distilled and passed back to the cell.

"The density of the cathodic current during the electrolysis varied from 0.2–0.4 amp./cm.². The temperature of the electrolyte varied from 30° to 50° C.

"After the electrolysis had been completed, the contents of the cells were treated with dry CO₂ (for the purpose of converting the potash into carbonate), and the heavy water was distilled off. No further purification was effected."

Part of this concentrated material was handed to Dr. F. W. Aston to examine in his precision mass-spectrograph whether any tritium was present. The following statement of the behaviour of this material has been given to me by Dr. Aston:

"The vapour of the concentrated heavy water was allowed to pass continually through the discharge tube which was in a very favourable state, the diatomic molecular lines being about 1,000 times as bright as the triatomic. The line 5 was examined by a 40 minutes exposure and the limits of detection estimated by very short exposure of line 4 (D₂) down to 1 second. Line 5 was unquestionably D₂H and no trace of a companion in the position expected for DT could be detected. This would have been about 0.5 mm. away and easily resolved. A second test was made with an exposure of 50 minutes with the same result. As line 4 could have been detected with an exposure of 1/20 second, it follows that

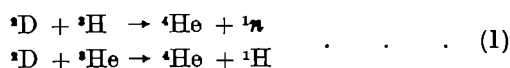
$$\frac{DT}{D_2} < \frac{1}{50,000}$$

The conclusion of Dr. Aston, that no trace of tritium could be found in the concentrated sample by his very direct and simple method, is very disappointing after the time and labour spent in Norway in preparing this material. While it is, of course, difficult to make any certain comparison of the concentration of T to be expected in these two large-scale experiments, it does not seem likely that the concentration of T would be less in the Norwegian experiment. I am informed by the Norwegian company that, in all, 13,000 tons of ordinary water were used for the production of the 43.4 kilos of heavy water employed by them to concentrate the tritium, while Taylor

and his collaborators started with 75 tons. The rather low yield of heavy water in the Norwegian experiments was due to the fact that the cells used were ordinary technical electrolyzers for the production of hydrogen and oxygen, heavy water being regarded as a by-product. In any case it is to be expected that in the earlier stages of the electrolysis the tritium would be enriched at least as much as the deuterium.

There is thus rather a conflict of evidence with regard to the concentration of tritium in the two similar experiments. The American observers obtained a positive result indicating a value of T/D = 1/10⁴ in their enriched sample, while Aston by a more direct method could detect no tritium at all in the Norwegian preparation, and concludes that T/D must be less than 2 in 10⁴. Unfortunately, an intercomparison of the samples is not possible, for Prof. H. S. Taylor informs me that their enriched sample has been lost. It is hoped, however, that it will be possible to arrange to test the Cambridge sample in Princeton by the sensitive method devised by Bleakney. It is important to decide that the ions of mass 5 shown by this apparatus are in fact due to molecular ions TD.

It was felt desirable, however, to confirm the negative result found by Aston by a transmutation test. This is in some cases a delicate method of analysis, as is shown by the fact that the presence of the small amount of deuterium in ordinary water can readily be observed by its use. Experiments were consequently made by Kempton and Miss Maasdorp in Cambridge, to test whether hydrogen separated from this concentrated material showed any characteristic difference from ordinary deuterium, when the accelerated ions were used for bombarding purposes. The ion beam was analysed by a magnetic field, and the part of mass 3, no doubt mainly due to charged DH molecules, was allowed to fall on a target consisting of a deuterium compound. The intensity of the beam of mass 3 was very small compared with that observed for the D ions. From general considerations, we might expect the following reactions to occur for fast ions corresponding to ³H and ³He:



the energy released in each case being about 20 million volts. Owing to the copious production of neutrons from the ordinary D—D reaction, it is not possible to distinguish the small number of neutrons or protons to be expected from the above reactions. On the other hand, the α -particles arising from these reactions should have a range in air of 2–3 cm., and should be readily distinguished from protons, owing to their greater ionizing power. Careful search failed to reveal any

such α -particles, and the number must have been less than 1/5,000 of the protons arising from the D—D reaction. Assuming that these reactions are all equally efficient at the voltage used, it follows that

$$T/D < 1/5,000.$$

While the limit of detection of T by this method is 10 times lower than that deduced by Aston, this conclusion nevertheless affords a useful check in indicating that very little if any T can be present.

It is desirable to add a short statement of attempts made to detect the artificial production of ^3H and ^3He in the D—D reaction already referred to. Since these transformations are highly efficient, and take place for very low bombarding energies, it is to be expected that both ^3H and ^3He should accumulate when an ordinary glow discharge is passed through heavy hydrogen. Accordingly experiments were carried out in America and in Cambridge to produce these new isotopes by passing heavy hydrogen slowly through a discharge tube across which a potential of 60–70 kilovolts was applied. Samples of the gas obtained by this treatment were tested in America for the presence of ^3H and ^3He by the sensitive method of Bleakney, previously mentioned. At first, evidence⁴ of small traces of these gases was found, but we understand that later work has failed to confirm these conclusions.

In the Cambridge experiments made by Oliphant, the treated gas mixed with an excess of helium was passed through the discharge tube, which produced a beam of fast ions for experiments on transmutation. After acceleration, the beam of ions was analysed by passage through a magnetic field, and the ion beam of mass 3 was found to be very feeble compared with that of mass 2, owing to the presence of helium, which has the property of dissociating the charged molecules produced by the discharge. The method of detection of ^3H and ^3He was similar to that already described. A search was made for α -particles which might

be expected to arise from the reactions (1), when the ions of mass 3 fall on a target containing deuterium. No such α -particles were detected, and the number was certainly less than 1/20,000 of the protons liberated from the deuteron beam under the same conditions. Assuming as before that these transformations are all of equal efficiency, it is evident that ^3H and ^3He cannot be present to the extent of 1/20,000 in the deuterium gas.

Attempts have been made by G. P. Thomson and F. A. Paneth in London to produce ^3He by the D—D reaction in sufficient quantity to be detected by the extremely sensitive micro-methods developed by Paneth, but so far without success. It may be that the reaction of ^3H and ^3He with D takes place very easily, so that a stage is soon reached when these isotopes are destroyed in the discharge as fast as they are produced.

The rapid disappearance of ^3H and ^3He by transmutation would account for the very small abundance of these isotopes in the earth and presumably in the sun. A number of experiments have been made to detect the helium isotope of mass 3 in ordinary helium by direct spectroscopic methods, but with entirely negative results. This, however, is not surprising when we consider that terrestrial helium is probably derived from the α -particles of mass 4 expelled from the radioactive substances present on our earth.

It is a striking fact that while in transmutation experiments using counting methods the D—D reaction is on a marked scale, giving rise to very large numbers of ^3H and ^3He particles, yet it does not seem feasible at the moment to obtain sufficient quantities of these two interesting isotopes to study their properties by ordinary physical chemical methods.

¹ Lewis and Spedding, *Phys. Rev.*, **43**, 464 (1933).

² Loder, Smith and Bleakney, *Phys. Rev.*, **45**, 655 (1934).

³ Schwood, Taylor, Loder and Bleakney, *J. Amer. Chem. Soc.*, **57**, 780 (1935).

⁴ Oliphant, Hartcock and Rutherford, *Proc. Roy. Soc., A*, **144**, 692 (1934). Oliphant, *NATURE*, **137**, 396 (1936).

⁵ Bleakney, Harnwell, Loder, Smith and Smyth, *Phys. Rev.*, **46**, 81 (1934).

Social and Political Application of Nutritional Science

THE historical development of any science is twofold. First come the discoveries of natural principles and facts of theoretical interest. These are followed at varying intervals of time by their application to practical life. The history of nutritional science offers no exception to this rule.

Recently, the trend of nutritional investigation has undergone a marked change. While disinterested studies of a purely theoretical nature

will always bulk large in the pages of scientific journals, there is clear evidence that pride of place is now being given to researches which will hasten the practical application of the new nutritional teaching. In short, there are welcome signs of a lessening gap in the relations between those who are engaged in ascertaining the facts of nutrition and those whose duty is the application of that knowledge to the practical affairs of public health.

Some evidence of this will be found in the fact that the number of papers noted in the section of *Nutrition Abstracts and Reviews* (published by the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Aberdeen), devoted to the application of nutrition to human health has increased by more than 90 per cent in the last five years.

The two outstanding features of present-day investigations are first, the attention which is being paid to the determination of nutritional needs, and secondly, the ascertainment of the extent of means to supply these needs. The economic blizzard which struck the world in the years around 1931 gave tremendous stimulus to this type of study, and we find the world's literature during the years of depression abounding in papers dealing with the influence of the economic crisis on the nutritional needs and health of the people, the dietary resources of the unemployed in relation to their physical fitness, and the prevalence of malnutrition in children and young persons living under conditions of limited means in distressed areas.

The relation between poverty and national physique has been re-examined in the light of our new knowledge of nutritional needs. Many recent studies have shown that as income increases the greater is the consumption of milk, eggs, fruit, vegetables, meat and fish. This finding is not altogether new. It has long been established from the innumerable records of family expenditures published by the well-known economists of the nineteenth century that additional increases in income are associated with an increasing amount spent on food, and further, that the struggle to consume better kinds of nourishment is greater than the striving to increase total amounts of consumption. Le Play and Engel, who were the first to generalize these laws, maintained that the upper classes were to be differentiated from the lower by the amounts of animal food they consumed.

What is entirely new, however, is the realization that rising income, associated with increased consumption of milk, eggs, fruit and the rest, goes hand in hand with decreased death-rate, better growth of children, greater adult stature and much improved general health. The explanation of this lies in the fact that the foods mentioned are just those found to be richest in vitamins, mineral matter and first-class protein, constituents proved by laboratory experiments to be essential for the preservation of health. This is the crux of what has been called 'the newer knowledge of nutrition'. It calls for a change in point of view rather than any fundamental or revolutionary alteration in dietary habits.

Undoubtedly, disquieting features in the state of national fitness have been revealed as a result of these recent dietary and family budget investigations in Great Britain, and very naturally a lively public interest in the whole nutrition question has been aroused. Social conscience is especially sensitive because, not only in Great Britain but also in many other countries, it has been estimated that a very large proportion of the population falls into groups in which the income per head is less than that considered sufficient for the purchase of foods necessary for the maintenance of optimum health. The unfulfilled needs of the people of Great Britain for essential foodstuffs have been assessed at £200,000,000 a year.

Inevitably, controversy has arisen. On the question of needs, typical examples of disagreement are those which surround the standards advocated by expert medical opinion and those adopted by Government departments responsible for unemployment assistance and other forms of public relief. In official circles the inclination has been to think in terms of minimum needs; that is to say, the level fulfilling conditions which would keep the population at the present average standard of health and physique. The scientific investigator, on the other hand, cannot conscientiously study anything less than an optimum, which has been defined as a level of requirement above which no subsequent addition would add to the individual's share of good health and of full physical development. Again, the absence of precise objective standards by which to measure the state of nutrition of a given individual offers another serious difficulty. The adoption of differing standards and the varying mental conceptions and impressions of individual observers have led to confusion in the assessment of malnutrition and the subsequent comparison of data from different sources. As a result, allegations that substantial and progressive declines in the health of communities have followed the years of economic depression are often difficult either to refute or to substantiate. Further fuel has been added to the fire of controversy by the expressed opinion of statisticians that some of the most recent contributors to the discussion on the relation between poverty and nutrition have based their findings on faulty methods and meagre and uncertain data.

The task of those who would distinguish what is true from what is false is not made any easier by the number of different bodies, official and non-official, which have contributed to the discussion. Data from all sorts of different sources—medical, chemical, physiological, social—have been accumulated piecemeal.

Questions of nutrition now regularly form an outstanding feature of the official reports, issued from

the Ministry of Health and the Board of Education, dealing with the state of national health and the welfare of infants and school children; and, year by year the number of local authorities which have instituted inquiry into nutritional conditions in their own areas becomes greater and greater. Further, in Great Britain at any rate, there have arisen within the last few years numerous semi-private organizations the self-imposed task of which is partly to educate the 'man in the street' upon what is properly considered to be a matter of immediate public concern, and partly to stimulate official circles into making authoritative pronouncements regarding what constitutes an adequate diet and how the Government proposes to bring such a diet within the economic compass of every section of the community. Chief among these are: the Committee Against Malnutrition, the Children's Minimum Council, the People's League of Health, and PEP (Political and Economic Planning), all of which have, by well-directed propaganda and other means, done much to focus public attention on the urgent need for the formulation of a sound national nutrition policy.

Whatever may be one's opinion on the validity of individual statistics purporting to show the extent of malnutrition and its precise relationship to family habits and circumstances, there is no doubt that, viewed in the widest perspective, a serious amount of malnutrition prevails in almost every country in the world, especially among children. Furthermore, it seems that where the dietary standards fail, the major cause is not ignorance but poverty.

It is not surprising, therefore, that following the presentation of facts there should have been a cry for official action. Before action can be taken, however, the public health administrator must satisfy himself that the principles suggested to him by the scientific investigator do really concern him. Broad generalizations must be accepted with caution. Alarmist statements on the prevalence of under-nutrition must be considered judiciously. Facts must be verified and must be interpreted with greater precision in order to determine whether action is justified and what form it should take. The tendency in Government circles, therefore, has been towards further inquiry rather than to the hasty acceptance of the new ideas.

In the United Kingdom, the Minister of Health and the Secretary of State for Scotland appointed, in May 1935, an Advisory Committee to examine the quantitative and qualitative facts of nutrition and to report as to any changes in the diet of the people which might appear desirable in the light of modern advances in our knowledge. This Committee has recently issued its first report, the out-

standing features of which are the Committee's adoption of the standards of dietary requirements drawn up by the League of Nations Committee to which reference is made below, its recognition of the importance of milk and its recommendation that in impending legislation dealing with the national milk supply the primary objective of the Government should be to ensure that specified amounts (two pints per day for every pregnant and nursing mother, and a pint and a half for every child) are brought within the purchasing power of the poorest. It has also accepted as reasonable and likely to be in accordance with the facts, the broad picture on food consumption at different income levels prepared by the Market Supply Committee and used by Orr as the basis of his estimates in "Food, Health and Income"; but recommends that it should be regarded not as final but rather as a framework to be filled in when an adequate number of budgets have been obtained and individually analysed. These are conclusions of far-reaching importance.

Of much wider interest, however, is the attention which has been paid to the nutrition question by the League of Nations. The Health Organisation has been engaged in the study of nutrition in its relation to public health since 1925. On the proposal of the Australian delegate, who, incidentally, was one of the first to appreciate the close nexus of interest between problems of health and agriculture, the League, at its sixteenth Assembly in 1935, recommended that the Health Organisation should continue and develop its work on nutrition in collaboration with the International Labour Office and the International Institute of Agriculture. At the same time, the Assembly decided upon the creation of a Mixed Committee of experts on agriculture, economics and public health, charged with the duty of presenting a general report to the Assembly on the problem of nutrition in its public health and economic aspects. The nineteenth International Labour Conference adopted a similar recommendation. In October 1935, the Health Committee decided to set up a Technical Commission on Nutrition composed of three experts each from the United Kingdom, the United States and France, and one from each of six other European countries. This Commission, at its first session in London in November 1935, laid down the physiological bases of nutrition and established the food requirements of human beings during their growth from conception until adult age. With a view to the application of these recommendations in different countries and their adaptation to varying geographic, economic and social conditions, the report was circulated for the observations of academies of medicine, research councils and other authorities in various countries.

the competence of which covers nutritional problems. At its second session, held in Geneva in June 1936, the Technical Commission examined the observations communicated by these bodies, revised and amplified its London report, and presented it to the Mixed Committee in conformity with the Assembly's resolution of 1935.

This revised report, embodying considered international opinion on human dietary standards, represents the first and most outstanding contribution towards evolving order out of the chaos of specialized data on requirements which has confronted nutritional workers in recent years. A yardstick has at last been provided by which to measure diets and determine how far they are deficient for health. As already mentioned, the report has been adopted by the Advisory Committee on Nutrition responsible to the British Ministry of Health, and, in common with all the other work of the League's Technical Commission on Nutrition, has created a considerable impression not only in Europe but also over-seas. Thus, items included on the agenda of the Inter-Governmental Conference of Far-Eastern Countries on Rural Hygiene have been inspired by the Commission's work, as also has the recent formation of numerous national councils, such as those in Australia and in the British Colonies, specially set up to study local nutritional problems along the lines of the League's recommendations.

Perhaps nowhere have the suggestions of the League been acted upon with greater promptitude than within the British Colonial Empire. In April 1936, the Secretary of State for the Colonies addressed a dispatch calling for a comprehensive survey of the nutrition position in each Dependency. One of the main purposes of the dispatch was to direct attention to the important bearing which nutrition should have upon agricultural, veterinary, educational and general policy in the Colonial Empire. In planning the production of any territory the aim should be twofold; on one hand, the provision to the entire population of a

locally grown food supply considered adequate by medical science and, on the other, the growth of remunerative export crops. Already many replies have been received, some of which have been made available as public documents. "Food in Relation to Health" has been issued by the recently established Nutrition Committee in Trinidad; a similar report, based on the well-known work of Nicholls, describes conditions as they apply in Ceylon; the report of a specially formed nutrition committee has been presented to the Legislative Council of British Guiana; and a "Nutritional Review of the Natives of Zanzibar" has also been submitted.

To consider these reports and to advise generally on nutritional matters relating to the British Colonial Empire, the Prime Minister, in November 1936, appointed a Committee of the Economic Advisory Council consisting of medical, agricultural and economic specialists. This Committee is expressly commissioned to keep in touch with the work of the League of Nations and enable His Majesty's Government to assist and support it more effectually.

No attempt has been made here to deal exhaustively with the subject under review. Rather the aim has been to present a brief general outline touching the reasons for, and the nature of, Government intervention and official international co-operation on a subject of intense universal interest. Unavoidably, the writer's approach has been from the British point of view. One must remember, however, that in the United States of America, in the U.S.S.R., in Italy and in many other countries, evidence that Governments have accepted their obligations to give authoritative public guidance on questions of nutrition is equally conspicuous.

By far the most important thing is that the League of Nations has been accepted as the common platform on which national aspects of the problem can be debated in their world setting and in an atmosphere of reason and mutual comprehension.

Obituary Notices

Prof. J. W. Michaelsen

PROF. J. WILHELM MICHAELSEN, *Hauptbustos* in the Hamburg Zoological Museum, died on February 18 in his seventy-seventh year. Born in Hamburg, he joined the Hamburg Museum in 1887 and worked there until the time of his death. As a young man he became interested in the Oligochaeta, and from 1886 until his death he wrote many papers on their anatomy, classification and geographical distribution. He also wrote on the Tunicates and the Polychaeta,

but his main interest was the Oligochaeta, and it would be difficult to over-estimate the extent of his contribution to our knowledge of this group. Vastly learned, disinterested and careful of minutiae he belonged to the great tradition of German scholarship, and the sheer quantity of his work—his papers on the Oligochaeta alone bind up into eight very bulky volumes—testifies to an extraordinary industry and persistence of motive. In addition to this, he found time to make journeys to the southernmost corners

of America, Africa and Australia in pursuit of evidence to throw light on the palaeogeographical problems arising out of his study of Oligochoeta distribution.

There has never been any question as to the consistently high quality of Michaelsen's work, and his co-specialist and in his own line his only peer, the late J. Stephenson, has for a heading to his monumental monograph on the Oligochoeta (Oxford Univ. Press, 1930) the words, "To my Friend and Master W. Michaelsen of Hamburg".

Those of a younger generation who had the good fortune to correspond with Michaelsen will testify to his great kindness and patience. Even when he was a man in the seventies he would go to extraordinary lengths to assist a beginner who applied to him for help or information. On one occasion, he copied out a whole paper himself by hand and traced the drawings to send to a young student who wrote to say that the particular work was not available. He had the rare characteristic of cheerfully acknowledging his own mistakes, and was entirely free from that failing which overtakes so many men who have devoted their lives to the mastery of a specialism, the failing which consists in treating a difference of opinion, especially one coming from a younger man, as a personal affront. His letters reveal a simple, unexpectedly humorous and kindly man.

Prof. A. Erman

THE death of Prof. Adolf Erman on June 26 inflicts an incalculable bereavement upon both the Egyptological world and a large circle outside it. In the realms of his own subject he was without doubt regarded as the foremost scholar, since it was he who first placed the study of the ancient Egyptian language upon a scientific basis. His "Ägyptische Grammatik", which first appeared in 1894 and which was destined to pass through four editions, revolutionized the method of approach to the classical language, while the later phase of Egyptian, known as "New Egyptian", was fully dealt with in his "Neuägyptische Grammatik" of 1890 and 1933. Yet he was far from belonging to that class, all too large even at the present day, of specialists who never trouble to interpret their discoveries for the benefit of the general reader. He could write excellent descriptive prose, informed by a considerable sense of humour, which presented a living picture to his readers, as in his "Ägypten", translated into English by Lady Tirard under the title of "Life in Ancient Egypt", his "Religion der Ägypter", translated by the same author and called "Handbook of the Egyptian Religion", and his "Literatur der Ägypter" of which the English edition has been prepared by Prof. A. M. Blackman. The last-named book is perhaps his greatest contribution of this kind, enabling the student of the past for the first time to become acquainted with specimens of ancient Egyptian literature of all periods, beautifully translated and explained.

The greatest of Erman's undertakings, however, was the enterprise of the Berlin hieroglyphic diction-

ary, which he edited jointly with other colleagues. This vast work, intended to cover the whole history of ancient Egyptian, is still in process of publication, the first five volumes having appeared between the years 1926 and 1931. It has been justly said that the wide range of Erman's abilities made him an interpreter of Egyptian civilisation unrivalled by any other except the Frenchman Gaston Maspero. He has left to his successors a standard of scholarship which can only be maintained if the scientific principles which he so assiduously taught during his long life are faithfully obeyed. A. W. SHORTER.

WE regret to announce the death on August 3 of Prof. Josef Woldfich, director of the State Geological Institute at Prague, at the age of fifty-seven years. Born in Vienna, Prof. Woldfich became well known in Central Europe for his geological investigations, which began with a re-examination of certain Bohemian rocks, notably those studied by the Frenchman Barrande and more recently by the late Prof. J. E. Marr of Cambridge. After the Great War, he was appointed to the chair of geology at the new University of Brno in Moravia. Here he commenced a series of geological studies of the lesser-known districts of Slovakia, a work of extreme importance for the compilation of the modern geological maps of Czechoslovakia. He had been director of the State Geological Institute for the past three years.

We regret to announce the following deaths:

M. André Beaumont (M. Jean-Louis Conneau), one of the pioneers of aviation, aged fifty-seven years.

Dr. W. M. Cumming, lecturer in bacteriology in University College, Dundee, an authority on tuberculosis, aged thirty-nine years.

Mr. C. E. L. Gilbert, C.I.E., formerly chief conservator of forests, Bombay Presidency, on August 8.

Prof. Vernon L. Kellogg, professor of entomology in Stanford University in 1896-1920, permanent secretary of the U.S. National Research Council in 1920-32, aged sixty-nine years.

Prof. Hans Reek, the distinguished German volcanologist, who was associated with the discovery of human remains at Oldoway, Tanganyika, in 1914, on August 4, aged fifty-one years.

Prof. A. E. Seaman, emeritus professor of geology and mineralogy in the Michigan College of Mining and Technology, on July 9, aged seventy-nine years.

Mr. A. Sharples, formerly Government mycologist, Federated Malay States, and head of the Division of Plant Pathology, Rubber Research Institute of Malaya, on August 6.

Mr. J. W. N. Sullivan, author of "Three Men Discuss Relativity" and other books of a popular character on aspects of modern science, on August 12, aged fifty-one years.

Prof. J. G. Thomson, professor of medical protozoology in the London School of Hygiene and Tropical Medicine, on August 13.

News and Views

The Sun's Outer Envelope

ACCORDING to a cabled statement from the New York correspondent of *The Times* published on August 14, Major Stevens of the United States Army, flying over Peru at a height of 30,000 ft. on June 8, during the total solar eclipse, obtained some very surprising photographs of the eclipsed sun. Surrounding the corona with its irregular streamers, there was found a bright envelope one million miles high in which the details of the corona became insignificant. The first natural reaction is to ascribe this result to photographic effects of over-exposure, especially as no details of the size of the image secured or other optical details of the apparatus used are given. But the name of Harvard University behind the announcement renders one unwilling to look to any simple instrumental explanation of this unexpected phenomenon. A link between the corona and the zodiacal light seems suggested, but no indication is given in the report of any extension in the zodiacal plane, such as would be expected. Again, since the zodiacal light and the corona both have the same distribution of radiation as ordinary sunlight, one would expect any connecting matter to be similarly conditioned. Only over-exposure, which blots out all coronal details, would account for the even globular envelope unless this outer envelope is relatively much stronger in light of short wavelength. It would be interesting to know what visual observations were made from the aeroplane. If these agreed in general outline with the photographs secured from the ground, then the photographs from the stratosphere suggest an extensive outer atmosphere giving bright line or bright band radiation which must be examined spectroscopically at the next suitable total eclipse. Further and fuller details of the photographs will be impatiently awaited.

Anglo-Egyptian Treaty Honours List

THE additional Egyptian Honours List issued in connexion with the signing of the Anglo-Egyptian Treaty in London, and published in the *Egyptian Mail* of July 28, contains the names of the following men of science: *Third Class of the Order of Ismail* (Commander), Dr. E. Hurst, director-general of the Physical Department of the Ministry of Works, and Mr. F. Newhouse, inspector-general of irrigation in the Sudan; *Second Class of the Order of the Nile* (Grand Officer), Dr. Roy S. Dobbin, professor of obstetrics in the Egyptian University, Cairo; *Third Class of the Order of the Nile* (Commander), Dr. J. Templeton, chief botanist, Botanical and Plant Breeding Section, and Dr. W. T. H. Williamson, chief chemist, Chemical Section, of the Ministry of Agriculture, Dr. J. H. Grindley, expert for technical education, Major W. L. Forsyth, professor of bacteriology, and Prof. D. H. Bangham, dean of the faculty of science in the Egyptian University, Cairo; *Fourth Class of*

the Order of the Nile (Officer), Mr. G. H. Jones, director of the Mycological Section, Prof. H. Priesner, director of entomological research, and Mr. C. H. Broun, senior botanist of the Ministry of Agriculture, Prof. T. L. R. Ayres, professor of physics, Dr. O. Zdanaki, professor of geology, and Prof. A. Naef, professor of zoology in the Egyptian University, Cairo.

Centenary of Dr. Edmund Weiss (1837-1917)

ON August 26, 1837, Dr. Edmund Weiss, the distinguished Austrian astronomer, was born at Freiwaldau, in Austrian Silesia. A part of his boyhood was spent in England, where his father was physician to a health institution, but he received his education at Troppau and at the University of Vienna, and at nineteen years of age became assistant to Karl von Littrow (1811-77) in the old Vienna Observatory which had been erected in 1826 by Joseph von Littrow (1781-1840) on the site of the observatory established by Father Maximilian Hell, S.J., in 1758. At first Weiss was employed on geodetic work, but it being proposed to remove the old observatory, which was situated among the narrow streets of the Austrian capital, to a more favourable situation, Weiss, in 1872, was sent on a tour of European and American observatories to study their methods, and optical works, and to him fell the task of planning the equipment of the new observatory at Währing, the foundation stone of which was laid in June 1874. On von Littrow's death in 1877 Weiss was appointed to the directorship. This post he held for thirty-two years, retiring in 1910. He died on June 21, 1917, at the age of seventy-nine years. During his career Weiss took part in several eclipse expeditions, was one of the observers of the transit of Venus in 1874, wrote on comets, meteors and orbits, and prepared a revised edition of Oeltzen's catalogue of Argelander's zones from 15° to 31° S. declination. He was a member of the Vienna Academy, a *correspondant* of the Paris Academy of Sciences, and for thirty-four years an associate of the Royal Astronomical Society.

Reginald Harrison (1837-1908)

MR. REGINALD HARRISON, who was equally eminent as a Liverpool and as a London surgeon, was born at Stafford on August 24, 1837. He was educated at Rossall School and St. Bartholomew's Hospital, and qualified in 1859. In 1866 he became fellow of the Royal College of Surgeons, and the following year was appointed assistant physician to the Royal Infirmary, Liverpool, becoming full surgeon in 1874. He was at first a general surgeon, but before long he specialized in diseases of the male genito-urinary system, and in 1889 he left Liverpool for London on his appointment as surgeon to St. Peter's Hospital for Stone and Other Urinary

Diseases. Harrison was the author of "Surgical Disorders of the Urinary Organs" which became a standard text-book, and went through four editions, as well as of "Selected Papers on Stone, Prostate and Other Urinary Diseases" and "The Use of the Ambulance in Civil Practice". During his residence in Liverpool he re-organized medical education at the Royal Infirmary, and took an active part in the introduction of the ambulance system, in which he continued to take an interest after his removal to London, being president of the Street Ambulance Association at the time of his death. He was the recipient of many distinctions, including those of Knight of Grace of the Order of St. John of Jerusalem, president of the Medical Society of London, and Hunterian professor of surgery and pathology of the Royal College of Surgeons. In 1903 he inspected the School of Medicine at Cairo for that College and received the Imperial Ottoman Order of the Medjidie.

Roman Dorchester

THE Dorset Natural History and Archaeological Society, concurrently with its share in the excavation of Maiden Castle, is investigating a site at Colliton Park, Dorchester, on which a county hall is to be erected. The site is within the walls of the Roman city and has not been built on since Roman times. In view of its situation, it was thought probable that Roman buildings would be found there, and the last opportunity upon which the site would be available for examination could not be allowed to pass by. Already, it is reported (*The Times*, Aug. 14), a large part of a house has been disclosed, of which one range of five rooms contains three for bathing, a central dressing-room, with a hot bath on one side with its hypocaust, still largely intact, and on the other side the cold bath-room. North of this range of rooms is a corridor looking out on the courtyard, in which is the well, now cleared to a depth of thirty feet. The filling of the well was found to be entirely composed of wreckage from the building, and included broken parts of at least nine stone columns, four of which are complete though fractured. They probably formed the colonnade of the corridor. At right-angles to the first range of rooms is a second, consisting of seven rooms. All these have mosaic floors, of which one is in perfect condition, while another, though badly damaged, still shows traces of considerable beauty. This latter has panels containing a head of Flora and another head which has not yet been identified. One of these rooms has a hypocaust beneath. An unusual feature in a Roman house in Britain is the lower part of two windows with internal splays. As this house is clear of the building line of the new hall it is hoped to preserve it intact. Trial trenches are being dug to find the other buildings which are thought to lie beneath the surface. As the whole area is to be explored, further financial assistance towards the considerable cost is required.

The Gyro Compass on the Hudson Bay Route

IN a summary of the eighth report of the Imperial Shipping Committee on Hudson Bay Marine In-

surance Rates, published by H.M. Stationery Office, 3d. net, which appears in *The Times* of August 13, it is mentioned without comment that the Committee quotes tributes by captains of ships to the value of a gyro compass in contributing to the confidence with which the Strait and Bay were navigated. It is stated that other masters have expressed the view that a gyro compass is essential for navigating the Hudson Bay with safety. The Committee submitted to the underwriters that a further reduction of premiums should be made in respect of vessels equipped with gyro. An illustration is given of the saving of premium which could be effected by installing a gyro compass for one voyage, two voyages, and three voyages in the same season; against this is set the cost of hiring a gyro compass for, say, three months, which including fitting would, it is stated, be approximately £200, plus a very small charge for inspection. The Committee concludes that there is now a considerable inducement to the owner of a vessel to instal a gyro compass for voyages to the Hudson Bay. A gyro compass is specially desirable in the Hudson Bay area on account of the proximity of the north magnetic pole, off the Prince of Wales Land; a ship entering Hudson Bay must approach this pole within at least 14° , and owing to the low value of the horizontal magnetic force (which becomes zero at the magnetic pole), the directive force on the compass is low, and disturbances have a proportionately large effect. On the other hand, the distance from the geographical pole, which is one of the factors in determining the directive efficiency of the gyro compass, is more than 25° .

Electricity and Marketing

AN account is given of the Farmer's Conference at the Royal Agricultural Show held at Wolverhampton on July 8, in the *Electrician* of July 16. Mr. F. H. Slade read a useful practical paper on "Electricity and Marketing". He said that now the rural distribution of electricity is extending so rapidly, the British farmer will be able to compete on better terms with the foreigner. He described machines for the electro-mechanical grading and packing of fruits. Such machines will grade in one hour 700 lb. of gooseberries or 1,400 lb. of plums or 180 boxes of tomatoes, without bruising them and with less loss of bloom than by hand methods. A $1\frac{1}{2}$ h.p. electric motor can divide hard fruit into fine sizes and two qualities at the rate of 1,000 bushels per day, ready for cold storage. It pays a grower having 20 acres or more to instal grading and refrigerating plant. The care of apples in a refrigerator is a matter of 'atmospheric control'. In a suitable atmosphere the fruit can have its life-cycle speeded up fifty per cent or the ripening of the fruit can be slowed down by fifty per cent. The average cost of cooling milk in a refrigerator for dairy purposes costs on an average about a penny for thirty gallons. Refrigerated stores for eggs are replacing water-glass immersion. Thanks to electricity, the British farmer, instead of merely getting low prices in season and losing markets out of season to foreign competitors, is now in a much

better position to get profitable returns. Mr. Borlase Matthews mentioned that eight years ago there were 600 British farmers using electricity; the number now is more than 30,000. He mentioned that electricity was available to every exhibitor in the Show and for the first time they had a telephone exchange in the Show yard.

Practical Difficulties in International Telephony

In Europe, telephone operation is mostly in the hands of State administrations, although there are some large private telephone undertakings. To ensure satisfactory international joint working, uniform provisions for the calls are an indispensable necessity. With this end in view, the International Consultative Committee for Telephony, known as the C.C.I.F., has drafted recommendations and working instructions intended for application to international telephone traffic. In the *Brisson Review*, No. 1, 1937, Mr. A. Lignell, director of telephones at Stockholm, discusses these recommendations from the point of view of practical operation. He points out that an international call makes use of the subscriber's line, the exchange equipment at both ends and one or more international lines, as well as two or more operators for making the connexions. This type of call is much more difficult to deal with both in respect of time occupied and handling than a local call, and as a rule is of greater importance than a purely local connexion. The C.C.I.F. has therefore recommended that a local call ought to be cut off to allow of an international call, and this is prescribed in its "instructions to operators". At the plenary meeting of the C.C.I.F. in Copenhagen in 1936, there was formulated a question to the following effect, namely, whether international calls should be established with the "least possible delay", instead of connecting them immediately, and so simplifying and cheapening the equipment of local and trunk exchanges. Mr. Lignell is afraid that such simplification would lead to appreciable economic and other disadvantages in international traffic. At the present costs of trunk lines, this seems inevitable. It is to be hoped that the priority over internal traffic which international regulations accord to international traffic may be maintained.

Illuminated Show Cases

When lamp fittings are used in the normal way, electricians usually assume that the ambient temperature is about 27° C. and this gives a rise of 23° C. in the connecting leads before the maximum permissible operating temperature (50° C.) of the rubber insulation is attained. If the lamp fittings are used in enclosed shop windows or show cases, the assumption about the ambient temperature is no longer valid, as it depends on the aggregate wattage of the lamps in the enclosure. In a technical report of the Electrical Research Association (E.R.A.) published in *World Power* of April, a very thorough research by H. G. Taylor, W. J. Fehrsich and the late P. D. Morgan has been made to find out the actual heating

and to suggest methods of reducing the ambient temperature when excessive. Four methods are considered. A fan can be used to disturb the air, and so provide a uniform temperature throughout the enclosure. Another method is to provide natural ventilation by holes at the top of the case for egress of the hot air and others at the bottom for ingress of the cold air. Forced ventilation may also be used. The last method considered is to use special glass which either transmits the infra-red rays emitted by the lamps, etc., or has a high thermal conductivity and so facilitates the transfer of heat from the inside to the outside of the show case. The first two methods were found to be of considerable value. It was found that if the area of the holes bored in the top and bottom of the show case was about 4 per cent of the area of the top and bottom, the maximum temperature rise was reduced by fifty per cent.

Oil Transport in the Middle East

So far as is known, the large oil-fields of the Middle East are situated in Iran and Iraq. In Iraq the principal producing field is in the neighbourhood of Kirkup to the east of the Tigris and 145 miles north of Bagdad. In Iran, oil is derived mainly from two large oil-fields. The exploitation of petroleum on a modern commercial scale in these countries is a very recent development which is producing social changes in the ways of the inhabitants, and in the economic sphere it is widening the basis of trade, increasing the revenue and bringing money into the country. In the Year Book of the Cambridge University Engineers' Association for 1936, Colonel H. E. Medlicott describes the engineering difficulties of constructing 1,600 miles of roadway in Iran, sometimes skirting precipitous hillsides. The Anglo-Iranian Oil Company has already raised more than seventy million tons of oil from the two main oil-fields. In Iraq, the Iraq Petroleum Company had under its concession to construct a pipe-line system from Kirkup to the Mediterranean. It was decided that the line should debouch at two points on the Mediterranean, Haifa to the south and Tripoli to the north. The distance along the pipe-line route from Kirkup to the Euphrates is 156 miles, and from there two sections bifurcate, the southern section going to Haifa and the northern section traversing Syria to Tripoli. The crossings of the Tigris and the Euphrates had to be made by 'Blondins' (overhead cable ways) and steel towers about 140 feet in height had to be erected in concrete to support the massive steel ropeways over the rivers which carried loads of ten tons from one bank and deposited them on the other. The author is strongly of the opinion that the Middle Eastern history of the near future will be a record of steady progress, sociologically, economically and politically.

Mining and Geology in South Australia

We have received the annual report of the Director of Mines and Government Geologist of South Australia for 1935 (Adelaide: Government Printer, 1936). After a lengthy list showing that more than a hundred

plaints were investigated by the wardens, there is a series of short reports concerning mineral deposits, of which the most interesting is probably that "the Government Geologist was appointed to the Geological Advisory Committee assisting the operations of the Anglo-Persian Company's geologists who are making an examination of Australian territory for The Commonwealth Oil Refineries Ltd." This is followed by a report of the chief inspector of mines on the inspection work, whilst the general manager gives a report of the operations of State batteries and cyanide works. The mineral production of 1841-1935 closes the report, and shows a value of only a little more than 55 million pounds, of which three fifths is derived from copper ore and a quarter derived from iron ore. We have also received the Mining Review (No. 64) for the half-year ending June 30, 1936, of the South Australian Department of Mines. The review records the progress of mining operations in the first half of last year. The large-scale operations at Iron Knob and the many small gold mines scattered throughout South Australia are particularly noted.

The Problem of Reality in Physics

THE April number of *Current Science* contains a report of a lecture delivered at the Indian Institute of Science, Bangalore, by Prof. R. Ortvy, of Budapest, on "The Problem of Reality in Physics". Prof. Ortvy outlined the positivistic and realistic attitudes in physical science, the contrast between which he described as analogous to the relation between nominalism and realism in philosophy. To the positivist our only direct data are sensations, which alone constitute physical reality. All other 'existence' is constructed mentally out of sensations, and possesses a lower degree of importance. It follows that it is a senseless question whether anything exists that cannot be observed. This doctrine originated with Mach, and is shared by Bohr, Heisenberg, Dirac, Schrödinger and Philipp Franck. On the other hand, physical realism, the chief representatives of which in physics are Planck, Laue and Sommerfeld, chooses as its fundamental task the construction of a description of the world which is independent of our individuality. In Prof. Ortvy's opinion, positivism and realism are ultimately equally legitimate, just as in a logical system it is to a certain degree arbitrary what is to be considered as belonging to the basis of the system and what as a deduction. Positivism, in the form which was developed under the influence of quantum mechanics, leads to a profound change of our idea of the physical state of a system, but does not destroy the notion of the objectivity of a state, and so is not beyond realistic expression. On the other hand, Prof. Ortvy does not agree with the identification of observability and existence. He believes that we must maintain that certain things exist which can never be observed.

Research on Radium Therapy

RADIUM therapy in Great Britain was given a great stimulus with the formation of the Radium Beam

Therapy Research unit towards the end of 1933. A series of papers during the last two years shows valuable contributions on many sides of the subject. Two of these papers have appeared in *NATURE*, one in the *Journal of Scientific Instruments* upon the properties of a new tungsten-nickel-copper alloy, the remaining seven in the *British Journal of Radiology*. Most of these papers are contributed by physicists, and deal in an exhaustive way with the physical properties of the radiation used and its intensity variations among the tissues that it penetrates. One paper, entitled "Delivery, Estimation and Control of Tissue Dosage in Radiation Therapy", by C. A. P. Wood and T. A. Green, exhibits in the most happy way how the carefully acquired physical data are being put to the direct service of the clinic. This paper may be said to mark an advance in the development of the use of big radium units in the treatment of cancer. The paper shows the importance of a knowledge of the state of radio-sensitiveness of the tumours being treated and how a best selection of the ports of entry of the radiation can only be made by those having the necessary anatomical knowledge combined with experience of the various modes of spread of cancer.

Indian Science Congress Association: Silver Jubilee

THE twenty-fifth annual session of the Indian Science Congress Association will be held in Calcutta on January 3-9 under the presidency of the Right Hon. Lord Rutherford. To mark the silver jubilee of the Association, the meeting is to be a joint session with the British Association. About a hundred men of science have been invited from Great Britain, while invitations have also been extended to a number of scientific workers in other countries. The Congress will be divided into the following sections under the presidents named: (1) Mathematics and Physics, Dr. C. W. B. Normand, director-general of observatories, Meteorological Office, Poona 5; (2) Chemistry, Prof. S. S. Bhatnagar, director, University Chemical Laboratories, Lahore; (3) Geology, Mr. D. N. Wadia, officiating superintending geologist, Geological Survey of India, 27 Chowringhee, Calcutta; (4) Geography and Geodesy, Dr. A. M. Heron, director, Geological Survey of India, 27 Chowringhee, Calcutta; (5) Botany, Prof. B. Sahni, professor of botany, University of Lucknow; (6) Zoology, Prof. G. Matthai, professor of zoology, Government College, Lahore; (7) Entomology, Mr. M. Afzal Husain, principal, Punjab Agricultural College, Lyallpur, Punjab; (8) Anthropology, Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta; (9) Agriculture, Rao Bahadur T. S. Venkatraman, Imperial sugar-cane expert, Lawley Road, Coimbatore; (10) Medical Research, Sir Upendranath Brahmachari, professor of tropical medicine, Carmichael Medical College, Calcutta, and honorary professor of bio-chemistry, University of Calcutta; (11) Veterinary Research, Sir Arthur Oliver, animal husbandry expert, Imperial Council of Agricultural Research, New Delhi; (12) Physiology, Col. R. N. Chopra, officiating director and

professor of pharmacology, School of Tropical Medicine, Calcutta; (13) Psychology, Dr. G. Bose, University College of Science, 92 Upper Circular Road, Calcutta. The main part of the British Association delegation will arrive at Bombay on December 16, and will tour Northern India before attending the Congress. The address of the General Secretary of the Indian Science Congress Association is c/o The Geological Survey of India, 27 Chowringhee, Calcutta.

Lubrication and Lubricants

THE *Journal of the Institution of Mechanical Engineers* of May describes the arrangements which have been made for a general discussion on lubrication and lubricants which is to take place at the Institution on October 13-15. The executive committee, with Dr. H. J. Gough as chairman, desires to make this an opportunity to review the present state of knowledge on the subject by means of contributions from those who are especially qualified to discuss the major problems, the immediate objects being to establish a correlation between theory, academic research and trade practice, to elucidate the methods of design of bearings, to obtain current views upon bearing metals and to explore the significance of laboratory tests. In connexion with the meetings, it is proposed to organize an exhibition. In view of the importance of the subject, the active co-operation of other societies has been invited and already more than forty British and foreign institutions have accepted. The programme, in its present state, contains about a hundred papers divided into four distinct groups dealing respectively with journal and thrust bearings, engine lubrication, industrial applications, and properties and testing, each of which has been split up into appropriate sections and subsections. From these it would appear that no aspect of the widespread applications of lubrication has been lost sight of, and besides those problems and considerations associated with all classes of machinery, such cases as those arising in connexion with wire-drawing, wire rope transmission, chains, metal pressings, cutting fluids and the like are to be subjects of discussion. In the group comprising properties and testing, the papers will deal with three main sections under the headings friction and wear, physical properties, and chemical properties. The papers already promised are being prepared by leading authorities on their subjects, and it is desired that further offers to contribute to the discussion should be addressed to the secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

Sphinx

THE problem of publishing results too specialized for such a journal as *NATURE* and not substantial enough for the proceedings of a learned society, which nevertheless have some permanent value and deserve to be recorded, is difficult. Many a pertinent observation must be buried in field-club notes in the files of local weeklies, and a glance at the pages of Dickson's "History of the Theory of Numbers" will

suggest the magnitude of the task of the conscientious historian in any subject in which isolated statements can be significant. These remarks are prompted by the appearance recently in *Sphinx*, a monthly devoted to mathematical recreations and published privately by M. Kraitshik, Institut des Hautes Etudes de Belgique, 65 rue de la Concorde, Bruxelles, of an article "On Hyper-Exponential Numbers", in which Mr. H. J. Woodall, formerly associated with Lieut.-Colonel Cunningham in a series of extensive computations, discusses some sequences which resemble the sequence of functions forming the exponential scale but replace the e of the analyst by an integer. Mr. Woodall gives specimens of classification, determines a few orders of magnitude, and finds a few inequalities. No better medium of publication exists for such work, but the fact remains that a future investigator is much more likely to repeat Mr. Woodall's calculations than to discover that the work has been done.

Bleaching of Wood-pulp

IN connexion with the article on "Wood Pulp and the Future" (see *NATURE*, 139, 867, May 22, 1937) we have received a letter from the Development and Research Department of the Pennsylvania Salt Manufacturing Co., 1000 Widener Building, Philadelphia, pointing out that the use of an emulsion of chlorine in water in multi-stage bleaching processes is the result of investigations made by this Company and is patented in twelve countries. It may be stated that the writer of the article was fully aware of the part played by the organization concerned in developing this particular method of bleaching. In a short survey covering such a wide field, however, it was not considered necessary to give references to the work of individual firms; in the case of bleaching processes in fact, this would indeed have been a particularly difficult matter, owing to the large number involved.

Genetical Society

THE summer meeting of the Genetical Society was held at the Courtauld Genetical Laboratory, Inner Circle, Regent's Park, on August 10. The demonstrations shown by Prof. R. Ruggles Gates and his staff included the following: many new species and varieties of *Abnothera*, in connexion with the genetic survey of the genus in eastern Canada; Indian and Japanese varieties of rice, with X-ray mutations, autotriploid and allotriploid progenies, showing an inverse relation between the number of extra chromosomes and the size of the plants; a cytological survey of various species of the Phalaridæ; cytogenetical studies of *Oicer aristinum*; experiments with the growth of pollen tubes in cotton plants, and a chromosome survey of various Malvaceæ.

Research on Mental Disease

THE annual report for 1936-37 of the Birmingham Joint Board of Research for Mental Disease consists entirely of pathological laboratory findings. Fifty-six named varieties of micro-organism are described as

occurring in the cavities or excretion of insane subjects and 769 tests were made of serological agglutination, though the absence of any record of control investigation among the sane population leaves the reader in difficulty as to the precise value of these results. The Board apparently does not concern itself with the psychological approach to the study of mental disease.

New Comet 1937 g (Hubble)

DR. E. P. HUBBLE, at Mount Wilson, discovered a new comet of magnitude 13 on August 4. Its position was R.A. $22^h 49.3^m$, S. Decl. 21° , and its daily motion $-30''$ in R.A. and $6'$ S. in Decl. Later observations have been made, but there is no mention of the positions, except one from Bergedorf. Cunningham and Shapley have computed the following orbit :

T	1937 Dec. 11.58	U.T.
ω	$54^\circ 54'$	} 1937.0
Ω	$11 \quad 12$	
i	$9 \quad 53$	
q	0.9010	

Its position in the constellation of Aquarius is not very favourable for observation in northern latitudes, and although it is approaching both the earth and the sun and will increase in brightness, it is not likely to become a conspicuous object. Its distances from the earth and sun at present are 1.1 and 2.1 units respectively, and on September 20 these will be 0.75 and 1.7 respectively.

Announcements

THE President of the French Republic has conferred the honour of La Croix de Chevalier de la Légion d'Honneur on Mr. Geo. E. Pearson, the governing director of the Wellcome Foundation, Ltd.

THE following appointments and promotions have recently been made in the Colonial Service: G. L. Carson, assistant conservator of forests, Malaya; W. P. Gaskell, inspector of mines, Nigeria; I. G. John, meteorological officer, Survey Department, Malaya; F. Birkinshaw (State agricultural officer, Perak), chief field officer, Agricultural Department, Malaya; W. G. Leckie (agricultural officer), senior agricultural officer, Kenya; J. N. Milsum (agriculturist), senior agricultural officer, Malaya; W. L. Watt (agricultural officer), senior agricultural officer, Kenya; M. E. Dommien (assistant conservator of forests, Cyprus), assistant conservator of forests, Nigeria; S. T. Phillips (inspector of plants and produce), senior inspector of plants and produce, Gold Coast; S. A. Roach (industrial instructor, Education Department, Tanganyika), livestock officer, Department of Agriculture, Sierra Leone; E. Wall (executive engineer, Public Works Department, Nyasaland), senior executive engineer, Public Works Department, Nigeria.

DR. THORVALD MADSEN, chief of the State Serum Institute of Copenhagen, has for the seventh time been elected president of the Health Committee of the League of Nations.

MR. FIORILLA H. LA GUARDIA, Mayor of New York City, recently laid the corner stone of a new health centre in New York, forming the ninth building which had been started under the plan of the New York City Department of Health to create full-time health districts.

AN international Congress of Tourism, Thermalism and Climatism will be held in Paris on October 14-17. Further information can be obtained from the Secrétariat Général de la Fédération thermique et climatique française, 127 Avenue des Champs Elysées, Paris VIIIe.

THE twenty-first International Congress against Alcoholism will be held in Warsaw on September 12-17 under the patronage of the President of the Polish Republic, with Dr. Chodsko, formerly Minister of Public Health, as president of the executive committee. The following papers, among others, will be read: "The Influence of Alcohol on the Brain", by Prof. Rose, of Wilno; "Wine as a Factor in Alcoholism", by Drs. Dauphin, Fillion-Roux and Faisant (France); and "Alcohol and Mental Disease with Special Reference to Beer as a Cause of Alcoholism", by Prof. Vermeulen of Brussels. Further information can be obtained from Dr. R. Hercood, La Glvoine, Epinettes, Lausanne.

MESSRS. BOOTS have issued a booklet dealing shortly with the use of protamine insulin (with zinc). It has a much more prolonged action than ordinary insulin, and is therefore more convenient to use. The booklet contains fourteen references to original papers, and may be obtained on application to the Wholesale and Export Department, Station Street, Nottingham.

"ZOOLOGIA SPECIALIS" is the title of a book catalogue (No. 711) issued by Gustav Fock (Leipzig), containing, amongst other items, books and papers from the libraries of the late Prof. G. Grimep of Leipzig and of Prof. L. Plate of Jena. The catalogue details 5,737 items, amongst which Vermes, Mollusca, Crustacea, Aves, Mammalia and scientific periodicals are especially well represented.

A SMALL book entitled "Clinical Colorimetry with the Pulfrich Photometer", compiled and published by Carl Zeiss, of Jena, in collaboration with Dr. W. Krebs (London: Carl Zeiss (London), Ltd.; W. and G. Foyle. 7s. 6d. net), gives details of a number of colorimetric tests applicable to clinical material. The technique of these tests is adapted for use with the Pulfrich stufenphotometer made by Messrs. Carl Zeiss. It will probably prove very useful to clinical pathologists.

ERRATUM.—In the fifth line from the bottom of the first column of p. 23 of NATURE of July 3, 1937, the names "Millikan and Cameron" should be replaced by "Bethe and Heitler". Millikan and Cameron have advanced no theory of showers.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 324.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

World-wide Effect in Cosmic Ray Intensity, as Observed during a Recent Magnetic Storm

MR. S. E. FORBUSH¹ noted a very striking similarity between the variation of the horizontal component of the earth's magnetic field intensity and of the intensity of the cosmic ray ionization (as registered by two Compton cosmic ray meters) at Cheltenham,

In Fig. 1 these values reduced to Greenwich Mean Time are plotted (thin curve) together with the bi-hourly means of the cosmic ray ionization on the Hafelekar, as registered with our Steinke standard apparatus shielded on all sides by lead (10 cm. thick) and in addition by iron plates (7 cm. thick). All values were reduced to standard pressure.

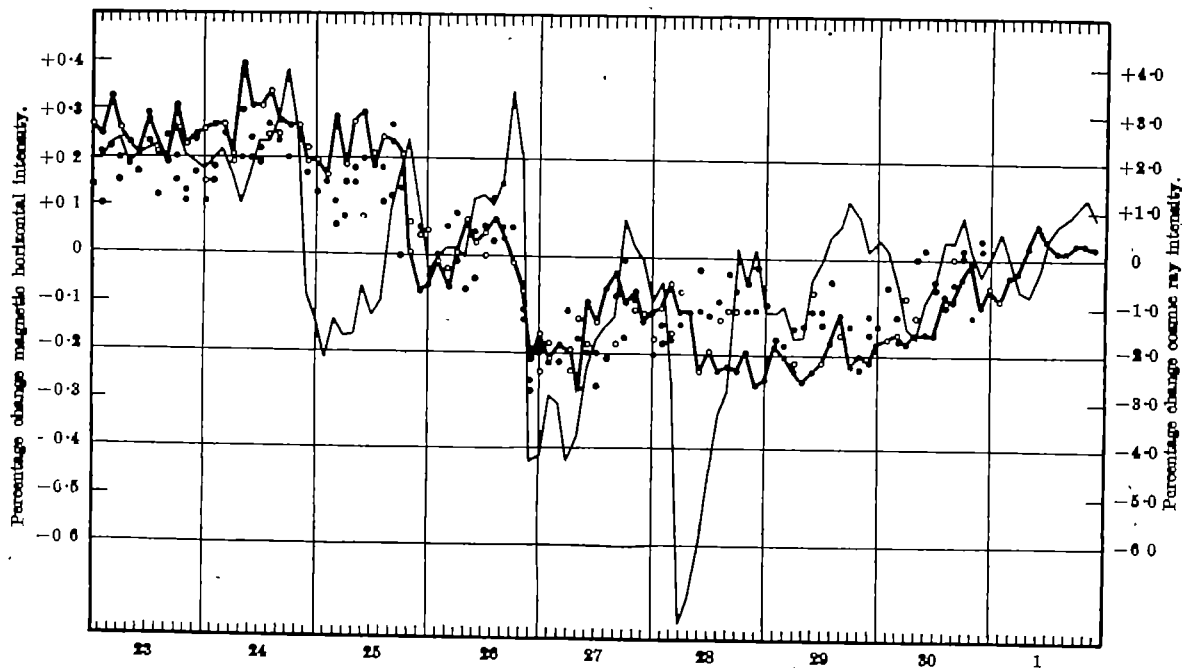


FIG. 1.
BI-HOURLY MEAN VALUES OF COSMIC RAY INTENSITY AND OF MAGNETIC HORIZONTAL INTENSITY,
APRIL 23 TO MAY 1, 1937.

•, Cosmic ray intensity, Huancayo. ○, Cosmic ray intensity, Cheltenham. —○—○—, Cosmic ray intensity, Hafelekar.

Maryland, U.S.A., and Huancayo, Peru, during the very severe magnetic disturbances between April 25 and April 30 of this year.

Our cosmic ray research station on the Hafelekar (2,300 metres above sea-level, near Innsbruck, Austria) gave results which corroborate Mr. Forbush's statements very strikingly. The magnetogram was taken from the registrations of the Vienna-Anhof Terrestrial Magnetic Station. We are obliged to Dr. M. Kofler, acting director of the Meteorologische Zentralanstalt, of Vienna, for placing the hourly values of the horizontal magnetic intensity at our disposal.

The variations of the ionization observed during the magnetically disturbed days (April 24–30, 1937) were uncommonly large: the maximum of the bi-hourly ionization means was 2,485 J. (April 24), the minimum 2,339 J., the deviations from the total average being +3.9 and –2.8 per cent respectively. Even the daily mean values varied by as much as +2.7 per cent (April 24) and –2.2 per cent (April 29).

In Fig. 1 the heavy-lined curve indicates our bi-hourly ionization values; the corresponding values of Cheltenham and Huancayo, indicated by small dots and circles in Fig. 1, were taken from Mr. Forbush's paper cited above.

In Fig. 1, Curves 1 and 2 represent the curves of the spectral sensitivity of plates sensitized with erythrocin and phloxine, reduced to the same number of incident quanta. Curves 3 and 4 represent the curves of absorption of these dyestuffs adsorbed on layers of silver bromide.

As it is to be seen from the figure, the wave-length of the maxima of sensitivity coincides exactly with the wave-length of the maxima of absorption of adsorbed dyestuffs (erythrocin, 558 m μ ; phloxine, 563 m μ) whereas the maxima of absorption of the dyestuffs in solution lie at 528 m μ for erythrocin and at 524 m μ for phloxine.

S. NATANSON.

Optic-Photo-Research Institute,
Karpov Institute of Physical Chemistry,
Moscow.

¹ Vogel, H., *Ber. dest. chem. Ges.*, 7, 976 (1874).

² Bonhoeffer, K., and Harbeck, P., "Grundlagen der Photochemie" (Dresden und Leipzig: Th. Steinkopff, 1933), p. 278.

³ de Boer, J. H., *N. physik. Chem.*, B, 15, 281 (1932).

Glyceraldehyde and Embryonic Glucolysis

It has already been reported^{1,2} that anaerobic lactic acid production from glucose in the chick embryo is a true case of non-phosphorylating glucolysis, strongly inhibited by *D*-glyceraldehyde. As possible intermediates, glycerol, glyceric acid, dihydroxyacetone and methylglyoxal were excluded. We are now able to add to the list pyruvic acid and glyceraldehyde.* Of the two stereoisomers, *only* *L*-glyceraldehyde inhibits glucolysis; this corresponds in its configuration to *L*-lactic acid (sarcolactic acid) which derives from glucose in the body. The inhibitory effect is complete at a concentration of about 2.5×10^{-3} *M*. The fact that *D*-glyceraldehyde does not apparently inhibit glucolysis more than about 90 per cent is due to a slow enzymic lactic acid formation from glyceraldehyde itself. This process needs glutathione as co-enzyme and is not based upon a primary condensation of trioses to hexose, as it is not inhibited by amounts of fluoride or iodoacetate which would be enough to poison a secondary glucose breakdown. It is due rather to the non-enzymic formation of methylglyoxal under the experimental conditions, which is then converted to lactic acid by the glyoxalase present.

The exclusion of so many 3-carbon compounds as possible intermediates of glucolysis proper induces us to refer to the work of Nef³, who showed an *in vitro* intramolecular shifting of the enol linkage along the carbon chain in hexoses, and suggested a similar enzymic breakdown of glucose. Such shifting of enol-linkages would make it possible to understand how lactic acid can derive from *D*-glucose *in vivo*. The final step would be an intramolecular dismutation. The occurrence of enolization and dismutation would explain the inhibition of glucolysis proper by fluoride and iodoacetate, which also poison (though in different concentrations) the enolase and dismutase of hexosediphosphate breakdown.

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HERMANN LEHMANN.

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Cambridge.

* We are greatly indebted to Prof. H. O. L. Fischer and Dr. Baer of Basel, for a gift of *D*-glyceraldehyde.

¹ Needham, Nowinski, Cook and Dixon, *NATURE*, 128, 462 (1936).

² Needham and Lehmann, *NATURE*, 120, 368 (1937).

³ Nef, *Leibniz Annalen*, 376, 1 (1910).

Technique of the Painting Process

Vijayalaya Cholisvaram in Puducherry

THE ruined temple of Vijayalaya Cholisvaram is situated in the village of Narthamalai (10° 35' N. 78° 45' E.) in Pudukottah State in South India, being about five miles to the north-east of Sittar¹ and about 33 miles, as the crow flies, from Tanjore². The temple was probably built in the ninth century A.D. during the time of Vijayalaya, king of the Chola Dynasty of South India. Details of the paintings, however, have either faded or disappeared, due to the vicissitudes of time and environment, so that it is very difficult to judge of art as such. But circumstantial evidences go to show that the paintings were probably executed during the eleventh-twelfth centuries A.D., and at the same rate, their date cannot be later than the fourteenth century A.D. If they belong to the eleventh-twelfth centuries A.D., they should have been contemporaneous with the Chola paintings in the Brihadeswara temple³ at Tanjore.

The paintings are executed on the inner walls of the front hall of the temple, which are constructed of large blocks of hornblende-gneiss. The technique adopted is a combination of tempera with fresco. The painted stucco consists of the *Rinzaffo* or rough coat of lime plaster with a fine lime wash thereon, the latter having been applied while plaster was still wet. Over this is a layer of plaster of appreciable thickness. The thicknesses of different layers are: painted stucco, 3.3 mm.; rough plaster, 2.3 mm.; lime-wash, 0.4 mm.; plaster film, 0.6 mm.

The results of analysis of the rough plaster and paint film (red paint film being chosen for the purpose) are given in the accompanying table.

	Rough plaster (per cent)	Red paint film (per cent)
Moisture	1.30	1.71
Carbon dioxide	20.95	11.67
Loss on ignition	4.20	11.86
Silica (SiO ₂)	37.83	38.86
Iron and alumina (Fe ₂ O ₃ , Al ₂ O ₃)	1.79	7.63*
Lime (CaO)	31.73	25.09
Sulphuric anhydride (SO ₃)	0.03	0.17
Magnesia (MgO)	0.66	1.68
Undetermined (mostly alkalis)	1.33	1.24
	100.00	100.00

* Al₂O₃ being only 0.73 per cent.

The high value of the loss on ignition of the paint film, amounting to 11.86 per cent, is significant, goes to show the presence of organic matter in the paint film used as a binding medium.

The only inert material used with the lime is sand. So far as the pigments are concerned, lime has been used for the white, carbon for black, yellow ochres for yellow and red ochres for red and terre verte for green. There are traces of a light, bluish-grey colour, but sufficient quantity of it is not available for identifying the blue pigment.

Full details of the investigation will be published elsewhere.

S. PARAMASIVAI

Chemical Laboratory,
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July 5.

¹ *NATURE*, 120, 114 (1937).

² *NATURE*, 127, 867 (1936). *Technical Studies* (Harvard University), 221-240.

of the Chicken Retina

Many bird and reptile retinas contain coloured oil globules. In the chicken they are red, golden and yellow-green^{1,2}. They possess considerable interest, for light must filter through them to enter the sensitive cone outer limbs, and they may serve, therefore, as a mechanism for colour vision³.

Kühne and Ayres⁴ effected a crude separation of chicken retinal pigments into three fractions: purplish red "rhodophane", golden or orange "xanthophane", and yellow-green "chlorophane".

We have crystallized three such pigments from natural extracts. They are carotenoids, and in suitable solvents reproduce closely the colours of the natural droplets:

1) The purplish red pigment, astacene. Epiphaseic when shaken with benzine and 90 per cent methanol. Insoluble in concentrated caustic potash; precipitates as a red soap on dilution with water. Crystallizes in methanol-acetic acid in thin, curved, purple leaves; from pyridine in fine needles. Crystals soluble in benzine, almost insoluble in methanol, slightly soluble in pyridine. The spectrum consists of a single broad band, maximal at 477 mμ in hexane (Fig. 1a), at 499.5 mμ in pyridine, at 497 mμ in castor oil (used to simulate the retinal oil).

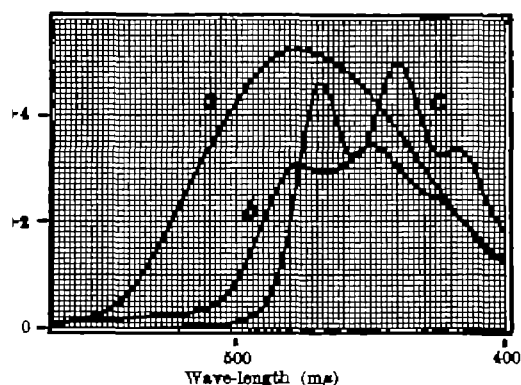


Fig. 1.

2) A golden or orange xanthophyll. Shaken with benzine and 90 per cent methanol, it is epiphaseic and hypophaseic after saponification. This is typical behaviour of xanthophyll esters. Crystals in methanol solution are orange-red in colour, practically insoluble in benzine, readily soluble in methanol. The spectrum possesses three bands, at 1), 449.5 and 478 mμ in hexane (Fig. 1b), and at 2), 463 and 490 mμ in castor oil. This is close to the spectrum of lutein (447.5 and 477.5 mμ in benzine).

3) A yellow or yellow-green hydrocarbon. Epiphaseic when shaken with benzine and 90-95 per cent methanol. Crystals from methanol solution are set in colour, almost completely insoluble in methanol, readily soluble in hexane. The spectrum possesses three sharp maxima, at 418, 440 and 469 mμ in hexane (Fig. 1c), and at 428, 450 and 469 mμ in castor oil. This spectrum lies at much shorter wave-lengths than that of any known carotenoid except sarcinene (415, 440, 469 mμ)⁴.

It seems clear from the appearance of the coneules that one of these pigments predominates in each of them. The fact that one pigment is acidic, one an alcohol and one a hydrocarbon greatly aids its separation *in vitro*. A precisely similar situation

is found in the retina of the turtle, *Olemmys insculpta*⁵. Possibly this chemical differentiation is the basis also of pigment segregation *in vivo*.

Astacene apparently is synthesized by the chicken. We found no trace of it in chicken livers or serum. Though none could be found in the egg yolk, red cone droplets appeared in our chick embryos on the nineteenth day of incubation (37°C.). The hydrocarbon pigment also may be synthesized *in situ*, for it has not been identified either in the egg or in the customary chicken diet.

If the chicken depends upon these pigments for colour discrimination, it should fail to differentiate monochromatic lights between about 600 mμ and 700 mμ, for none of the pigments in castor oil absorbs appreciably in this region. It is significant that the pigeon, which possesses a similar system of cone droplets, is unable to discriminate hue differences between 615 and 700 mμ⁶.

GEORGE WALD.
HYMAN ZUSSEMAN.

Biological Laboratories,
Harvard University,
Cambridge, Massachusetts.
June 26.

¹ Hannover, A., *Arch. Anat.*, 314 (1848); colour plate in Hess, O., "Hdbch. vergl. Physiol.", 4, 555 (1913).

² Kühne, W., and Ayres, W. O., *Unters. physiol. Inst. Heidelberg*, 1, 841 (1878); *J. Physiol.*, 1, 109 (1878-79).

³ Schultze, M., *Arch. mikr. Anat.*, 2, 175 (1896); Roaf, H. H., *Physiol. Rev.*, 12, 43 (1932).

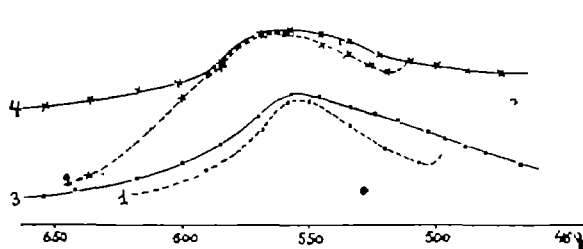
⁴ Chergaff, H., *Naturwiss.*, 20, 872 (1932).

⁵ Wald, G., unpublished observations.

⁶ Hamilton, W. F., and Coleman, T. B., *J. Comp. Psychol.*, 15, 183 (1933).

Position of Maximum Optical Sensitivity of Sensitized Photographic Plates

In one of the first papers¹ on the phenomenon of sensitization of photographic plates to the long-wave rays of the spectrum by dyestuffs, Vogel noted that the maximum sensitivity is often shifted by several hundred Angstrom units towards the red in comparison with the maximum absorption of the dyestuffs in solution. The usually accepted explanation² of this phenomenon is that it is due to the displacement of the maximum of absorption of the dyestuff by its adsorption on the silver halide. But on account of the difficulties connected with measuring the absorption by scattering media, this hypothesis has not yet been confirmed experimentally.



POSITIONS OF MAXIMA OPTICAL SENSITIVITY

Fig. 1.

With the aid of the König-Martens spectrophotometer, we have obtained absorption curves of erythrocin and phloxine sensitizers adsorbed on transparent layers of silver bromide sublimated in vacuum. They were prepared by a method analogous to the method of de Boer³ as described in a series of papers by him on the adsorption of dyestuffs on sublimated layers of alkali earth metals.

The general trend of the curves of these two stations is in beautiful agreement with our curve. The magnetic intensity curve from Vienna-Auhof is nearly identical with the curve of the two American stations.

In Fig. 2 the daily mean values of the horizontal intensity are plotted together with the cosmic ray ionization and with the number of triple coincidences as observed by L. Jaeger on the Hafelekarr with two sets of Geiger-Müller counters, consisting each of three counters placed vertically above each other. Here once more the close similarity in the variation of the cosmic ray intensity and the horizontal magnetic force during the magnetic storm is clearly demonstrated.

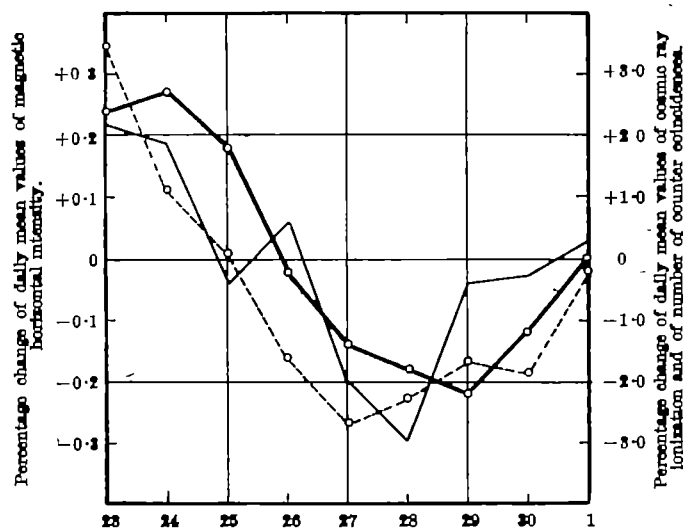


Fig. 2.

DAILY MEAN VALUES OF COSMIC RAY IONIZATION, OF NUMBER OF COUNTER COINCIDENCES AND OF MAGNETIC HORIZONTAL INTENSITY, APRIL 23 TO MAY 1, 1937. $\circ-\circ-\circ$, COSMIC RAY IONIZATION; $\circ-\circ-\circ$, NUMBER OF COUNTER COINCIDENCES; —, MAGNETIC HORIZONTAL INTENSITY.

We think that Forbush's results taken together with our own results prove: (1) that cosmic ray ionization was influenced all over the earth by the magnetic disturbances between April 24 and 30 of this year and that a decrease of the cosmic ray intensity followed a decrease of the magnetic intensity; (2) that the magnitude of the variations of the cosmic ray intensity during magnetically disturbed days may amount to as much as ± 3 per cent; (3) that these variations occurred simultaneously all over our planet. We agree with Mr. Forbush in concluding that the study of the magnetic storm effects will give valuable information on the energy spectrum of the cosmic radiation.

A detailed analysis of the magnetic effects on cosmic ray ionization during one whole year (1936-37) will be published later in *Terrestrial Magnetism and Atmospheric Electricity*.

VICTOR F. HESS.
A. DEMMELMATH.

Physical Institute,
University of Graz,
Austria.
July 17.

¹ *Phys. Rev.*, 51, 1106 (1937).

Concentration of Mesothorium-I by Duckweed (*Lemna*)

It is characteristic of the waters of the earth's crust—among which we can distinguish more than 550 different mineralogical species—that all these chemically different water-solutions constitute theoretically one and the same natural body—a unique great water-equilibrium of the earth's crust¹. They are in constant close material connexion. This connexion is produced by two physical equilibrium systems common to all natural water-solutions:

Water+water vapours (in contact with gaseous atmospheres).

Water+pellicular water (in contact with solids).

The solid substance of the earth's crust is penetrated by pellicular water-solutions². It is characteristic that there are chemical elements which do not enter into the constitution of these solutions³. Among these elements one, on account of its great geochemical and geological importance, must be studied with the greatest attention, namely, thorium. Two deductions can be made from this characteristic of thorium atoms in the geochemical history of thorium:

(1) In relation to the content of thorium atoms in sea-water⁴: either not thorium atoms, but the products of their disintegration—mesothorium-I, radio-thorium, and thorium-X—are present in sea-water, or the thorium atoms are included in the dispersed solid particles distributed in sea-water.

(2) In relation to the thorium content of living organisms: thorium atoms should not be found in the living organisms, which obtain all their metallic atoms from water-solutions, soil-solutions and surface or underground waters.

To verify the second deduction, researches were carried out by B. Brunowsky and C. Kunasheva in the Biogeochemical Laboratory of the Academy of Sciences, Moscow, which proved its truth. A large quantity of duckweed belonging to two species, *Lemna minor* L. and *Lemna polyrrhiza* L., was collected in 1935 from the Orangery Pond at Peterhof (near Leningrad), and a 200-litre sample of water taken.

The plant mass was divided into two lots. The first lot (30.4 kgm. live weight) was dissolved, and the isotopes of radium and thorium separated in the solution by ammonia. The fraction of the solution containing radium isotopes was examined after two years by way of Tn for its mesothorium content, which proved to be $(10.3 \pm 0.3) \times 10^{-12}$ per cent. A month after the separation, in the fraction containing thorium isotopes, the thorium-X was precipitated by barium sulphate, and the quantity of radio-thorium evaluated by determination of Tn. The radio-thorium content of *Lemna* proved to be exactly such as should have generated in *Lemna* from mesothorium-I during the period of time between the taking of samples and the separation of the isotopes.

In 1935, the second lot of *Lemna*, which had been preserved in an air-dry condition for two years, was dissolved and the Tn content determined. The calculation of the mesothorium-I content of *Lemna* was then made on the basis of the observed ionization

affect, taking into account the possibility of thorium atoms being either absent or present. In the first case, the content was calculated to be 10.2×10^{-15} per cent, and in the second 9.05×10^{-15} per cent. These results, compared with the mesothorium-I content given above for the radium isotope solution, which certainly contained no thorium atoms, led to the conclusion that the thorium content of *Lemna* does not exceed 1 per cent of the quantity in equilibrium with mesothorium I, that is, that *Lemna* does not contain isotopes of thorium.

Analogous tests of the pond water proved the presence in it of 8.25×10^{-17} per cent of mesothorium-I, and not exceeding 20 per cent of the radio-thorium for equilibrium with the mesothorium-I. This suggests that, although isotopes of thorium are present in water, they are not assimilated by *Lemna*. On the other hand, *Lemna* accumulates mesothorium-I and concentrates it a hundredfold as compared with its content in the water. The plant, therefore, assimilates radioactive elements, if present in the nutrient medium, in strict accordance with their chemical properties.

W. I. VERNADSKY.
B. K. BRUNOWSKY.
C. G. KUNASHENVA.

Biogeochemical Laboratory,
Academy of Science of the U.S.S.R.,
Moscow.
May 12.

¹ Vernadsky, W. I., "History of Natural Waters" (in Russian), 1. (1933-36).

² Vernadsky, W. I., *Ibid.* 1, 11-12.

³ Vernadsky, W. I., *Priruch.* (in Russian), No. 8-9, 26 (1933).

⁴ Vernadsky, W. I., *Priruch.* (in Russian), No. 5, 414 (1932).

Histological Changes produced by Castration and by Sex Hormones in the Adrenals of Normal and of Castrated Male Rats

In our previous publications¹ we have shown that in male rats after castration the weight of the adrenals increases and that this 'castration hypertrophy' decreases or disappears after injections of androsterone, androstanediol, dehydroandrosterone, testosterone, testosterone propionate, androstanediol and androstenedione. In the present communication the results of histological examination of these adrenals are given.

The occurrence of 'castration hypertrophy' in the adrenals of male rats has been observed previously. The effect of injections of some of the hormones mentioned above has been studied only on the X-zone of castrated mice^{2,3}.

The hypertrophy of the 'castration' adrenal is due to the hypertrophy of the zona fasciculata and reticularis, especially the latter, resulting chiefly from a considerable increase in the size of the cells composing these layers. The lipid content of the outer half of the zona fasciculata is definitely increased while that of the reticularis is decreased.

The 'demarcation zone' lies between the glomerulosa and fasciculata zones, and consists of 1-4 rows of cells, in which lipid granules are normally few or absent; after castration it becomes impregnated with lipid and hence appears to be absent.

The width of the zones and size of the cells return to normal or nearly normal size if sufficiently large doses of sex hormones are injected into castrated

rats. Moreover, some hormones may decrease to below normal both the zones and the size of the cells (androsterone and androstanediol).

Vacuolation, which is slightly increased in the zona fasciculata after castration, is decreased after injections of sex hormones, sometimes in a most striking degree, almost disappearing with high doses of androsterone. Testosterone presents a special case; small doses decrease vacuolation, but after high doses (1400 γ) it appears again.

Most doses and hormones investigated produced in all zones, in some cases excluding the glomerulosa, a partial, sometimes nearly complete, disappearance of lipid granules. The discrepancy between the very pronounced vacuolation and greatly decreased number of lipid granules, as shown by Sharlach R staining, was most striking after injections of 1400 γ of testosterone, and somewhat less so with testosterone propionate.

The demarcation zone, apparently absent in castrated animals, appeared again in the injected rats.

The effect of a resting period of nine days after testosterone propionate injections (group 2) was examined by comparing the adrenals of these rats with those of their litter mates killed the day after the last injection (group 1). The following striking difference was noted. In both groups the width of the zones and the size of the cells were reduced to the normal condition. The number of lipid granules, however, was abnormally low in group 1 (usual effect of the injection), but returned to normal in group 2. Thus a complete return to normal was obtained in the adrenals approximately nine days after the last injection.

Injections of testosterone propionate into normal rats greatly decreased both the number of lipid granules in the cortex (especially with 1500 γ) and the vacuolation of the fasciculata cells, and caused an increase in the number of faintly stained nuclei with a poor chromatin network.

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July 14.

¹ Korenchensky and co-workers, *NATURE*, 136, 434; 136, 185 (1935); 137, 494 (1936). *Biochem. J.*, 30, 2534; 30, 558 and 1514 (1936); 31, 467, 475 and 780 (1937).

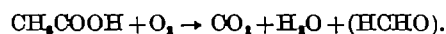
² Cramer and Horning, *Leads*, 1, 1230 (1937).

³ Deanealy and Farries, *Quart. J. Physiol.*, 26, 393 (1937).

Prevention of Assimilation in Respiring Cells

UNTIL recently it was generally assumed that so-called 'resting' cells, suspended in a buffer solution in the presence of a nitrogen-free substrate, could be employed in studying respiration separately from other metabolic processes. Some doubt as to the validity of this assumption is suggested by the studies of Cook and Stephenson¹, which show that the oxygen consumed during the oxidation of glucose, lactate or acetate by *Bact. coli* amounts to only from two thirds to three fourths of that required for complete oxidation.

Barker² advanced considerable evidence that this incomplete oxidation may be due to an oxidative assimilation, which in the case of the oxidation of acetate by the colourless alga *Prototheca Zopfii* may be represented as



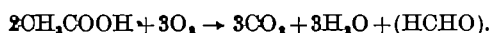
Barker also reported that the amount of carbon assimilated varies with the nature of the substrate. Giesberger² also observed this phenomenon with different species of *Spirillum* and showed, moreover, that the amount of carbon assimilated from a given substrate varies with the different species.

The fact that this intimate relation between respiration and assimilation is encountered in such widely different groups of organisms makes it probable that the phenomenon is of a quite general nature. It seemed, therefore, of importance to investigate whether respiration and assimilation are indeed intimately associated in one reaction chain as suggested by the equations advanced by Barker and Giesberger, or whether it is possible to block one process and not the other.

In the course of investigations (Warburg technique) on the oxidative metabolism of washed suspensions of *Pseudomonas calco-acetica* Beijerinck in phosphate buffer of pH 7.1, it was observed that the oxygen consumed during the oxidation of acetate or of butyrate amounted to only approximately three fourths of that required for complete oxidation.

It has now been observed that suitable concentrations of sodium azide ($M/800$) or 2:4-dinitrophenol ($M/4000$) block the assimilatory process and bring about a complete oxidation of the substrates, the rate of respiration being in general only slightly decreased. Higher concentrations of the poisons markedly reduced the rate of respiration also.

In the case of acetate this change in metabolism is not accompanied by any change in the respiratory quotient, since in the absence of the poison its value is also approximately 1.0, the conversion of the acetate apparently proceeding according to the equation



The oxidation of butyrate, however, presents another picture, as under normal conditions the respiratory quotient was approximately 0.68, suggesting that the reaction may be represented as



In the presence of the azide or dinitrophenol the observed respiratory quotient was 0.8, the value characteristic of the complete oxidation of butyrate. The oxidation of acetate by *Bact. coli* proceeds in a manner similar to that described for *Ps. calco-acetica*, and assimilation is also blocked by the same poisons. It was observed that $M/4000$ dinitrophenol tended to stimulate respiration to a slight extent while at the same time the oxidation proceeded to completion.

The observations suggest that it is indeed possible to block the assimilatory process in non-proliferating organisms by the addition of critical concentrations of certain chemical agents, thus permitting the oxidation of a given substrate to proceed to completion at an almost normal rate. These observations also suggest that the so-called 'slimming' agents such as 2:4-dinitrophenol may exert their weight-reducing action in man by a suppression of assimilation, rather than simply by their stimulatory effect on respiration.

Full details will soon be published elsewhere.

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¹ *Biochem. J.*, **23**, 1368 (1928).

² *J. Cell. Comp. Physiol.*, **8**, 251 (1936).

³ *Dissert.*, Delft, 1936.

Nutritional Value of Some Indian Diets

MCCARRISON¹ has pointed out the great superiority of northern Indian diets as compared with those consumed in the east and south of India. It appeared to us to be of interest to compare the northern Indian well-to-do and poor Hindu diets, the ingredients of which he has listed², by feeding them to rats.

The diets were found to contain calcium and phosphorus in the following amounts:

TABLE 1.

	Ca. (per cent)	P (per cent)	Ca. : P ratio
Northern Indian	0.17	0.23	0.52
	0.18	0.27	0.40
Well-to-do Hindu	0.09	0.22	0.42
	0.09	0.21	0.43
Poor Hindu	0.018	0.06	0.23
	0.021	0.11	0.20

It will be noted that all three diets are low in Ca and P, and especially the poor Hindu diet, which has a rachitogenic Ca : P ratio.

Groups of 8 rats were fed on these diets, group A being fed on the northern Indian diet and B and C on the well-to-do and poor Hindu diets respectively. The diets were fed uncooked. The mortality in groups A and B was nil, but of those in group C, six died of pneumonia and none survived more than 105 days. The rate of growth of group A was about 2 gm./day, of group B about 1.4 gm./day and of group C about 0.9 gm./day. In the case of rats on stock diet, this is about 2.7 gm./day.

Rats were killed at intervals and the ash content determined in the lower incisors, one femur, tibia and fibula. The figures for bone ash at 105 days of age, which are typical of all the values obtained, are given below, together with figures from control rats on the Rowett Institute stock diet.

TABLE 2.

Age (days)	ASH CONTENT OF BONES.			Control
	A	B	C	
105	50.8	42.0	31.0	63.3

These values show that calcification was impaired in all three groups, compared with the controls, and especially so in group C. Changes in the same direction, but of smaller degree, were found in the teeth. This is in accordance with the well-known fact that the composition of the teeth is not so readily altered by dietary means as is that of the bones.

The width of the predentin in the upper incisor teeth was measured, the following average values being obtained:

A	B	C	Control
25 μ	21 μ	51 μ	18 μ

The normal value is about 18 μ and is increased when calcification is poor; these values therefore indicate that the calcification of the teeth was impaired in all three groups compared with the controls, and especially so in group C. In groups A and B, the incidence of interglobular dentin was higher than normal. In group C, the dentin contained a great many interglobular spaces and also showed a high degree of stratification; the predentin in this group had many vascular inclusions.

In breeding, all three groups were definitely inferior to normal rats on stock diet. Group C did not breed at all. Group A mated at the normal time, but the litter weights, weaning weights and number of young surviving to weaning were low. Group B showed the same poor reproductive performance and in addition the mating date was much retarded.

Although the number of rats used was small, the results confirm McCarrison's finding that the northern Indian diet is superior to both the Hindu diets. The poor Hindu diet is defective on all points; and it is of interest to note that, judged by modern standards, the northern Indian diet is further capable of improvement.

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¹ McCarrison, *Nat. Abstr. Rev.*, 2, 2 (1932-33).

² McCarrison, "Food", pp. 118-115 (Madras, 1931).

Solubility of Silica Dusts

THE industrial disease of silicosis has been postulated to have a relation to the dissolution of particles of mineral silicates in the lung. Whether this 'solubility theory' of silicosis be true, considerable interest is attached to the production of soluble silica from finely divided mineral dusts. The amount of silicic acid which a mineral form of silica will yield in solution is exceedingly small when it is present as crystals or as coarse fragments. But if it be reduced to a particle size of the order of the dust in the air (that is, < 1 to 10 microns) then the dissolution rate becomes appreciable.

In a recent paper, Emmons and Wilcox¹ gave figures for the silica dissolved from a number of mineral silicates. The method adopted in the study of the dissolution of these dusts is open to grave criticism. For the separation of the liquid phase (blood serum) from the solid (the powdered mineral) these workers relied on centrifugalization at 3,500 r.p.m. for fifteen minutes: the dusts having been exposed to the serum for two months at 37°. The total amount of silica in the supernatant fluid was determined by ashing an aliquot, following by gravimetric analysis.

The rate of sedimentation of particles depends on their shape; a roughly spherical particle tends to settle more quickly than a fibrous particle, even though the particles be of approximately the same size. Centrifugalization at the modest speed of 3,500 r.p.m. for fifteen minutes will not completely remove fine particles of the size (1-10 μ) used by Emmons and Wilcox—particularly from a viscous fluid like blood serum; and the extent to which they are removed will depend on the particle shape. It is notable that the figures showing the greatest percentage of silica dissolved are for fibrous minerals. Thus, in the results for human blood serum, sericite and asbestos give a much greater apparent 'solubility' than opal, quartz or cristobalite. In some cases, for example, that of quartz, which sediments rapidly, the results may approximate to the true solubility figure, but in others where the rate of sedimentation is low they are probably greatly in excess. If the results are expressed in terms of the mgm. SiO₂ contained in 100 c.c. of solution, then figures of 5.0 and 3.8 are found for quartz, a solubility figure in reasonable agreement with other published data. But the figures found for sericite, namely, 14.3 and 9.2, are very much higher than other recorded results. It is suggested that these results do not, in fact, represent the silicic acid in solution; they represent

the total amount of silica left in suspension, plus what small amount may be in solution. Only by high-speed centrifugalization, for example, 15,000 r.p.m. for forty-five minutes, is it possible completely to remove these particles from suspension.

A true measure of the amount of silicic acid which has gone into solution from a powdered mineral can be gained in two ways. The suspended material can be completely separated from the soluble, and the total silica in the separated liquid determined by gravimetric analysis; or secondly, advantage can be taken of the fact that in certain chemical reactions only the silica present as silicic acid will take part. Such a reaction is represented by the well-known formation of silico-molybdic acid, a substance which imparts an intense yellow colour to its aqueous solution even when it is present only in minute amount.

Powdered amorphous or crystalline silica when freshly suspended in water gives no colour on the addition of molybdic acid, but does so after it has stood in contact with the water for some hours, that is, when some of the silica has passed into solution as silicic acid. The measurement of the intensity of the yellow colour (or of the blue colour in a refinement of the method where the silico-molybdic acid is reduced to a blue complex) furnishes a means by which the amount of silicic acid in solution can be estimated, the maximum part of the suspended material having been removed by filtration through very fine paper. Results obtained by this type of procedure probably show fairly accurately the actual soluble silica content of the solution. Such results will vary, of course, with the concentration of the dust and its degree of fineness, as well as with the

DISSOLUTION OF MINERAL DUSTS
(mgm. SiO₂ dissolved by 100 c.c. of liquid)

(1) 0.1 gm. of dust in 100 c.c. of 1 per cent sodium bicarbonate				
Days at 37°	Quartz		Sericite	
	20-40 μ	< 1-5 μ	Plate*	Fibrous*
1	0.71	0.70	0.33	0.51
3	0.97	1.66	0.39	0.57
5	1.03	2.08	0.33	0.62
8	1.20	2.74	0.46	0.78
Hours at 100°				
	20-40 μ	< 1-5 μ	Plate*	Fibrous*
2	1.25	2.06	0.30	0.37
4	1.46	4.15	0.40	0.39
6	2.02	4.57	0.42	0.39
(2) 2 gm. dust in 100 c.c. acetic fluid at 37°				
Days	Ppt'd. silica	Quartz	Kaolin	Mica
4	7.04	4.53	0.23	—
8	7.12	5.91	0.26	1.0
16		5.82	0.24	1.8

* Plates of sericite < 1-2.5 μ (few larger); fibres of sericite in length by about 0.1-1 μ in width.

type of mineral and liquid used. In the accompanying table are presented figures which are believed substantially to represent the rate at which silicic acid will pass into solution from a powdered mineral of a certain range of particle size when suspended at a given concentration in a liquid.

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¹ Emmons and Wilcox, *Amer. Mineral.* 22 256 (1937).

Acidosis and Off-flavoured Milk

VETERINARIANS have assisted in explaining one cause of taint of milk when showing that in cases of acidosis the body fluids, including the milk, contain acetone and acetone-bodies. It was stated that the milk would react to Rothera's test¹.

As a result of recent experiences with samples of milk from cows suffering from acidosis, we can commend this very simple test to the dairy industry (it appears at present to be quite unknown) as a rapid and certain means of diagnosis, offering an explanation of many cases where the milk is mildly, but to a skilled palate, definitely of abnormal flavour even at the time of milking. Such cases have hitherto been somewhat vaguely ascribed to 'indigestion'.

Furthermore, we find that for more accurate work, quantitative estimations may be made by the method of Van Slyke². Several samples from cows giving tainted milk have been so examined, and in addition more than 98 per cent recovery has been obtained from samples of milk to which small amounts of acetone have been added.

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¹ Beaumont, G. H., and Dodds, H. C., "Recent Advances in Medicine" (1931), p. 70 (sixth edition).

² Van Slyke, D. D., *J. Biol. Chem.*, **22**, 3, 455 (1917).

Points from Foregoing Letters

COMPARISON of the change in the intensity of cosmic rays for a period of nine days (April 23–May 1, 1937) during a magnetic storm at Innsbruck (Austria), Cheltenham (Maryland, U.S.A.) and Huanacayo (Peru), shows very good agreement in the general trend, according to Prof. V. F. Hees and A. Demmel-mair. There is also a close parallelism to the change in the horizontal component of the earth's magnetic field during this period, and the authors conclude that cosmic ray ionization was influenced simultaneously all over the earth by the magnetic disturbances, and that the study of the magnetic storm effects will give valuable information on the distribution of energy in the spectrum of the cosmic radiation.

Chemical analysis of a sample of duckweed (*Lemna*) shows, according to Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunaheva, that the plant contains about one hundred times more mesothorium-I (10×10^{-15} per cent) than the water in which it grows (Orangery Pond, near Leningrad). On the other hand, although isotopes of thorium are present in water, they are not assimilated by the duckweed. The authors conclude that the plant assimilates radioactive elements in strict accordance with their chemical properties.

K. Hall and Dr. V. Korenchevsky find that the increase in the size of the adrenals in castrated rats is due to increase in the width of certain zones (fascioulata and reticularis) resulting chiefly from an increase in the size of the cells. They return to normal if sufficiently large doses of sex hormones (androsterone, testosterone, etc.) are administered. In a similar way, the large numbers of lipid granules which invade the 'demarcation zone' upon castration may be made to disappear.

From the effect of critical concentrations of sodium azide or 2:4-dinitrophenol on the rate and extent of oxidation of acetate or butyrate by bacteria, Dr. C. E. Clifton deduces that these agents block the assimilatory process observed in association with the respiration of widely different non-proliferating cells under normal conditions. This blocking of the assimilatory process is accompanied by a complete oxidation of the substrate, at an approximately normal rate. He suggests that the weight-reducing action of the dinitrophenols in man may be due in part to a suppression of assimilatory processes.

By feeding rats with diets as used in Northern India, by well-to-do and by poor Hindus respectively, and observing the effects upon the teeth, the fertility and the health of the young, D. N. Mullick and Dr. J. T. Irving find that the Northern Indian diet is superior to both Hindu diets and that the poor Hindu diet is seriously defective as shown by both chemical and biological tests.

A table giving the amount of silica dissolved by a 1 per cent sodium bicarbonate solution and by acetic fluid from silica dusts (quartz, sericite) after various periods of time, is given by Dr. E. J. King. The author states that many of the values reported by Emmons and Wilcox for the solubility of finely powdered silicates are too high, because their method does not eliminate completely the fine particles in suspension.

The presence of a minute hole in a polished glass disk enables it to make 'optical' contact with another polished plate by application of slight pressure at a single point, according to Dr. J. W. French. The contact spreads spontaneously, due apparently to the surface tension effect of a grease-like film (less than one millionth of an inch thick) present at the glass surface.

D. Porret and Dr. E. Rabinowitch find that the reversible bleaching of chlorophyll by light is proportional to the square root of the light intensity. Formic acid causes a considerable increase in the reversible bleaching, while oxygen and ferrous chloride suppress it.

The interference in the two segments of the X-chromosome of *Drosophila melanogaster* is characterized by Prof. K. de Kőrösy by two constants, the *transitive* interference from one segment on the other by a third. The average deviation between the calculated and observed data is 0.6 per cent, with a maximum of 1.8 per cent.

A table showing the Raman spectra of various heavy-hydrogen substituted ethylenes is given by Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse. Some of the lines were determined by using pure compounds (C_2D_4 , $C_2H_3D_3$) and the remainder from a mixed sample. The authors find a slight discrepancy between the experimental results and the theoretical calculations carried out by Manneback and Verleisen.

where $\bar{f}$ is the whole map-distance between the two intervals, $\bar{f}_r$ is the map-distance on the right segment from the boundary; $a = 0.257 = a_s$, $b = 0.559$ (Fig. 2). The limits of the validity of this equation can be discussed only when suitable experimental data are available.

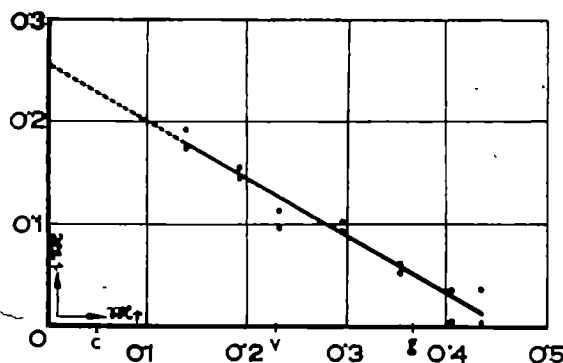


Fig. 2.

TRANSITIVE INTERFERENCE. ABSCISSE: PRIMARY MAP OF THE RIGHT SEGMENT; 0 POINT=MIDDLE OF THE INTERVAL OF C.

The three constants a_s , a_r , b make it possible to compute from six f -values between neighbour genes, which stand for the six observed f -values—that is, from the loci of the seven genes on the primary map—all 21 f -values, the average deviation being 0.6 per cent with a maximum of 1.8 per cent (Table 1).

TABLE 1. f -VALUES OF THE "XPER" EXPERIMENT.

ac		ec		es		cs		sc	
Calc.	0.068	Calc.	0.068	Calc.	0.068	Calc.	0.068	Calc.	0.068
Obs.	0.068	Obs.	0.068	Obs.	0.068	Obs.	0.068	Obs.	0.068
cr		er		sr		rc		rc	
Calc.	0.164	Calc.	0.164	Calc.	0.164	Calc.	0.164	Calc.	0.164
Obs.	0.163	Obs.	0.163	Obs.	0.163	Obs.	0.163	Obs.	0.163
c		e		s		r		f	
Calc.	0.247	Calc.	0.247	Calc.	0.247	Calc.	0.247	Calc.	0.247
Obs.	0.245	Obs.	0.245	Obs.	0.245	Obs.	0.245	Obs.	0.245
r		f		s		c		e	
Calc.	0.371	Calc.	0.371	Calc.	0.371	Calc.	0.371	Calc.	0.371
Obs.	0.370	Obs.	0.370	Obs.	0.370	Obs.	0.370	Obs.	0.370
f		s		c		e		r	
Calc.	0.428	Calc.	0.428	Calc.	0.428	Calc.	0.428	Calc.	0.428
Obs.	0.430	Obs.	0.430	Obs.	0.430	Obs.	0.430	Obs.	0.430
f		c		e		r		s	
Calc.	0.466	Calc.	0.466	Calc.	0.466	Calc.	0.466	Calc.	0.466
Obs.	0.465	Obs.	0.465	Obs.	0.465	Obs.	0.465	Obs.	0.465

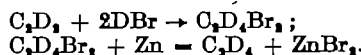
The left segment was calculated on the basis of the simplifying assumption $t = 1$. Using Morgan's terminology, the two equations represent the relation between frequency of crossing-over and frequency of recombination¹.

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Raman Spectra of Deuteroethylenes

THE various deuteroethylenes can be obtained by exchange from ethylenes and deuterium oxide on a nickel catalyst. 15 gm. of heavy water (D_2O) and 6 litres of ethylenes (N.T.P.) yielded after an exchange of several days at $150^\circ C$. a mixture of ethylenes containing about 50 per cent of the hydrogen as deuterium. The Raman spectrum of this substance was taken. In order to identify the lines and attribute them unambiguously to the different compounds, some of the deuteroethylenes have been prepared in a pure state. The ethylene C_2D_4 was obtained in the following way:



The compound so obtained contained about 10 per cent C_2D_3H ; its D content was thus about 97 per cent of the total hydrogen. The *cis* and *trans* di-deuteroethylenes were obtained in an analogous way starting from C_2D_4 and HBr . The comparison of the various spectra permits the classification of the lines as shown in the accompanying table:

C_2H_4	C_2D_4	C_2H_3D	C_2HD_3	$C_2H_2D_2$ <i>cis</i> and <i>trans</i>	$C_2H_2D_2$ <i>asym.</i>
1621	1515	1600	1545	1507	1581
3007	2251	3016	2372	2376	2331
1341	981	1397	996	2390	
3082	2304	3104		1282	1379
		1236		1214	
		2356	2215	2033	
		2965		2046	
				763	
				863	

(cm.⁻¹).

There is a slight discrepancy between the experimental results and the theoretical calculations carried out by Manneback and Verleisen. The potential function proposed by these authors has thus to be revised; this revision has been started by Manneback and his co-workers. The comparison of the first three lines (S_1 lines) of C_2H_4 and C_2D_4 gives a measure of the anharmonicity correction. The ratio of the product of these three frequencies should be 2. Deviations from this value are to be ascribed to the anharmonicity of the vibration. This constant was not taken into account in the earlier calculations; in fact, we find the value:

$$\frac{1621 \times 3007 \times 1341}{1515 \times 2251 \times 981} = 1.954.$$

The results indicate that it is of the order of magnitude of 2 per cent. Several lines not given in the table could be detected in the spectrum of the di-deuteroethylenes. It has not been possible to ascribe them unambiguously. Further work is in progress.

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¹ v. Kőrösy, K., "Versuch einer Theorie der Genkoppelung" (Berlin, 1929).

² Bridges, C. B., and Olbricht, T. M., *Genetics*, 11, 41 (1923).

³ v. Kőrösy, K., *Naturwiss.*, 20, 324 (1933).

⁴ Dobzhansky, Th., *Biol. Zentralbl.*, 53, 493 (1933).

⁵ Bridges, C. B., *Biol. Zentralbl.*, 47, 600 (1927).

⁶ Stern, C., "Handb. der Vererbungslehre", 1, H. 125 (Berlin, 1933).

⁷ Morgan, T. H., Bridges, C. B., and Sturtevant, A. H., "Biological genetics", 2, 99 (1925).

Research Items

Blood-Brotherhood in Dahomey

M. PAUL HAZOUMÉ, in the course of an account of the blood-pact in Dahomey (*Trav. et Mem. Inst. d'Ethnol., Paris*, 25), has essayed a critical analysis of the practices and beliefs with which it is bound up. While religious practices and beliefs hold first place in the institutions of Dahomey, the blood-pact has a profound effect on the formation of character in the individual. It is this which has created their spirit of solidarity and at the same time is responsible for their reserve towards strangers. Those who are parties to such a pact are aware that although it does not create the deep-seated affections, which are attributed to the action of certain mysterious philtres, it does give rise to a feeling of unlimited confidence, because those who are bound by this tie are aware that their 'brothers' will never betray them with impunity. In other words, the chastisement which is the sanction of a violated oath will keep those who have subscribed to the pact within the paths of duty it has laid down. In the mutual drinking of blood they have taken on a mutual obligation of affection, confidence and help which overrides even the claims of blood relationship. The assistance due extends from the erection of huts and work in the fields to sacrifice of life itself. It involves the taking up of arms on behalf of blood-brothers against injustice and treachery. It is also a protection against robbery; and kings found in it an instrument of power for personal or political objects, disregarding rank and allying to themselves any who might prove useful to their purposes, including experts in magic and spies. On the other hand, no one was allowed to exploit this relation with the monarch for personal gain or social advancement. For long the pact had none but noble objects; but unfortunately it was perverted to evil ends and became an instrument of crime. Originally it was confined to adult males. Now it is a means of assuring the fidelity of married couples, and thieves have resorted to it to join to themselves women, who assist in their nefarious practices by entering into friendly relations with those whom it is intended to rob.

Pain Nerves

WHEN a sharp or a hot object is applied momentarily to the toe, two bursts of pain are felt, the second following the first by an interval of nearly two seconds. T. Lewis and E. E. Pochin (*Clin. Sci.*, 3, 67; 1937) show that this double response depends on the transmission of pain-sense by two sets of nerve fibres having widely differing rates of conduction. They point out that if a pain stimulus is applied at different points on a limb, the interval between the two sensations lengthens as the periphery of the limb is reached. It has been shown by others in the experimental animal that asphyxia interrupts conduction in the fast before the slow fibres; cocaine, on the other hand, paralyses the slow fibres before the fast. Lewis and Pochin show that in man asphyxia abolishes the immediate but not the delayed response to pain, while cocaine abolishes the second response before the first.

Pharmacology of Tetramethylammonium

TETRAMETHYLAMMONIUM has various actions of pharmacological interest. A. J. Clark and J. Raventos (*Quart. J. Exp. Physiol.*, 28, 361-392; 1937) have studied some of these actions and compared them with those of substances formed from it by altering some of the chemical groups in the molecule. The actions studied may be classified as muscarine actions (contraction of rat's intestine and inhibition of frog's heart), nicotine actions (contraction of leech muscle), atropine actions (inhibiting muscarine actions) and curare actions (inhibition of neuro-muscular conduction in voluntary muscle, which may be essentially an inhibition of nicotine actions). The action of drugs on the frog's rectus abdominis is apparently intermediate between these main types. Replacement of one methyl group by a straight-chain alkyl group of increasing length first increases the muscarine activity and then leads to the appearance of the opposed atropine activity. This is explained on a theory, to which Gaddum has given mathematical expression, according to which the antagonistic drugs combine with the same chemical groups in the tissues as the active drugs and block them up. The results generally agree quantitatively with this theory. These changes in the molecule do not much affect nicotine actions or curare actions. Replacement of all four methyls by ethyl, propyl or butyl abolishes muscarine actions and increases atropine actions. Replacement of methyl groups by increasing numbers of ethyl groups diminishes all actions except that on the leech, which is first diminished and then increased. The introduction of a phenyl group has an effect like that of the introduction of three carbon atoms in a straight chain.

Speed of Flight of Birds

IN a Circular (No. 428) published by the U.S. Department of Agriculture, May Thacher Cooke has collected all the records of the speed of flight of North American species of birds and of a few European species which have occurred in North America and are closely related to North American species for which no records are available. There are also included a few running speeds which show that for short distances quail may cover the ground at 12-15 miles per hour, the road-runner at 10-20 miles, while for the emu Le Souëff's record is quoted of a bird driven for 10 miles at a speed of 31 m.p.h. Of the flight records it must be said that many are unsatisfactory, since it would appear that in many cases no allowance has been made for favouring or adverse wind. Thus presumably arises the anomaly of one observation from a moving train giving a speed of 25 m.p.h. for the crow, while another gives 60 m.p.h., and an automobile observation 25-32 m.p.h. But the author seems to consider that wind has no great influence upon the flight of birds, and in support she quotes the case of brown pelicans timed along the beach at El Pismo: 14 m.p.h. with practically no wind, 16 m.p.h. with half a gale blowing half rear, 22 m.p.h. with wind velocity of 50 m.p.h. in the same direction. The old statement

is repeated that birds prefer a side or even a head wind to a following wind. Until observers realize that the speed of a bird's movement in relation to the ground has no biological meaning until corrections have been made for the influence of the wind, these faulty records will continue to accumulate.

Migrations of Salmon

FURTHER evidence of the actual movements of salmon in the sea is given by W. J. M. Menzies (Fisheries, Scotland, Salmon Fish., 1937, No. 1) from the recapture of marked fish. The main experiment was carried out in 1936 at Loch Inchard, twelve miles south of Cape Wrath, a spot chosen as the result of knowledge obtained from experiments in other localities in previous years. Of 1,255 fish marked, 11.7 per cent have been recaptured, at various places so far away as 145 miles to the south and 410 miles east, and south to the Yorkshire coast and even in Norway. The suggestion is put forward that these fish had collected at Loch Inchard from some feeding ground to the west or north, and thence migrated purposively to the positions at which they were recaptured. This view is supported in a remarkable manner by scale examination. As a result of extensive investigations in recent years, the type of parr growth, which differs from river to river, is now known for a large number of rivers. With one exception, all these recaptured salmon showed on their scales the parr growth typical of that of fish from the rivers in which they were recaptured. This seems rather conclusive evidence that the fish were proceeding via Loch Inchard on a definite migration to their own particular rivers.

Hemipterous Insects of the Family Peloridiidae

THIS small and scarce family of hemipterous insects was for a number of years only known from two examples from the southern extremity of South America. In 1920 a further example was discovered in New Zealand, and in 1924 a nymph was found on Lord Howe Island. Later, examples turned up in Australia and in 1933 a number of specimens were found in that country by Mr. I. W. Helmsing, which have enabled a more detailed study of the family to be made. In the *Annals and Magazine of Natural History* of May, 1937, Messrs. Helmsing and W. E. China discuss the Australian species, *Hemiodocous vitichi*. The favourite habitat for this species appears to be among moss in forests of Antarctic beech (*Nothofagus moorei*). The few known examples of the family were formerly placed in the Heteroptera, but it is now agreed that its affinities are with the sub-order Homoptera. These authors conclude that the establishment of a separate new suborder for the Peloridiidae is not justified, and that the group belongs to a new series in the suborder Homoptera for which the name Coleorrhyncha was given by Myers and China in 1929. The Peloridiidae are evidently a very primitive and generalized family associated with primitive vegetation (mosses), and it is concluded that its members may well have been descended in an almost direct line from protohemipterous ancestors.

Colour of Hydrangea Flowers

It would perhaps be difficult to say whether pink or blue hydrangea blooms are most popular for floral decoration, but the reliable production of blue-coloured flowers has long been a horticultural desideratum. Mr. E. M. Chenery has made an exact

study of this question, and his findings have recently been published (*J. Roy. Hort. Soc.*, 62, Pt. 7, 304-320, July 1937). The paper considers the problem from historical and horticultural points of view, and also compares the influence of soil conditions with the physiology of the plant. From all sources of evidence, aluminium seems to be the element the presence of which induces a blue colour in the flowers, and not iron, as was at one time supposed. Analyses of blue and pink sterile flowers or petaloid sepals showed that aluminium was always greatly in excess of iron when the blue colour appeared. The anthocyanin from pink flowers would, however, form a blue delphinidin complex with both iron and aluminium ions.

Dipterocarpaceae of the Eastern Tropics

IN Forest Products Research Records No. 16 (Timber Series No. 5. H.M. Stationary Office, 1937), Mr. S. H. Clarke, under the title "Gurjun, Apitong, Keruing, Kapur and allied Timbers", deals with a group of timbers from the eastern tropics which has in recent years become increasingly important to the wood industries of Great Britain. From a commercial point of view, the family Dipterocarpaceae is the most important group of timber trees in the eastern tropics—occupying a more or less similar position in Burma, the Malay Peninsula, Sumatra, Borneo and the Philippine Islands to that occupied by the soft woods in the great forests of Canada and the U.S.S.R.; the dipterocarps, however, rarely occur in pure forests, yet they yield a larger volume of timber than all the other species occurring in mixture with them. The family comprises nineteen genera and some 880 species. The *Shorea* timbers are the lightest; *Dipterocarpus* and *Dryobalanops* moderately heavy, and, though not very durable under exposed conditions in the tropics, are well suited for constructional and other purposes in the temperate climates. The hardest woods of the family come into the genera *Vatica*, *Hopea* and *Balanocarpus*. These are too heavy and hard to be of use for general purposes in Great Britain, though they form the chief constructional timbers in the countries producing them. The chief exploited species of the family are magnificent trees with a bole running up to 80 ft. or more without a branch, and a diameter which may reach 5 ft. Resin or gum occurs in some of the species. The pamphlet gives a general classification of the timbers in a tabular statement showing the countries of origin and the chief species of the principal genera *Dipterocarpus*, *Dryobalanops*, *Shorea*, *Hopea*, *Vatica* and *Balanocarpus*.

Erosion Surfaces of Cornwall

MARINE action has clearly played a great part in shaping the physiographical features of Cornwall. Platforms at 1,000, 800 and 400 ft. have been mentioned and a 200-ft. level has been suggested. Mr. W. G. V. Balchin, in an article in the *Geographical Journal* of July, gives the result of his investigations in north Cornwall, and tries to date the platforms which he has recognized, pointing out that the present physiography had its origin, for the major part, in the dissection of a series of platforms. The erosion surfaces are generally separated by a bluff which when not of structural origin is probably due to marine action. In the area investigated the highest platform, notable on Bodmin Moor, is at 1,000 ft. and is probably late Miocene. Below that is a minor platform at 850-920 ft., and again one at heights

varying from 600 ft. to 820 ft. conspicuous near Camel-ford and probably later Miocene. The best preserved platform is at 300–430 ft., well seen between Boscastle and Tregardock and of Pliocene origin. Finally comes a surface at 240–285 ft. of late Pliocene age, noticeable in many of the flat-topped hills of the Padstow district.

Magmatic Differentiation

At the Tercenary Conference at Harvard University last September, Dr. C. N. Fenner summarized some of the major difficulties that are encountered in attempting to explain all the phenomena of differentiation of igneous magmas by a single process. The paper is now published in the *Journal of Geology* (158–168; 1937). It is pointed out that the Goose Creek diabase contains both quartzo-felspathic micropegmatite and very basic macropegmatite. Unless, therefore, liquid immiscibility be granted, both cannot represent residual magmas, since this would mean that the magma was differentiating simultaneously in two very different directions. The official interpretation of the Glen More ring-dyke (Mull) as an example of differentiation into gabbro and granophyre is shown to violate fundamental principles of chemistry and dynamics. Granitic rocks from the Bushveld Complex are similar to those which have been claimed as products of crystal fractionation from basic magma, and yet they have been demonstrably produced by the granitization of sedimentary quartzites. For many years, a controversy has been carried on as to whether, or to what extent, magmas are capable of assimilating solid rock. It has been repeatedly stated that the great obstacle to assimilation is the supposed inadequacy of the heat supply. Fenner describes phenomena from Alaska and the Yellowstone Park which irrefutably prove that "rhyolite magma was able to do things that the theory of crystal fractionation declares impossible". The facts show that rhyolite magma, so far from being the coolest of the evolution series, possesses great and hitherto unsuspected reserves of latent energy. Fenner insists on the necessity for giving such facts more adequate consideration. So did Goodchild more than thirty years ago, in a paper that was quietly ignored (*Trans. Roy. Soc. Edin.*, 202; 1904), so strong was the prejudice in favour of theory when theory and observation were in conflict. Fortunately, that prejudice is at last crumbling away, as the irrepressible facts become more widely known.

Retardation of Chemical Reactions

The reaction between potassium permanganate and hydrogen peroxide is retarded by hydrogen peroxide in fairly concentrated solution, an effect which has been attributed to the formation of inactive H_2O_2 molecules at higher concentrations. K. C. Bailey and G. T. Taylor (*J. Chem. Soc.*, 994; 1937) have re-investigated the reaction, measuring the extent of decomposition with a photo-electric colorimeter, the effects of stirring and of traces of manganous ions being particularly controlled. With initial permanganate and sulphuric acid concentrations constant, the reaction velocity reaches a maximum at $(H_2O_2) = 0.005$ equiv./l., falls to a minimum at $(H_2O_2) = 0.16$, and rises slowly at higher peroxide concentrations. With initial permanganate and peroxide constant, and the latter at concentration greater than 0.02, the velocity rises to a maximum

with increase of sulphuric acid, falls to a minimum, and then rises again. Manganous ions catalyse the reaction powerfully at peroxide concentrations rising to the maximum velocity concentration but have little effect near the minimum velocity. Other effects were found and a theory covering all the data is not proposed. It is considered that the reduction of MnO_4^- to Mn^{2+} probably takes place in stages, the first perhaps involving the production of MnO_3^- which may be capable of being re-oxidized to MnO_4^- by a molecule of H_2O_2 with sufficient energy. A fair agreement with experiment is obtained by an empirical equation: $v = k_1(H_2O_2)(H_2SO_4)(KMnO_4) / (k_2 + k_3(H_2O_2)^2(H_2SO_4)^2)$, the terms in the denominator representing two types of retardation, the second being the re-oxidation of partly reduced permanganate by active hydrogen peroxide.

Investigation of Porous Structure

An emanation method has recently been described (G. Graue and N. Riehl, *Naturwissenschaften*, 25, 423; 1937) which offers possibilities of examining the porous nature of catalysts and of studying reactions in solid phases. The emanation method of Hahn, first described in 1929, depends on introducing a radioactive element which forms a gaseous emanation on disintegration into the solid. The degree of porosity is indicated by the quantity of emanation which can be detected in the neighbourhood of the solid. This method has the disadvantage that it can only be used for special substances in which the radioactive substance can be included. The method now proposed is to allow the emanation to penetrate the solid from outside, the amount penetrating indicating the porosity. The method has been used to determine the true specific volume of crystalline and precipitated zinc sulphide. The value obtained for the specific volume of crystalline zinc sulphide was the same as that determined by the pycnometer method, but for precipitated zinc sulphide the value obtained by the emanation method was much smaller than that with the pycnometer. It must therefore be assumed that in amorphous (precipitated) zinc sulphide there are pores or fissures of atomic dimensions due to an irregular arrangement of atoms. It is possible that gases penetrate into the interior of solid catalysts not only by means of large pores, but also by inter-atomic pores and clefts due to badly formed lattices.

Recent Sunspot Activity

DATA contained in Nos. 36 and 37 of the Zurich *Bulletin for Character Figures of Solar Phenomena* for the six months October 1936–March 1937 show how considerable has been the sun's activity of late. The mean daily sunspot 'numbers' for each of the six months are, respectively, 89, 115, 123, 133, 128 and 84. The highest value reached in the preceding 11-year cycle was 108 for December 1929; but in the earlier cycle with a maximum in 1917 the value 155 was reached in August of that year. The mean number for the year 1936 was 80.4 as compared with 36.1 for 1935, 8.7 for 1934 and 5.7 for 1933. Since March 1937, activity has remained considerable. Large sunspots crossed the sun's central meridian on April 22.4, April 23.2*, April 24.6*, April 29.6, May 20.8*, May 27.2, June 4.9, June 15.6, June 16.9*, June 21.2, June 27.0 and July 28.6*. Those groups marked with an asterisk exceeded, at maximum development, 1,000 millionths of the sun's hemisphere as given by the Greenwich measures of area.

The Palace of 'Discovery at the Paris International Exhibition, 1937

By Dr. Pierre Biquard

EVERY day thousands of visitors from all parts of the world enter the Palace of Discovery of the Paris International Exhibition. Some go as experts to see how far science lends itself to spectacular demonstration. Others, realizing their lack of knowledge, go to learn. Furthermore, some people, especially the young, go brimful of eager curiosity, hoping to find somewhere in those halls an inspiration which will guide them in the choice of their career.

One thing is certain, no one is disappointed. It is obviously impossible to cover in a brief article the entire field of present-day science, and relate the history of scientific progress up to date. This is merely a brief statement of what has been achieved in the different sections of the Palace of Discovery. The Palace covers an area of 23,000 square metres. All branches of scientific learning are represented, from mathematics and astronomy to medicine and botany.

The greatest efforts have been made to replace by real demonstrations the silent testimony of documents and pictures. In all sections a staff of demonstrators escort the visitors and carry out experiments, though many work automatically and can be set in motion by the public. The magnitude of the undertaking is shown by the single fact that the electrical installation of the Great Palace is on a greater scale than that of a whole district in Paris: ten kilometres of feeders and sixty kilometres of cables were needed, and it is estimated that the cost of the electricity used during the course of the Exhibition will amount to 1,000,000 francs.

In accordance with the views of Auguste Comte, mathematics will be dealt with first. It may be true, as Emile Borel wrote in Paris, 1937, that "only those who have given up their lives to mathematical research know what it is, what are its aims and by what means it attains them"; nevertheless the rooms set apart for mathematics show to all visitors the development of this science from the earliest times and the growing importance that it has acquired in modern developments of physics, chemistry, biology, etc. Certain questions are explained by means of films: in this way visitors are introduced to such subjects as four dimensional space and the laws of similitude, showing that if the dimensions of an individual were increased ten times he would collapse under his own weight. Mathematicians are given the opportunity of working out on the spot at the black-board problems the solutions to which are posted up the following day. It is interesting to see that the eternal riddle of the squaring of the circle occupies a place, and the value of π to 707 places of decimals is exhibited on the surface of a cupola.

The task undertaken by those responsible for the astronomy section has been no small one. They have had to crowd into a few rooms all that is known about a universe so vast that light takes a thousand million years to traverse it. Three models show the structure of portions of space of decreasing sizes: the first represents the galaxy, the diameter of which is of the order of five million light years: the second shows the sun and the twenty-five stars surrounding it in a portion of space through which light travels in

twenty-five years: finally, the third model shows the sun and its attendant planets, that is, a very small space through which light travels in seventeen hours. The northern Milky Way is shown in a photographic enlargement measuring 20 m. $\times$ 4.5 m.; there are also many good photographs of nebulae, of the sun, moon, planets, comets, etc. The movements of the planets in the solar system are reproduced in the great planetarium, and to make them more clearly visible, the rates of their revolutions have been multiplied by 432,000, allowing one revolution of Mercury around the sun to be seen in eighteen seconds. After having examined all that can be seen in space from the earth, the visitor naturally wonders what our world would look like to other beings living on some other planet. An answer to this question is given by a model 70 cm. in diameter which was made as the result of the observations of explorers of the stratosphere.

Physics occupies a favoured position in the Palace of Discovery. In a room dedicated to Galileo are seen the fundamental experiments relating to falling bodies, the oscillations of the pendulum, centrifugal force, the laws of composition of forces. All the foundations of the so-called 'rational' mechanics are there, and it is impossible not to dwell on the scientific progress in physics and astronomy made on this basis up to the time when its application to optics was found to be impossible.

The history of our knowledge concerning light appears in the section devoted to optics. After having thus learnt anew the laws of reflection and refraction, and measured the velocity of the propagation of light, the visitor can watch a series of experiments on interference, diffraction, polarization, interference photography, and will then perhaps be convinced of the truth of the wave theory of light. The photo-electric phenomena which can be examined later will give him food for thought.

Another section is given over to electrostatics. Once again the public may see the production of electric charges by the friction of cat skin and, on the other hand, watch the working of the Van de Graaf electrostatic machine set up under the direction of M. Joliot by MM. Lazard and Savel. This machine can produce sparks of several million volts passing between two spheres of three metres diameter.

The field of oscillations is the subject of another section in which electromagnetic and sound vibrations are studied. Special attention must be directed to the manner in which are exhibited the consequences of the discovery by Pierre and Jacques Curie of the piezo-electric property of quartz; the stabilization of high-frequency emissions, quartz pianos, emission and reception of ultra-sound waves, submarine sounding, etc.

Ampère's experiments and the laws of electrodynamics lead up to the triumphs of electrotechnics. By a parallel procedure, it is possible to follow the progress which, starting with the phenomenon of thermionic emission, has led to the creation of modern radiotechnics.

Some of the most beautiful experiments are shown in a section devoted to the states of matter and the

structure of the atom. Matter is heated, cooled, compressed under several thousand atmospheres, expanded, etc. The experiments shown on fluorescence and phosphorescence are as conclusive as they are beautiful. Last comes what is perhaps the most glorious chapter of modern science, the study of atomic particles and radiations. In this section are reproduced all the experiments which have marked a decisive step forward in the study of electrons, of X-rays and the radiation of radioactive bodies, thus passing from the first Crookes tube to the artificial radio-elements and to the cosmic rays made visible thanks to the Wilson expansion chamber.

Four laboratories have been chosen by the chemists to show the history of their particular branch of science: an alchemist's laboratory, Lavoisier's laboratory, Berthelot's laboratory and finally a modern chemical laboratory. While further on, the 'elements' air, water and fire have a special room reserved for them. A great illuminated chart shows the periodic classification of the elements and an ingenious arrangement demonstrates the structure of all the atoms, from hydrogen to uranium. The principal analyses and syntheses are reproduced before the visitors' eyes, notably the separation of the gases of the air and the synthesis of acetylene in Berthelot's 'electric egg'. With regard to each of the important branches of this science—physical chemistry, inorganic chemistry, organic chemistry, metallurgical chemistry, photochemistry, geochemistry—it is possible to estimate how much the researches of pure science have contributed to the progress of industry (paper making, manufacture of sulphuric acid, preparation of colouring matters, dyeing and printing of materials, etc.).

Biology, as might be expected, shows here a living summary of the work of Pasteur together with an exhibit of the developments of microbiology—discoveries relating to smallpox, intestinal affections, cholera and typhus.

Medicine is divided into: (1) the diseases of nutrition, (2) cardio-vascular pathology, (3) medical physics, and (4) the history of medicine, in which

special stress is laid on the fundamental part played by the discovery of auscultation. Also, for surgery, the considerable progress made in the last ten or twenty years is shown, more especially the influence of discoveries bearing on asepsis and anaesthesia. If anyone wishes to learn more about his own organism, and to know what his qualities are, both good and bad, he may take his place on the seat where the human machine is tested. There, after a series of tests, his biometric ticket will be made out and may prove useful in choosing a profession. If the results are good, he will be all the more surprised when confronted with the sensorial illusions shown in the section of psycho-physiology. Experimental biology demonstrates how living beings react to physical and chemical reagents. Plant physiology and biology are illustrated by dioramas, films and collections. Finally, mention must be made of the section reserved for plant genetics, in which are exhibited the great facts of natural selection, of the formation of new species and of natural or induced changes.

Space will not permit the inclusion of the names of the many scientific men from France and abroad who have collaborated in the preparation of this great Exhibition. One exception must, however, be made in the case of the president, M. Jean Perrin. This Palace is the fruit of his untiring labours, and it is thanks to him also that France will soon possess a permanent Palace of Discovery.

It is only natural that in an exhibition representing the arts and technical sciences in modern life, scientific discovery should have its rightful place as the foundation of all progress. The Palace of Discovery brings this home to the general public and also shows the real beauty of science. Possibly, on leaving, the visitor will realize the truth of these words taken from Henri Poincaré's *"Dernières Pensées"*: "Celui qui aura goûté à la Science, qui aura vu, ne fût-ce que de loin la splendide harmonie des lois naturelles, sera mieux disposé qu'un autre à faire peu de cas de ses petits intérêts égoïstes; il aura un idéal qu'il aimera mieux que lui-même et c'est là le seul terrain sur lequel on puisse bâtir une morale".

A Mesolithic Site in Brittany*

THE Mesolithic site of Tévéc, a rocky islet situated about eighteen hundred metres west of the shores of the peninsula of Quiberon in Brittany, which has been explored by M. and Mme. Péquart, is up to the present the most important station of this period that has been submitted to systematic and complete examination. Incidentally, it may be said, it gains in significance by the fact that examination of human skeletal remains from Tévéc has elicited from MM. Boule and Vallois a detailed analysis of the physical characters of Mesolithic man, so far as known from the remains which have survived, and a comparison of this race or type with those of the Upper Palaeolithic.

The investigations leading to the discovery of the site were undertaken by M. and Mme. Péquart in the hope of throwing light on the domestic and tribal economy of the early inhabitants of Brittany,

which had been neglected by archaeologists owing to their preoccupation with the all-absorbing study of the monuments of the country. For this purpose they were convinced that there was little hope of obtaining undisturbed evidence on the mainland, and consequently directed their investigations to the numerous small islands which lie off the coast of the Morbihan. In 1926 they were attracted by the evidence of a kitchen-midden exposed by marine erosion on this barren rock—it is little more, its dimensions being only four hundred metres in its greatest length and two hundred metres at its greatest breadth, while its elevation over the greater part of its extent is no more than ten metres—and began its excavation in July, 1928. After twenty-one days' excavation they were rewarded by the discovery of the first burial. The work of excavation was continued in 1929 and 1930.

The island is completely barren, and even with the resources of modern civilization the excavating party found difficulty in keeping themselves provisioned

* Tévéc. station-nécropole mésolithique du Morbihan. Par Marthe et Saint-Jost Péquart, M. Boule et H. Vallois. (Archives de l'Institut de paléontologie humaine, Mémoire 18.) Pp. ii+227+10 plates. (Paris: Masson et Cie., 1937.) 220 francs.

during their stay on the island. There is, however, reason to believe that at the period of occupation under investigation the island was joined to the mainland, and the mode of life of the inhabitants was riverine, rather than marine. This view is supported by the character of the charcoal, of which an abundance was found. This is the produce of forest trees. The animal remains are also those of a forest fauna. The inhabitants, however, do not appear to have subsisted to any great extent by either fishing or hunting, and their diet was almost exclusively of shell-fish. There is no supply of fresh water on the island.

It was largely this difficulty of making any prolonged stay on the island that was responsible for the fact that it had not been explored archaeologically. The site was actually first discovered by M. F. Gaillard in 1883, but he was able to do no more than make a few *sondages* on the north-west of the island. This brought to light some fragmentary evidence of a cooking-place and gave an approximation of the extent of the kitchen-midden; but the great antiquity of the site was not appreciated. The present explorers recognized by the quantity of culinary refuse, molluscs, fish and game, the quantity of charcoal and the fragments of bone and stone, as well as of the finished implements of these materials, that they were dealing with a kitchen-midden, while the absence of pottery and polished stone as well as the Tardenoisian character of the industry, indicated a Mesolithic site, or to be more precise a site belonging to a phase of culture corresponding to the post-Axilian Maglemose, Mullerup, or Mùgem.

The station covers a superficial area of about two hundred metres square, though without doubt originally it was much larger. Much of it has disappeared by marine erosion. The archaeological bed runs to a depth of from 0.60 m. to 1 m. and is entirely homogeneous throughout its depth in composition and contents. It is composed of a black earth, heavily loaded with carbon, indurated, but breaking up readily, owing to the mass of organic material, bones and artefacts, it contains. The artefacts are homogeneous in character throughout. The site was, in the words of the authors, "*vierge de tout remaniement*".

A number of hearths and burials were found, constituting in all "18 monuments". The burials were of twenty-three individuals, male and female, adult, adolescent and infant. In several instances infants were found buried with adults, for reasons that are not apparent. It is not invariably the burial of mother and child. In one grave the adult was male. Provision was made for the after-life in the form of implements and ornaments, especially necklaces of shells, placed with the body. There appears to be a ceremonial use of deerhorn, possibly as a mark of a special position in the tribe, which recalls the magical significance of horns in Palaeolithic art, as well as possibly being an anticipation of later belief.

The hearths which were found appear to fall into different categories. They are classified by the authors as domestic hearths, which show heavy and protracted use in the calcining of the stones used, cooking hearths, possibly set up for funerary feasts, and ritual hearths for sacrificial meals, which do not show the same signs of protracted use.

The burials are partly in the soil and partly covered by the kitchen-midden material. They show no signs of orientation. The bodies are disposed in

a sitting position, with the legs forcibly flexed and the back against the wall, or else laid on the back, with head and shoulders raised, and the legs flexed, or sometimes crossed on the stomach.

The station is not in reality rich in industries of either bone or stone. Stone artefacts fall into three categories—small implements of geometric outline, finely and carefully worked, flakes retouched over part or the whole of their outline, and a group of specimens of larger size, bolder flaking, comprising nuclei, scrapers and thick flaked tools of various types, in which the fracture seems crude, rather than purposively directed. The bone objects include handles of deerhorn, polishers, objects of indeterminate use made from the tusk of a boar which may have been for piercing leather, and various points, of which one form, a "stiletto" (though only 15-17 cm. long) appears to be accorded a special position in certain burials. Several objects show a simple attempt at decorative art in the form of engraved parallel diagonal or vertical lines. There is no evidence whatever of anything in the nature of permanent structures for habitation.

This discovery of a Mesolithic habitation-necropolis has for prehistoric studies, and for the study of the Mesolithic in particular, a triple interest. It shows for the first time in the prehistory of Brittany a homogeneous and sealed station in the Morbihan of civilization of a people anterior to the builders of the megaliths, and proves, what had previously been denied, that Brittany was inhabited before the Neolithic age. In regard to French prehistory, Ténac may be regarded as the type station of the French Mesolithic, and in fact it is the first to furnish in abundance for France evidence relating to the fauna, flora and industries of that period, while it is the only station which has yielded such an abundance of material for the study of the physical characters of the peoples of Mesolithic age. Further, it throws a flood of light on their culture and beliefs. Finally, in relation to prehistory in general, it makes an important addition to knowledge of the distribution in Europe of Mesolithic culture and a link between the stations of the north of Europe and the south.

While it is clear that this Mesolithic civilization has no relation with the Neolithic of Brittany, there is no indication of its origin. Like the Mesolithic elsewhere, it shows certain features reminiscent of Palaeolithic culture, and it may be that it is a descendant of a Palaeolithic of Brittany as yet unknown.

The physical characters of the inhabitants of the site may be summarized as follows, although this affords only a very inadequate idea of the carefully detailed examination of the skeletal material which has been made by MM. Boule and Vallois.

From the twenty-three burials, twenty-one skeletons were obtained in such a state of preservation as to afford material for observation and study. In general terms, the subjects were not of an advanced age, and there was none who could be described as elderly. Of two very young individuals a few teeth only were obtained. Of the remaining twenty-one, six were infants and six only were truly adult, five ranging in age between twenty and twenty-five years. The sex was easily determined, as in all but one instance the difference between male and female was strongly marked. Out of fourteen individuals six were male and eight were female. An indeterminate individual was probably male, though a low stature possibly indicates a female.

The head measurements were: length, male, 180–190 mm., female, 170–190.2 mm.; breadth, male, 129–143 mm., female, 133–142 mm.; basi-bregmatic height, male, 128–150 mm., female, 129–142 mm.; capacity, male, 1,561 c.c., female, 1,548 c.c.; cephalic index, male, mean, 74.3, female, 75.1. The skulls show a tendency to vary from a moderate dolichocephaly to mesocephaly, this tendency being more pronounced in the female.

In general character the skull is massive, but without marked prominences, thick, and relatively capacious. In form it is 'beloid'. It is high, especially in the men, and carinated with a pronounced median ridge. The forehead is broad and rounded, the glabella moderately developed. The face is large and low, euryprosopic, and mesognathous to prognathous. The mandibles are robust with a pronounced chin. The dentition is megadont. The teeth are remarkable as showing the first known example of caries, not previously recorded before Neolithic times. The stature is distinctly below medium. The forearm is

relatively long. The lower limbs show marked platymeria, and the tibiae are platynemic. As a type, this population is well evolved.

MM. Boule and Vallois have also, as a basis of comparison, made a detailed survey of all the skeletal material of man surviving from the Mesolithic period. This they classify into five types—the Ofnet brachycephal, the dolichócephalic-mesocephals of Tévies, the Ofnet dolichocephals, the Mugem dolichocephals, and the Natufians of Palestine.

On the whole, the authors are inclined to the view that notwithstanding certain clearly marked differences there is a close resemblance between Tévies man and the Chancelade skull of the Upper Palaeolithic. It is certainly closer than to Cro-Magnon man. Of the three possibilities that the type is new in western Europe, that it is a cross-breed, or that it is a variation from Chancelade which has been produced in the long interval of time which has elapsed between the occurrence of the two types, the authors incline to the last-named.

The Electrotor Smoke and Dust Meter

A RECENT paper by Dr. S. C. Blacktin (*J. Indus. Hygiene and Toxicol.*) describes an instrument he has devised for measuring dust suspended in the air. It is of a new type, and in designing it he has attempted to "avoid extraneous mechanisms or electric batteries which mar convenience and portability". The instrument consists of a hand pump of 100 c.c. capacity which draws air through a number of small nozzles, causing it to impinge upon a disk of celluloid or ebonite which, during the impact of the air, is made to revolve by means of a coarsely screwed rod which engages a nut or suitable projection on a hollow piston rod. The revolution of the disk is said to electrify it by rubbing against insulating material. In operation, a clean disk is inserted in the cap and the pump handle is next withdrawn to its greatest extent, and the cap with its disk screwed into position. The pump handle is next pressed downwards, rotating and electrifying the disk and emptying the pump. The ingress port is now held in the dust or smoke dispersion to be determined and the pump handle is withdrawn to its greatest extent

with a steady pull. The air or gas entering the ingress holes against the electrified disk is said to deposit its particle content. The records obtained appear to be circular rings upon the record disk, and these are examined in the usual way under a suitable microscope.

In the paper the instrument is illustrated and described, but no data are given on its efficiency of operation. The apparatus is very simple and, provided it fulfils the function it is intended for, should be a useful addition to the methods available.

It is not easy to see how the construction described could be very effective in its operation; for example, it appears that the dust deposit takes place upon the surface of the disk which is being rubbed by rotation and electrified. Mechanically speaking, it cannot be easy to ensure a suitable rubbing pressure between the disk and the surface in contact with it, taking into account the clearances required in the bearings of the screw and such like. However, as stated already, no information is given on its actual use.

J. S. OWENS.

Performance of Noise Meters in Terms of the Primary Standard

DURING the past few years considerable progress has been made on the intricate subject of noise measurement and many experimental data are now available. A paper on this subject was read by B. G. Churcher and A. J. King to the Institution of Electrical Engineers early this year.

Since loudness is a sensation and not a physical magnitude, its definition and measurement involve subjective considerations such as the manner in which the sound is heard. Until recently these factors were not specified, and so the various types of portable noise meters in use gave appreciably different

indications for a given noise. The British Standard Institution (B.S.I.) has taken an important step in removing difficulties. It has published an authoritative glossary of acoustical terms and definitions (B.S.S. 661) to which most of the workers in Great Britain will conform. Loudness is defined as, "that subjective quality of a sound which, in general, increases regularly with the intensity within the limits of audibility". A natural loudness scale is one such that when the number of units on the scale is doubled the magnitude of the sensation experienced by normal listeners is doubled also. The expression

"equivalent loudness" has been adopted for the physical intensity level of the reference tone relative to the standard pure tone. The unit of equivalent loudness is the 'phon', which is defined as follows: "The standard tone shall be a plane sinusoidal sound wave train coming from a position directly in front of the observer and having a frequency of 1,000 cycles per sec". It is also stated that the listening must be done by both ears, the standard tone and sound under measurement being heard alternately. If when measured in this way the intensity level is found to be n decibels above the standard tone, the sound is said to have an equivalent loudness of n phons.

Equivalent loudness is defined in terms of the loudness-equality judgment of a hypothetical "normal observer" whose loudness judgment is representative of the average person. A group of persons is therefore selected; the larger and the more representative the group the more closely in all probability the group judgment will approximate to that of the normal observer. Experience shows that good results can be obtained, using mathematical statistical methods, with ten normal observers.

Reproducible noises of physically specified composition are set up by means of a loud-speaker, and their phon values determined in accordance with the definition. The same noises can then be applied to noise meters of any type and the difference between the phon values is the meter error for the type and level of the noise applied.

The measurement of noise is a problem of great and increasing importance in engineering. The authors conclude that the B.S. phon enables a consistent and unifying system of noise measurement to be set up, relevant to the manner in which sounds are normally heard.

The measurement of the frequency, intensity, purity and field distribution of the experimental tones is effected by condenser microphone methods. The analyser has a range of 25–25,000 cycles per second, is continuously adjustable and is highly sensitive. The microphones are calibrated by means of a Rayleigh disk. An ingenious electromagnetic tone generator is described by means of which harmonic noises containing up to ten components of any relative intensity may be set up.

Academy of Sciences, Vienna

ANNUAL MEETING

AT the general meeting of the Academy of Sciences in Vienna, held on June 1, the following officers were elected: *President*: Dr. Oswald Redlich, emeritus professor of history in the University of Vienna; *General Secretary*: Dr. Egon von Schweidler, professor of physics in the University of Vienna; *Secretary of the Philosophical and Historical Section*: Dr. Heinrich Ritter von Srbik, professor of history in the University of Vienna.

The following were elected to membership of the Philosophical and Historical Section: *Active Members*: Dr. Camillo Praschniker, professor of classical archaeology, Dr. Rudolf Egger, professor of Roman antiquities, and Dr. Johannes Mewaldt, professor of classical philology, all of the University of Vienna; *Corresponding Home Members*: Dr. Friedrich Wild, professor of English philology in the University of Vienna, Dr. Franz Martin, director of land administration records in Salzburg, Dr. Alfred von Verdross, professor of international law in the University of Vienna; *Honorary Foreign Member*: Dr. Edward Schröder, emeritus professor of German language and literature in the University of Göttingen; *Corresponding Foreign Members*: Dr. Walter Otto, professor of ancient history in the University of Munich, Dr. Jan Huizinga, professor of history in the University of Leyden, Dr. Friedrich Panzer, professor of German language and literature in the University of Heidelberg, Dr. Theodor Litt, professor of philosophy and pedagogy in the University of Leipzig, Dr. Adolf Grohmann, professor of semitic philology and cultural history of the Orient in the German University of Prague.

The following were elected to membership of the Mathematical and Scientific Section: *Active Mem-*

bers: Dr. Karl Terzaghi, professor of hydraulic engineering in the Technische Hochschule in Vienna, Dr. Theodor Pinter, emeritus professor of zoology in the University of Vienna, Dr. Erwin Kruppa, professor of descriptive geometry in the Technische Hochschule in Vienna, Dr. Leopold Adametz, emeritus professor of animal genetics in the Technische Hochschule of Agriculture in Vienna, Dr. Richard Schumann, professor of geodesy and astronomy in the Technische Hochschule in Vienna; *Corresponding Home Members*: Dr. Josef Weninger, professor of anthropology, Dr. Johann Solch, professor of geography, Dr. Roland Grassberger, professor of hygiene, Dr. Karl Mayrhofer, professor of mathematics, all of the University of Vienna, and Dr. Wilhelm Petrascheck, professor of geology, palaeontology and stratigraphy in the Montani Hochschule in Leoben; *Corresponding Foreign Members*: Dr. Otto Grosser, professor of anatomy in the German University of Prague, Dr. Enrico Fermi, professor of physics in the University of Rome, Dr. Ernst Küster, professor of botany in the University of Gießen, Dr. Herman Nilsson-Ehle, professor of botany in the University of Lund and director of the Plant Breeding Institut in Svalöf.

The following awards were made by the Academy: the Ignaz L. Loebl prize, which this year is awarded for physics, to be divided equally between Dr. Marietta Blau and Dr. Hertha Wambacher for their work on the photographic action of α -rays, proton and neutrons; the Rudolf Wegscheider prize for chemistry to Dr. Otto Brunner for his work on stearins and the vitamins of the eye; the Frit Pregl prize to Oberst Max Haitinger for his work on fluorescence microscopy.

Science News a Century Ago

Dr. Andrew Fyfe on the Voltaic Battery

THE first article in the *London and Edinburgh Philosophical Magazine* of August 1837 was by Dr. Andrew Fyfe and was entitled "On the Use of Sulphate of Copper for exciting Voltaic Electricity and on the Employment of Iron in the Construction of Batteries". Fyfe was aware that sulphate of copper was easily decomposed by zinc, and was induced to try it as the exciting fluid in the galvanic battery; he found it far superior to the acids in common use. He had a trough constructed of copper and sheet-iron, the plates being of the same size and number as those in a zinc battery. When sulphate of copper was used in the batteries, "electrolyzation", he said, "commenced almost the instant the trough was filled, and continued in the same way as when zinc was employed, indeed I could observe little difference as to energy of action and to the time that it continued, with this exception, that in general there was rather less gas evolved in the volta-electro meter". In view of the cheapness of the materials used, he conceived that the iron trough might be used for certain purposes.

Fyfe, who was born on January 18, 1792, and died on December 31, 1861, graduated in medicine in 1814 at Edinburgh. At one time he was assistant to Thomas Charles Hope (1766-1844), the professor of chemistry, and himself lectured privately on that subject. In 1827 he published his "Elements of Chemistry". He was president of the College of Surgeons, Edinburgh, in 1842-43 and in 1844 was appointed to the chair of chemistry at Aberdeen, a post he held until his death.

Science in Parliament

COMMENTING on the approaching opening of the first parliament of the reign of Queen Victoria, the *Mechanics' Magazine* of August 1837 said, "The new parliament will, to all appearance, have a smaller number of scientific members (always few enough) than the last, which, in its turn, had fewer than that which preceded it. Sir George Cayley will have no seat in the first parliament of Queen Victoria, while Mr. Babbage is further off the object of his ambition than ever . . . The principal scientific men who remain there are Mr. Heathcoat, the member for Beverton, well known for his inventions in lace machinery, and the (said-to-be-unsuccessful) steam trough; Mr. Handley, the member for Lincolnshire, whose exertions to introduce steam-machinery in agriculture have been great and long continued; and Mr. Jephson, the member for Marlow, who holds a high reputation in the mechanical world. We believe Mr. Roach, the barrister, better known to fame as the inventor of the patent screw-flx, has not secured a seat on the present occasion, or, of course, he would have been added to the scanty list."

The First French Railway

IN August 1837, the railway between Paris and St. Germain—the first in France—was opened. Writing on August 26, the correspondent of *The Times* said, "Paris has put on her seven-leagued boots, and reached St. Germain in a stride! The chateau of Louis le Grand, and the fine terrace sweeping through the forest until it is lost in distance, have kindly consented to approach the metropolis for the

gratification of the numerous *guides* who inhabit it; and St. Germain, with all its interesting scenery, although, if we are to credit the map, it is twelve good English miles from Paris, is now more accessible than the windmills of Montmartre. This *triomphe merveilleux*, as the Parisians delight to call it, is the work of that grand miracle-monger of the nineteenth century—steam . . . For statistics, it will be sufficient to state that the *material* is composed of 105 vehicles, capable of containing 4,070 persons, and of transporting the entire population of Paris to St. Germain in the course of one fine Sunday. The railway, 4½ leagues in length, passes through a beautiful country, traversing no fewer than eighteen bridges, three of which are across the Seine. . . . There is a tunnel, Batignolles, which is divided into two galleries, being above 400 metres. The construction is very solid, the rails being fifteen times heavier than those upon the Liverpool and Manchester road." An account of the lines was published shortly afterwards in the *Mechanics' Magazine*, in which it was stated the rails were 60 lb. per yard as compared with the 30 lb. per yard of those on the Liverpool and Manchester line. By 1840 there were 265 miles of railways open in France; by 1860 this had increased to 5,865 miles and by 1882 to 17,006 miles.

Societies and Academies

Dublin

Royal Dublin Society, May 25.

Report of the Radium Committee for the year 1936. The total number of millicuries of radon issued during the year was 12,835, the number of cases recorded in the report being 552. The report includes a number of detailed reports by various users of radon supplied by the Society.

M. J. GORMAN: A non-bulbing derivative of yellow-fleshed Swedish turnip. A non-bulbing form described resembles Swedish turnip (*Brassica napus* var. *napobrassica*) in having yellow flesh, buff flowers, and behaving as a biennial. By selfing, successive generations were obtained of rape-like plants quite uniform in appearance and similar to the original.

J. BRENN, J. KRANE and T. J. NOLAN: The chemical constituents of lichens found in Ireland—*Portuscaria concreta*. The main constituent of this lichen is nor-stictic acid $C_{18}H_{18}O_8$. Besides mannitol, it also contains a small amount of a substance crystallizing in yellow needles, m.p. 287° C. This latter substance, $C_{14}H_{14}O_8Cl_4$, contains three hydroxyl groups and is probably a trichlor trihydroxy methyl xanthone. It gives an olive green coloration with ferric chloride.

Paris

Academy of Sciences, June 21 (C.R. 204, 1849-1908).

LÉON GUILLET and MARCEL BALLAY: Krupp's disease in steels.

CHARLES PISOT: The modulo 1 distribution.

MME. HILDA GHEBRINGER: Chance variables arbitrarily connected. (Convergence according to Poisson's law.)

BERTRAND GAMBER: Jonas surface and *R* surfaces.

SERGE BACHVALOFF: Pairs of stratifiable rectilinear congruences.

SZOLEM MANDELBROJT: The equivalence of two classes of functions of Paley and Wiener.

LÉON BRILLOUIN: Disturbance of a problem of individual values by deformation of the boundary.

GEORGES NADJAKOFF: A new species of permanent polarization of dielectrics.

PIERRE DONZÉLOT and JEAN BARRIOL: The relation between Raman frequencies and interatomic distances.

LÉVI HERMAN and Mlle. FANNY BERNSTEIN: Remarks on the properties of photographic plates treated with aqueous or alcoholic solutions of sodium salicylate.

HENRI BIZETTE and BELLING TSAI: The magneto-optical properties of compressed gases. The magnetic double refraction of nitric oxide. The magnetic rotatory power of helium.

FRANÇOIS BOURION and Mlle. ODILE HUN: The determination of the hydration of the ions of sodium iodide.

W. BRONIEWSKI, S. PRZEMPELSKI and S. SULOWSKI: Some physical and chemical properties of very pure steels. The steels were prepared from electrolytic iron and lampblack in an induction furnace, and contained less than 0.014 per cent of impurities other than carbon. Curves are given showing the variation of several physical properties as a function of the percentage of carbon.

J. BERTHOIS and J. FURNESTIN: Study of the sediments dredged by the *Président Théodore Tissier*. Continental plateau (Celtic and English Channel) and the North Sea.

LÉON AUFFRÈRE, EDOUARD GIRARD and EDMOND VIGNARD: The alios of the forest of Montmorency.

EDGAR AUBERT DE LA RUE: Contribution to the geological study of the New Hebrides.

GEORGES COLANGE and YVES LE GRAND: Observation of the atmospheric image of a lighthouse.

RAYMOND-HAMET and COLAS: The botanical origin of the Chuchuhuasha. The bark of a Peruvian plant, possessing physiological activity, locally named Chuchuhuasha much resembles *Maytenus communis*, but is regarded by the author as a new species of *Maytenus*.

LUCIEN PLANTHOL: Demonstration of the extrinsic character of oxidations induced by glucose.

OCTAVE DUBOSQ and Mlle. ODETTE TUZET: The fusome and crosswise cells of the calcareous sponges.

RAOUL LECOQ: The influence of iodine and of some inorganic and organic iodine compounds on the bone lesions of experimental rickets. Iodine exerts a clear curative action on bone lesions of the rat with rickets experimentally produced. This action is the same whether the iodine is free or in combination.

P. LASSABLIÈRE: A new property of foods, trophophylaxy.

HENRI BIERRY, BERNARD GOUZON and Mlle. COLETTE MAGNAN: The variations in the proportion of glycogen in edible oysters.

Mlle. VERA DANTCHAKOFF: The relation between genic sexual determinism and sex.

MAURICE FAVRELLÉ and GEORGES DE VICHET: The results of impregnation, by an Algerian male, of French parthenogenetic females of *Bacillus rosei*.

GEORGES CHAMPETIER and EMMANUEL FAURÉ-FRÉMIET: The roentgenographic study of an intracellular protein.

Mlle. RACHEL SCHOEN: Lymphogranulomatous virus and neoplasm.

GEORGES MOURIQUAND, HENRI TATE, GEORGES WENGER and PAUL VIMMOIS: The action of sterilization and of some modes of preservation on the antiscorbutic power of lemon juice.

PIERRE GLEY: The antistreptococcal action of certain organic sulphur derivatives.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 4; 1937).

L. GODHAUX: An algebraic variety in three dimensions the operation of adjunction on which has the period three.

F. H. VAN DEN DUNGEN: Report on the legal systems of weights and measures in Belgium.

O. ROZET: A linear system of plane hyperelliptic curves.

G. DUFRANE: A birational transformation of space of four dimensions with a given fundamental curve.

D. S. MITRINOVITCH: A problem on the asymptotic lines of a class of surfaces.

N. NEBRONOFF: The reduction of a plane problem in hydrodynamics to the solution of a system of functional equations.

L. MATHÉWE: Note on the axial rotational periods of stars.

ELISABETH BODSON and FRANÇOISE DEHALU: New researches on the bands of aluminium oxide. New bands of the $^3\Sigma - ^1\Sigma$ system of AlO obtained by explosion of an aluminium wire.

P. VAN RYSSSELBERGHE: Application of affinity to coupled biochemical reactions. Theoretical study of some reactions produced by bacilli and algae.

Cape Town

Royal Society of South Africa, June 16.

J. L. B. SMITH: The South African fishes of the families Sparidae and Denticidae. Sparid and denticid fishes occur in all tropical and temperate seas, and are of very considerable economic and taxonomic significance. In South African waters, there are forty species, many of which are endemic, and some are highly specialized and unlike any from other parts. Some species occur in vast numbers and are among the most important food-fishes of South Africa. Taxonomic relationships of the species have never been fully investigated, and the whole group has stood in need of critical revision, which has now been undertaken. Very considerable changes, both taxonomic and nomenclatorial, are proposed in the present work. Illustrations of all species of which no reliable figure exists have been provided, also photomicrographs of several selected scales of most species.

A. J. H. GOODWIN: Archaeology of the Oakhurst shelter, George: (6) The Wilton deposit. Throughout the uppermost 3 ft. of deposit there is a single cultural continuity present. At 36 in., the culture is a normal Wilton; after this level the typical Wilton stone implements are replaced by shell implements. After 18 in. there is an increase in pebble implements. In the uppermost 9 in. pottery appears. Throughout the whole Wilton period the subsistence basis remains the same, and consists of shell-fish, sea-fish, and animals of modern type.

Cracow

Polish Academy of Science and Letters, May 10.

M. JACOB: A possibility shown by Cesàro of summing developments in series of Hermite polynomials.

J. WEYSENHOF: The metric field and field of gravitation.

A. KANIA: The magnetic declination at Cracow during the period 1914-36. The formula western declination = $3.200^\circ - 0.160^\circ (t - 1925)$, t being expressed in years, obtained by the method of least squares, reproduces the observations, 589 in number, with a mean quadratic error of $\pm 0.093^\circ$.

H. LACHS and W. PIKIELNY: The oxidation of sulphur vapour at low pressures.

G. BIRSTEIN and M. BLUMENTHAL: The kinetics of the phenomenon of crystallization.

B. KAMIEŃSKI: Superficial phenomena and the dissociation constant of weak electrolytes.

E. GORSKI: Researches on the utilization of the optical antipodes of racemic acid by *Aspergillus fumigatus*.

B. SWIDERSKI: The fauna of the Jurassic Klippes in the Czarny Czeremcha basin.

J. WILBURG: The survival, at a temperature of 38°C , of the tissues of the embryo of a fowl after its death.

MMR. I. MIKULSKA: Comparative study on the biology and metamorphosis of the larvae of the genus *Catocala*.

J. MARCINKOWSKI: The hybrids of guinea fowl (*Numida meleagris*) and a domestic cock (*Gallus domesticus*) obtained by artificial impregnation.

H. SZARSKI: The vessels of the thymus of some tail-less batrachians.

S. SKOWBON, Z. WIOŃSKI and S. ZAJACZEK: Observations concerning the result of defect or excess of the thyroid hormone in the maternal organism on thyroid body of the foetus, and notes on the effect of partial extirpation of the parathyroid glands on parturition.

Moscow

Academy of Sciences, (C.R., 14, No. 9; 1937).

L. KANTOROVICH: (1) The moment problem for a finite interval. (2) Some theorems on nearly complete convergence.

K. PRESIDSKIJ: A theorem of Liapounoff.

G. M. KOVALENKO: Influence of carbon tetrachloride vapour on breakdown voltages of air.

D. I. MIRLIS: Kinetics of wetting and linear corrosion of metals in polyphase systems: metal-liquid-liquid, and metal-liquid-gas (2).

V. O. MOCHNAČ and V. S. BAGNIUK: The action of the halogen compounds of arsenic and phosphorus on ethincarboxylic acids (1). Addition reaction of arsenic chloride with tetrolic acid.

V. O. MOCHNAČ and A. I. STOLJAROV: Geometrical isomerism of halogen-substituted ethene acids. (2) Addition of hydrogen bromide to tetrolic acid.

N. S. VOBONITS: The existence of the Upper Triassic in the region of the Bureya River basin.

A. S. SEREBROVSKY: The third variant in the 'triangle method'.

V. I. PATRUŠEV: Inheritance of biochemical characters by animals, and its relation to their growth. (1) Glutathione concentration in the blood and difference in size of breeds of farm animals. (2) The catalase content of the blood of horned cattle and of sheep.

Vienna

Academy of Sciences, June 10.

J. KISSER and K. LOHWAG: Histochemical study of lignified cell walls. The early wood of firs is much more resistant to chemical attack than the late wood, and the radial cell walls of the latter are more resistant than the tangential walls.

O. RIED: Influence of irradiated metal compounds on the growth and development of *Phaseolus vulgaris* L. Copper sulphate and sulphide lose their property of inhibiting growth when irradiated with ultraviolet light. The property of bacon fat of stimulating growth is increased by irradiation, especially in the presence of zinc oxide.

A. MALABOTTI: Action of β -indole-acetic acid on plants (2). Influence of growth-promoting substance on the cotyledons of *Phaseolus vulgaris* L.

J. JURÍČÍK: Action of β -indole-acetic acid on plants (3). Action of heteroauxin on foliage leaves and cotyledons.

L. PORTHEIM: Action of β -indole-acetic acid on plants (4). Studies with buds of *Phaseolus vulgaris* L. The curvatures produced in leaves when drops of heteroauxin are placed on different parts are studied.

E. ROUSCHAL: Velocity of the transpiration current in maqui wood.

A. ERDÉLYI: Theory of confluent hypergeometric functions of several variables.

A. KAILAN and F. HARTEL: Velocity of catalytic hydrogenation of oleic and cinnamic acids.

H. DOSTAL: Kinetics of thermal polycondensation reactions.

H. LACHS and A. I. GROSSMAN: Viscosity of cuprammonium solutions of cellulose.

D. BALABEW and N. KOLAROW: Vapour pressure and the size of drops.

M. MLADENOVIC: Elemic acid from manulemi (9). Dihydroelemolic acid.

K. PREIBRAM: Correction to the paper of I. Leitner "Quantum Yield in the Coloration of Rock Salt by X-, γ - and β -Rays".

O. SCHINDLER: A new species of fish (Characidae) from north-east Paraguay.

June 17.

A. KÖHLER and A. MAROHEIT: Recent volcanic rocks in the Lainzer Tiergarten in Vienna.

P. and E. KRUMHOLZ: Diphenylcarbazone. Pure diphenylcarbazone has been prepared from the substance erroneously referred to by this name in the literature.

P. KRUMHOLZ and H. WATZEK: Autoxidation of diphenylcarbazone. Autoxidation is accelerated by traces of copper. The effect is highly specific and can serve for the quantitative estimation of minute traces (10^{-4} mol/litre) of copper in solution.

K. GRAFF: (1) Estimation of colours of stars in large instruments. (2) Red cloud and distribution of stars round δ , ϵ , ζ Orionis.

BERTA KARLIK and K. PREIBRAM: Fluorescence of divalent rare earths.

W. SALOMON-CALVI: Continuation of the clay line in Asia Minor.

A. ROLLETT: Azocolours (3).

R. SERBAL: Studies of the Raman effect (73). Derivatives of cyclic compounds with three and four atoms in the ring.

J. LÖBERING and K. P. JUNG: Kinetics of polymerized aldehydes.

O. BRUNNER and W. KLEINAU: Material of the retina (5). Isolation of vitamin C from the retina.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

ASSISTANT CLINICAL PATHOLOGIST in the Preventive Medicine Department Laboratories of the University of Bristol—The Secretary (August 28).

ASSISTANT IN AGRICULTURAL ZOOLOGY in the University of Aberdeen—The Secretary (September 1).

ASSISTANT LECTURER AND DEMONSTRATOR IN ZOOLOGY AND COMPARATIVE ANATOMY in University College, Cardiff—The Registrar (September 8).

ASSISTANTS (grade III) in the Meteorological Office—The Secretary (S.S.A.), Air Ministry, Admiralty House, Kingsway, London, W.O.2 (September 7).

DEMONSTRATOR IN BIOLOGY in the Royal Veterinary College and Hospital, Camden Town, London, N.W.1—The Secretary (September 7).

SECRETARY to the Institution of Civil Engineers—The Chairman of the Selection Committee, Institution of Civil Engineers, Great George Street, Westminster, S.W.1 (November 1).

JUNIOR SCIENTIFIC OFFICER (PHYSICIST) at the Fuel Research Station, Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 18, Old Queen Street, London S.W.1 (quote J. 37/11).

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Great Britain and Ireland

British Non-Ferrous Metals Research Association. Research Reports Association Series, No. 449: Creep of Non-Ferrous Metals and Alloys; a Review of Published Information. By W. A. Baker. Pp. 19. (London: British Non-Ferrous Metals Research Association.) 2s. [17]

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Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 7 (Mathematics, No. 23): Beiträge zur Geometrie der Kreise und Kugeln (18), von Sôshi Matsumura; Über Flächen und Kurven (7), von Sôshi Matsumura. Pp. 184-202. Vol. 18, No. 8 (Mathematics, No. 23): On a Pair of Surfaces mutually Related (6). Von Sôshi Matsumura. Pp. 203-214. Vol. 18, No. 9 (Mathematics, No. 24): Über Flächen und Kurven (18). Von Sôshi Matsumura. Pp. 215-223. (Taihoku: Taihoku Imperial University.) [27]

Hyderabad Geological Series. Bulletin No. 2: A Brief Outline of the Geological History of Hyderabad State, with a Reference to its Mineral Resources. By Khurshid Mirza. Pp. III+58. (Hyderabad: Geological Survey Department.) 1 rupee. [27]

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Vol. 140

International Co-operation in Science

THE organization of international co-operation must in the nature of things be very different in different branches of science. Thus in astronomy, where no one country can cover the whole of the heavens or observe the sun continually through the twenty-four hours of the day, progress in many branches of statistical and even observational astronomy must depend on observers working in many countries of the globe on mutually agreed programmes. In geodesy the shape of the earth can only be determined with the highest possible accuracy by the survey of long arcs passing through a number of countries. Meteorology, geography and radio-science similarly present obvious examples where international agreements can alone secure the maximum of beneficial results from separate sets of observations and from instrumental and theoretical developments.

On the other hand, in sciences such as physics, chemistry and the biological sciences, where most developments come from the individual investigator and his team of co-workers, the value of international organization is less obvious, being limited at first sight to such important questions as the definition of standards or agreements on nomenclature. These have become the care of International Unions or International Congresses. The organized Union is to be preferred for such work to the Congress, as its framework is on the whole more suited to the maintenance of permanent committees. Both Unions and Congresses fulfil one further purpose of great value in bringing together periodically for discussion and mutual intercourse fellow-workers from many scattered lands, studying a group of cognate subjects. A similar service on a more limited scale is served by the gatherings of specialists in a given field of work held from time to time at various academic centres.

The International Council of Scientific Unions, heir to the old Association of Academies, serves as a link between the chief scientific bodies of the nations and also as a link between the various International Unions that adhere to it. One of its most useful tasks is to organize committees for the study of problems in which a number of Unions are interested: the Committee on Solar and Terrestrial Relationships examines just such a set of problems; the Unions of Astronomy, of Geodesy and Geophysics and of Radio-Science are all interested in its work and nominate members to serve on it.

The International Council may be said to approach the question of international co-operation from the side of the Unions. Another body, the Organisation Internationale de Co-opération Intellectuelle de la Société des Nations, working through its committee of scientific experts, has had quite another line of approach. It may be said to look at scientific questions from the points of view of those familiar with the problems that daily face the League of Nations. Thus the question of organizing help for scientific bodies of undoubted international value that for financial reasons find themselves unable to continue with their work comes naturally to the Organisation. Or again, the publication of important learned papers in languages not widely diffused in the world—a question of importance to scientific workers but not to them alone—has been studied by the Organisation, and a solution is more likely to be reached by the channels to which it has access than by individual Unions or Congresses or even the International Council. The same is true of the question of unauthorized translations of scientific work, and of the co-ordination of funds available in different countries for special

researches—a co-ordination necessary in order to avoid unnecessary or undesirable overlapping.

After some years of negotiations, the International Council of Scientific Unions and the Organisation Internationale de Co-operation Intellectuelle have come to an agreement to work together in the several tasks which they face—not as one body but as two bodies in close touch with each other. Last month, in Paris, at a joint meeting of the two bodies (see *NATURE*, July 17, p. 121), Prof. Ch. Fabry and Sir Gilbert Murray signed an agreement which lays down the method of co-operation of the two bodies, the respective spheres of action being broadly along the lines indicated above. Purely scientific questions will go to the Council, which will work through its constituent Unions: questions of a primarily international nature will be referred to the Organisation. At a recent meeting of the General Assembly of the International Council a proposal

was made for the appointment of a committee on the relation of science to the life of the community. It was pointed out that in its original form this motion covered a field lying beyond the purview of the Council. In the amended form which was adopted, the work of the Committee, which has now been appointed (see p. 358), was limited to the scientific side of the question. The more political side may be taken up elsewhere, and represents the kind of question that may fall to the Organisation to study.

There remain gaps on both sides. Subjects—geology and mathematics may be mentioned—lie outside the range covered by the Council; countries stand aloof from the League of Nations. Still, the *rapprochement* between the two bodies can but strengthen both and may lead to more active co-operation between them and those other bodies which stay outside, though each is carrying out work of similar purpose in its own branch of science.

Native Science in Southern Sudan

Witchcraft, Oracles and Magic among the Azande

By Dr. E. E. Evans-Pritchard. Pp. xxx + 558 + 34 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 21s. net.

DR. E. E. EVANS-PRITCHARD, already well known in anthropological circles for some penetrating studies of the manners, customs and mental constitution of certain peoples of the Anglo-Egyptian Sudan, has by this book placed himself in the front rank of British anthropologists. Europeans who have visited primitive people have always been attracted by the notions which they think they have found concerning witchcraft, oracles and magic; but most of them have attempted to interpret these notions mainly in the light of their own, or what they consider to be their own, habits of thought. Consequently, these topics have been treated as if their main interest lay in their curiosity, their oddity; and not infrequently they have been taken to indicate that there is some sort of primitive logic exceedingly different from that of the Western world. Dr. Evans-Pritchard is no mere curiosity hunter; he realizes that many of the Azande notions about witchcraft, and the ways in which the people use them, are not far removed from some of our own current ideas and practices about medicine and the chances of life; and he knows perfectly well that

though his book is entirely concerned with witches, witch-doctors, magicians and sorcerers, it covers only a very small part of Azande activity: "Most of their talk is common-sense talk, and their references to witchcraft, whilst frequent enough, bear no comparison in volume to their talk about other matters".

The Azande are a fairly numerous people living on the Nile-Congo divide. At present they form a homogeneous group, but they were formerly of many different tribes, with a variety of languages and institutions. As is natural, in such circumstances differences of social status play a great part in Zande culture. In particular, while the general rank and file are easily accessible, sociable, good-natured, assimilative, the royal class remain aloof, conservative, superior.

"Every Zande is an authority on witchcraft." If anything unusual happens, especially anything of an unfortunate character, it is attributed to some person—less often to some animal—in whom witchcraft resides as an inherent quality. This person does not need to do anything special in order to exert his influence; in fact, he cannot well help himself, for within him, whether he knows it or not, is some "witchcraft substance". Dr. Evans-Pritchard has himself never seen this substance, but it can be discovered by autopsy, and the evidence leads him to believe that it is the small intestine at a certain phase of digestive process.

Anyway, whatever it is, it is hereditary, and since it is a part of the body, it grows with the body, and becomes more potent as its possessor grows older. It can threaten misfortune, and then may be counteracted in various ways through the co-operation of oracles. It may produce death, and then must be avenged, though very little appears to be known about the precise operation of vengeance-magic.

In the early parts of his book, Dr. Evans-Pritchard describes, with copious illustration, what witchcraft is to the Azande, what sorts of things it can do, and what socially controlled processes there are for taking precautions against its more disastrous effects. It provides for these natives a kind of "natural philosophy by which the relations between men and unfortunate events are explained", and it gives them a "ready and stereotyped means of reacting to such events". So there is no kind of contradiction if a man treats a festering wound as due to witchcraft, and at the same time treats the wound as due to a spear or a splinter. Equally there is no contradiction if he should say that a death is caused by a weapon in some particular place, and at the same time by witchcraft in some other place. A good many Europeans have wished to verbalize all these actions or attitudes, and then to show that the different statements made together are mutually incompatible, and to prove from this that the native mind works in some manner peculiar to itself. But Dr. Evans-Pritchard puts the truth perfectly clearly: "We have to be careful to avoid in the absence of native dogma constructing a dogma which we would formulate were we to act as the Azande do. . . . The Zande actualizes his beliefs rather than intellectualizes them, and his tenets are expressed in socially controlled behaviour rather than in doctrines. . . . His ideas are imprisoned in action and cannot be cited to explain and justify action".

A person who is in a line of witches is probably inhabited by witchcraft; but he need not worry overmuch about that. Anybody can be a witch, and so he can live comfortably, respected, and even somewhat admired by his neighbours. A Zande who is worried about his health will go off to consult an oracle in the socially approved way. He may be a little downcast until he has taken the necessary steps to render the witchcraft quiet, but this is unlikely to carry him into downright illness. Also, contrary to the sort of opinion which has been expressed in some quarters, these people, at any rate, are no more likely to be thrown into a variety of mental disorders by their beliefs about ubiquitous witches than are most people in our own community when they read newspaper reports of road-accident statistics. The Zande, indeed, "is

never so happy as when he is consulting the poison oracle, and he easily banishes all other considerations from his mind when he is engaged upon this task of supreme interest". For him it is clearly as good as a visit to Harley Street is for many of us. Dr. Evans-Pritchard shows, moreover, the social value of many of the controlled methods for the consultation of oracles, as well as of the ways in which such practices may be abused. Destroyed for ever, in this case, at any rate, is the picture that when a people talk often about witchcraft and its potency for misfortune, they must be miserable, hag-ridden, harried and hunted by malevolent forces. They can be as curious, and, in their ways, as knowledgeable as anybody, about the sequences of natural events; and, when they come to the other questions about why certain sequences happen when they happen, they can get from their witch philosophy the same sort of satisfaction that others find in 'chance', or 'probability', or in different beliefs more dogmatically formulated.

In Part 2 of his book Dr. Evans-Pritchard considers witch-doctors; that is to say, the specialized profession among the Azande who have "vested interests in the knowledge of medicines" and are consulted when witchcraft is suspected. The witch-doctor is a diviner, exposing witches, and a magician, thwarting them. Here, if possible, the book becomes more interesting still. The topics discussed are: how the witch-doctor conducts his *séance*, what is the basis of Azande belief in the witch-doctor, how the novice is trained in the art, and the place of the witch-doctor in Zande society. The accounts of the technique of the doctor, of how he maintains his social prestige, of the ways in which he elicits just the sort of information which his vocation requires, of the skill with which he often meets individual desire and need and satisfies important social demands are both convincing and delightful to read. Anyone who has talked with witch-doctors in an African community, as I have done, and watched them at work, will be interested to find that Dr. Evans-Pritchard was "impressed with their ability" and that he thinks it probable "that as a rule men who show a strong desire to become witch-doctors have a higher degree of intellectual curiosity and greater social ambition than the ordinary Zande possesses". In view especially of the great amount of administrative trouble which has arisen in many parts of the British Empire owing to the adoption of purely repressive measures against the diviner and magician, it is particularly to be hoped that people responsible, directly or indirectly, for the government of native races will read and seriously consider this part of the book.

Dr. Evans-Pritchard next discusses various practices connected with oracles, their collection

and use, and deals finally with magic and sorcery, with some comments also upon native leechcraft. It appears that of late a number of associations have developed among the Azande for the practice of magic in assemblies. One of these is described in considerable detail, and it is demonstrated how a specific organization may be used to introduce new ideas and to spread them throughout the community, although the ideas themselves may have a much wider application than the avowed purpose of the organization would seem to imply.

Dr. Evans-Pritchard modestly hopes that his book will "be of service to political officers, doctors, and missionaries in Zandeland, and later to Azande themselves". If they will read it, it certainly will be of service to all of these; but it will also be of

wider value than this. Every social anthropologist should study it, not only for the wealth of information which it contains, but also as a model of well-controlled and sane methods of investigation. Everybody interested in the development of primitive science and the ways in which other minds than our own attempt to explain natural processes should read it, for it will correct a mass of popular and third-hand speculation concerning these matters. Further, everybody who is practically interested in native administration anywhere throughout the British Dominions ought to read it, for it will help him to understand the core of many difficult administrative problems and to solve them with a minimum of disastrous friction.

F. C. BARTLETT.

Chemical Stabilization

The Retardation of Chemical Reactions

By Prof. Kenneth O. Bailey. Pp. viii+479. (London: Edward Arnold and Co., 1937.) 26s. net.

THE problem of the supply of drinking water to troops sent to tropical stations was extremely difficult during the early part of the Great War. For removing the excess of chlorine used in sterilizing water, hydrated sodium sulphite was dispatched to places like Basra, Bagdad, etc., where the temperature goes up to 118° F. (48° C.) in the shade in summer. It frequently happened that by the time the sodium sulphite reached its destination, it was wholly converted by oxidation into sodium sulphate, which was useless as an 'antichlor'. Hence investigations were carried on to discover stabilizing agents or retarders of the oxidation by air of sodium sulphite. Hydroquinone (quinol) and other organic compounds when added even in traces were effective in preserving sodium sulphite from such oxidation.

Sodium sulphite, which is a valuable material in photography as well, and other useful substances like vitamins, butter, fats, cod liver oil, rubber, petrol, ether, chloroform, hydrogen peroxide, acrolein, and so on, are stabilized on a commercial scale against oxidation, polymerization, decomposition, etc., by the addition of chemicals, which in general can themselves combine with oxygen. The use of acrolein as a poison gas led the late Prof. Moureu and Prof. Dufraisse to study its stabilization by different reagents.

Not only is the subject of importance to chemists and industrialists, but physiologists also know that fats and especially carbohydrates act as protein

economizers in the animal body. Moreover, carbohydrates, pentosans, cellulosic materials, etc., when added to soil, cause nitrogen fixation and also preserve the soil nitrogen from too rapid oxidation and loss.

Prof. K. O. Bailey has collected the literature on the subject and has ably discussed it from the theoretical and practical points of view. After a brief account of the historical development, the author takes up the oxidation of phosphorus and the combination of hydrogen and oxygen. A number of retarders for both these reactions have been known for some time. He considers the mechanism of these oxidations from the point of view of the chain theory and goes on next to the oxidation of hydrocarbons and other compounds. This is followed by an excellent account of the work of Moureu and Dufraisse, who have given a great impetus to research in the retardation of oxidations. The slowing down of the oxidations of inorganic substances like sulphites, arsenites, antimonites, ferrous, stannous, cuprous salts and organic compounds like aldehydes, chloroform and other halogenated substances, adrenaline, carbohydrates and allied compounds, dyestuffs, etc., has also been discussed. It is interesting to note that the rancidity of butter, cod liver oil and similar substances is chiefly due to their partial oxidation by air, and many reducing agents such as hydroquinone and pyrogallol even in traces retard this oxidation and delay rancidity.

In recent years, 'anti-knock' compounds and their function in motor-car engines have been extensively studied, and Prof. Bailey has given an adequate account of this work with the various theories that have been put forward to account

for it. Existing theories appear to be inadequate, and further work is necessary.

The protection of rubber from deterioration, the preservation of hydrogen peroxide from decomposition and the prevention of metallic corrosion are also considered in this book. The function of retarders in the setting of plaster-of-Paris and cement is also discussed.

In the last portion, the decomposition of numerous organic and inorganic compounds, the reactions of halogens with hydrogen and other reducing agents and the retardation by water in the processes of esterification, saponification,

hydrolysis and the decomposition of organic substances by concentrated sulphuric acid, have been summarized. A brief account of the quenching of fluorescence and the after-glow of active nitrogen has also been included. There is a bibliography of 1,630 original papers at the end of the book.

The subject-matter of this book is of considerable practical and theoretical importance. Prof. Bailey's discussion of the diverse topics involved is clear and exhaustive, and presented in a very readable form. The book should be valued and widely read.

N. R. DHAR.

Reflections on Life

Life Here and Now :

Conclusions Derived from an Examination of the Sense of Duration. By Arthur Ponsonby (Lord Ponsonby of Shulbrede.) Pp. 289. (London : George Allen and Unwin, Ltd., 1936.) 10s. 6d. net.

THIS rather unusual book of reflections on life not only gives us in effect an interesting portrait of one of our greatest authorities on the type of data which characterize the 'commonplace book', but also an unexpected plea for individual action in support of high ideals, whether of peace or of social reform. Lord Ponsonby has long been occupied with thought on the nature of time and on our appreciation of its meaning and value in the art of living. He now advances a general argument based on an analysis of the sense of duration, and relying on the scientific attitude of Huxley's generation, he tilts valiantly at organized religion as he conceives it. The idea of personal immortality is challenged, and its rejection appears to be inspired largely by his contention that too much time is occupied in vain speculations about the future to the neglect of the present.

If Lord Ponsonby appears to overstress the logical part of man's nature, there is nothing in this finely written plea for more effective use of the immediate moment to control the duration of our living which can possibly impede that *rapprochement* between science and religion for which Smuts and others have been pleading. Not even those whose convictions he brushes on one side—not always on the most convincing grounds—can fail to recognize the dignity and sincerity of his plea for a better use of our present term, of the proper use of the new in the here, of the moment as it passes in our own environment. He gives us wise words on the small matters which make up the art of

living, but most will welcome the book for its inspiring idealism. Planning the future, he claims, is better for the mind than analysing the past, and if he is impatient with creeds it is perhaps mainly in so far as they impede progress.

Lord Ponsonby believes in individuality, and nowhere is this clearer than in his plea for a courageous stand for peace. "Our forefathers certainly would be unable to discover any element of glory in modern warfare; but they would observe in the world a noticeable depreciation of the value of human life." The warm human sympathies of the writer are as conspicuous as the sincerity of his thought and the lucidity of his diction, and they lead him to a final plea for action and service which is poles asunder from the frenzied plea of the demagogue to "do something". Its calm and dignified courage should win the sympathy of all who appreciate the inspiring personality imprinted upon that plea: "Now is the greatest of moments, the most real thing of which we can be aware. . . . To seize it as an opportunity means bracing ourselves up for action, decision, bite, endeavour . . . not vague resolutions but insistent occupation, not irresolute hopes but intent purposes, not languid aspirations but ready service, not 'Time will tell', but 'I will tell Time' . . . the errors of impetuosity are far less serious than the errors of caution and indolence and the enervating paralysis of procrastination. . . . There is no failure except in leaving off trying."

These are no pages from a dilettante's notebook, but a glimpse into the soul of one who has made time his servant, and himself compelled the hours to suit his intentions, the minutes to serve his purpose.

R. BRIGHTMAN.

Trade Marks in India

The Law of Trade and Merchandise Marks in India

By Dr. S. Venkateswaran. Pp. lxxx+767. (Madras : Madras Law Journal Office, Mylapore ; Calcutta : Law Book Co., 1937.) 20 rupees.

THE year in which an amending Trade Marks Bill is passing through Parliament in England is singularly appropriate for the appearance of a book on trade marks in India. The book is not only in itself an excellent and comprehensive guide to English trade mark law, but is also a most powerful argument for the trade mark legislation in India that its author desires. The position to-day in India is very much the same as it was in England before 1875 ; the owner of a trade mark can only attempt to protect his rights by a cumbrous passing-off action or by invoking the Indian Merchandise Marks Act, under which the onus is on him to prove his entitlement, and a successful action can give him neither damages nor an injunction.

Simplicity and a reasonable degree of certainty can only be attained by direct trade mark legislation, for which there has been a demand since 1877. Mr. Venkateswaran, the author of the work under notice, an examiner in the Indian Patent Office, has a melancholy tale to tell of the abortive efforts that have been made to secure such legislation. Agreement on the need has not been accompanied by agreement on the method, and India, unable to join the International Union for the Protection of Industrial Property, by reason of the absence of trade mark legislation, has only privately run registers to show as the result of sixty years of persuasion, petition and argument by chambers of commerce and other interested bodies in India and the United Kingdom.

One of the great difficulties about trade marks is to be found in the fact that they are dealt with in most countries by the same Government department that handles patents. This encourages the idea that the two forms of protection are closely parallel. In fact, patents and trade marks have considerable fundamental differences, which were not clearly realized, for example, in the United States, for the greater part of the nineteenth century. The delay in getting adequate legislation in India will be regarded less harshly when it is realized that, in the United States, Thomas Jefferson was recommending trade mark legislation so early as 1791, and not until 1905 was there water-tight legislation there, a first Act of 1870

having been declared, *more Americano*, unconstitutional.

Mr. Venkateswaran, who is completely up to date, has a good deal to say about the Goschen Committee on Trade Marks, the report of which, issued in 1934, forms the basis for the English Trade Marks Bill. He is not only in favour of Indian trade mark law following the British model in general but also advises, with a varying degree of insistence, the adoption of most of the recommendations of the Committee. He approves, for example, of assignment in gross, but is doubtful of the applicability of Clause 8 to India, feeling that, in her present state of industrialization, abuse might arise there if the names of "registered users" as well as those of the actual proprietors could be entered on the register. Nor is he altogether happy about the marks, introduced in England in 1905 and used to indicate certification by some competent authority of the origin, material, accuracy, etc., of goods so certified. On one point, the division of the Trade Mark register into Part A and Part B, he advises a clean breakaway from English practice. He feels that the effective demand for Part B is relatively small in Great Britain, and in India can be ignored. But he goes further and states that the difference between the requirements for the two parts is neither clear nor well-explained by the English courts, and refers in support to Mr. Justice Romer's remarks in the "Liverpool Cables" case to the effect that it was doubtful whether there was any difference between "adapted to distinguish" and "capable of distinguishing", and that if a mark did in fact distinguish, it should be adapted to distinguish.

Cotton marks, for very obvious reasons, are of the first importance to India, and Mr. Venkateswaran has very definite views about the shape that relevant Indian legislation should take. He would allow the registration of word marks for cotton goods but not that of line headings. He quotes with approval in connexion with word marks some of the rules of the Bombay Mill Owners' Association, which has a register of trade names, but suggests that the exclusion of the names of gods, goddesses and mythological persons from this private register is definitely on the harsh side and sets an example not to be followed when an official register is set up.

There should be no disagreement about the need for trade marks legislation in India, and there should be the minimum of discussion before it is decided that the legislation must be on a purely

Federal and not on a States basis, the experience of the United States alone being quite sufficient to make a decision in favour of a strictly central system inevitable. Sufficient has been said, however, to show that there will be considerable debate on detail and even on certain major points of principle before trade mark India leaves the 'law-less' company of Monaco, Sarawak and the Solomon Islands and is able to take her place as a full member of the International Union.

When active consideration of prospective legislation for India does take place, it is inconceivable that Mr. Venkateswaran should not be called into consultation, for his book shows him to have both a masterly grasp of principle and a keen perception of detail. Sir Courtney Terrell, chief Justice of the Patna High Court, says in an introduction to the book that it astonished him to find "that legal

principles should be so admirably expounded by one who is not a professional lawyer" and reinforces from his wide experience at home and in India the author's demand for action to end the chaos that exists in a country where no action for infringement of a trade mark can lie and the actual form of action possible—and the decision—may vary from one provincial court to another.

In a work which was merely an industrious compilation, the fact that there were some two thousand five hundred actions listed in the table of cases would normally go to show the practitioner that the book was worth acquiring. It is mentioned here only to indicate that though Mr. Venkateswaran has produced a powerful large-scale propaganda document, he has at the same time written a first-class text-book very suitable for the Indian and far from being unsuitable for the English student.

A Survey of Psychopathology

Modern Discoveries in Medical Psychology
By Dr. Clifford Allen. Pp. x+280. (London: Macmillan and Co., Ltd., 1937.) 8s. 6d. net.

DR. CLIFFORD ALLEN gives a general survey of the recent history of psychopathology suited for the medical man or the intelligent layman. He rehabilitates Mesmer as an honest worker whose results, though given a wrong explanation, were nevertheless worthy of that investigation which was denied them. He might have shown the parallel between Mesmer and Charcot, for the latter's results were genuine but misunderstood phenomena, the anatomical nervous system taking the place of Mesmer's magnetism in a spurious explanation.

Janet's work, with his theory of dissociation of consciousness, prepared the path for Freud, and to this period belong Morton Prince's studies of multiple personality. The description of the gradual nature of Freud's discoveries helps to their understanding, though the necessary condensation of material does rather less than justice to this important stage of development. Dr. Allen defends the use of what he perhaps wrongly calls mechanistic devices and mental mechanisms, by which he means those theoretical constructions giving a spatial and dynamic view of mental processes. One might, however, object to the personification by which the superego "can still wreak its revenge on the patient by making him have a terrible sense of guilt, and sometimes compel him to do something for self-punishment".

The author is fair towards Adler's theories, but, like everyone with practical experience of analytical procedure, finds them incomplete and unsatisfying, though clinically useful because of their easier demands and avoidance of emphasis upon sexuality. Jung receives credit for his work on psychological types, but the author accuses him of spoiling the technique of Freud "by the addition of a hotch-potch of religion and mythology which cannot act in any other manner than as suggestion".

Kretschmer and Pavlov are adequately handled, but only one phrase (on p. 277) indicates that Pavlov is by some people placed in opposition to Freud, and regarded, indeed, as having made psychology unnecessary. This opposition can be understood only by a knowledge of the historical conflicts in medicine between animists and vitalists on one side and iatro-physicists on the other, which form a continuous series with present controversies and depend not upon knowledge but upon basic differences of outlook. This is a field of interest that Dr. Clifford Allen has not approached.

The author's aim of presenting current views is efficiently carried out, but a unifying summary of the position to-day would have been welcome. There is fortunately among the younger generation of psychiatrists and psychotherapists an agreement upon certain fundamental principles which the author's scheme of presentation cannot convey to the reader. His literary style is straightforward and simple, and he has made the subject intelligible without shirking its difficulties.

M. C.

A Text Book of Trigonometry :

for Colleges and Engineering Schools. By William H. H. Cowles and James E. Thompson. Pp. x+373. (London : Chapman and Hall, Ltd., 1936.) 12s. 6d. net.

So many books on trigonometry are published that, when a new one makes its appearance, especial characteristics are naturally looked for. The present volume is much larger than usual, but it surveys a wider field as the course is intended to be a preparation for the study of higher mathematics, physical science and engineering. The authors state that several new and unique features are developed in the presentation of the subject, and this claim is well substantiated, for the fundamental principles of trigonometry are not dealt with in a piecemeal fashion so common in many books. Circular functions are, for example, defined generally at the beginning; radian measure, too, is introduced at once and used throughout the course. The discussion of complex numbers, expansions in series and general analytical trigonometry is not only thoroughly sound, but also is more interesting and complete than is usual. Two chapters are devoted to the manifold applications of the subject to surveying, mechanics, geodesy and astronomy. Instructive chapters are also given on logarithmic computation and the use of the slide rule, whilst emphasis is rightly laid upon accuracy, precision and significant figures in all numerical work. Considerable attention is also directed to the analysis of problems and the reduction of the formulae deduced to a suitable form for numerical evaluation.

The student is provided with a large number of varied exercises to which answers are supplied, and some very useful tables are given at the end. The book is certainly well adapted to the purpose for which it was written, and reveals that trigonometry is something far more interesting than the mere solution of plane triangles.

F. G. W. B.

Moeurs et coutumes des indiens sauvages de l'Amérique du sud

Par Marquis de Wavrin. (Bibliothèque scientifique.) Pp. 656+16 plates. (Paris : Payot et Cie, 1937.) 60 francs.

In this impressive work of more than six hundred closely printed pages, the Marquis de Wavrin has embodied the results of fifteen years of travel and observation on five journeys of exploration among the less-known Indians of South America. He has covered a wide territory, for there is scarcely a part of the continent which he has not visited in that period; but his most entertaining and informative (in the anthropological sense) material is drawn from the various peoples of the Amazonian region. His method is anecdotal rather than systematic, except that he has classified his data into chapters according to subject, covering material culture, social organisation, relations of the sexes, religious beliefs and folklore.

Although amusing and instructive enough to read, the unfortunate lack of method, by which the data

from widely separated tribes are massed together without order or discrimination, makes it a source book for the delver after facts, rather than an ethnographical treatise. This is especially to be regretted as the author is an acute and careful observer. Perhaps he will conform to the suggestion made by M. de Créqui-Montfort in the preface, and produce a more formal account of his results later.

Thermodynamic Theory of Affinity :

a Book of Principles. By Prof. Th. De Donder and Prof. Pierre Van Rysselberghe. Pp. xx+142. (Stanford University, Calif. ; Stanford University Press; London : Oxford University Press, 1936.) 13s. 6d. net.

THEORIES of affinity have interested physical chemists for a considerable time; moreover, greater recognition is now being given to such concepts as aids in the interpretation of experimental results.

The book now before us represents an essentially synthetic outlook, and the introduction of the terms "uncompensated heat" and "degree of advancement of a reaction" gives the basis upon which it is written. The former expression is simply the dQ' of Clausius under a slightly new guise, the latter (ξ), however, is decidedly interesting as representing the state of a chemical system; its time-derivative is a rate, which leads at once to a criterion of equilibrium. These two quantities are combined in the fundamental hypothesis that $dQ'/d\xi$ is independent of any particular relation between the pressure, temperature and "degree of advancement" during a reaction. A detailed analysis leads the authors to identify this coefficient with the affinity.

In general, the treatment developed in these pages is suitable for obtaining straightforward solutions to problems like Le Chatelier's principle; another volume is promised, to deal with applications and numerical examples.

F. I. G. R.

Freud and Marx :

a Dialectical Study. By R. Osborn. Pp. 285. (London : Victor Gollancz, Ltd., 1937.) 8s. 6d. net.

IN this comparative study—the first of its kind to be undertaken—the author emphasizes the importance of a closer study of psycho-analysis by Marxists, of Marxism by psycho-analysts and of both by the general public. He maintains that as psycho-analysis teaches us to recognize that unconscious motives are at work in us all, the curriculum of the Marxist should include a study of the unconscious mind, both Freud and Marx being pioneers in revolutionary psychological discoveries.

The work contains a study of the relationship between Freudian and Marxist theories regarding primitive society, the materialistic conception of history, religion and dialectical materialism. In conclusion, the author declares that "the Marxist without knowing something of the subjective side of man's life will remain one-sided, as will the Freudian who misconceives the objective situation in which man's subjective life expresses itself".

Physical Investigations on Falling Snow*

[In this article I have used the nomenclature with which I have endeavoured to standardize the English names of the various snow forms. Prof. U. Nakaya, who had not seen my work when preparing his papers, has now agreed to follow this, except that he proposes to continue to call a particle of falling snow a "snow crystal" in preference to my "snowflake". As all snow, whether falling or having lain on the ground for months, is crystalline, the word "snow crystal" is likely to lead to ambiguity. I admit that "snowflake" ("simple" for a single crystal; "compound" for an assemblage) is not perfect, but until a better word is devised it must, I fear, remain.—G. S.]

THE researches which form the subject of this article were carried out by Nakaya and his assistants at Sapporo and Mt. Tokai in the island of Hokkaido, the most northerly member of the Japanese archipelago. Ukitirô Nakaya, who is professor of physics at the Hokkaido Imperial University, has been studying the general subject for many years, but the special work of which the results are now given was done during the winters of 1933–35.

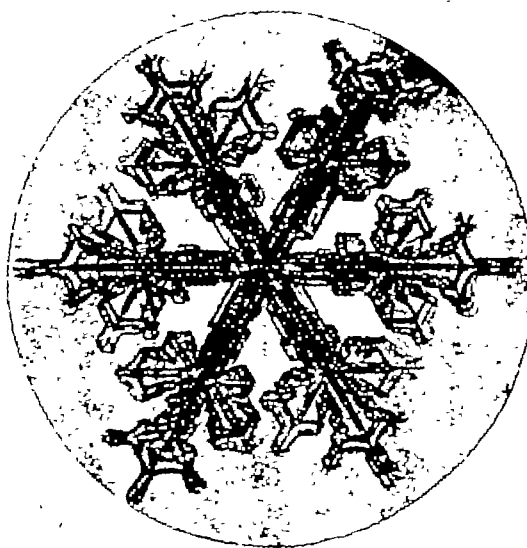
Nakaya commences his researches with a preliminary examination of the problem of snowflake structure in an attempt to find a method of classification for the many varying types, and of ascribing to each the conditions favouring its development. He wonders at the marvellously symmetrical form of the dendritic branches of a flake. "There is apparently no reason for a twig . . . to grow from one main branch when a corresponding twig happens to extend from another main branch. . . . We must suppose the existence of some means which informs other branches of the occurrence of a twig on a point of one branch." He suggests, but with doubt, the possibility of a bud of the twig causing a distortion of the lattice, which is transmitted to the other branches.

It seems simpler, however, to believe that, as I have suggested elsewhere, "changes in the scheme of ornamentation are caused by the flake passing

through different temperature and concentration gradients", and clearly each portion of the flake would normally come under these changes at the same instant and so symmetrical growth would be promoted.



(a) FROST CRYSTALS (photograph by Mr. Hatakeyama).



(b) CORRESPONDING SNOWFLAKES (photograph by U. Nakaya). MAGNIFICATION, 21.

Fig. 1.

One of the most important features of Nakaya's work was the designing of an apparatus for making hoar and rime under controlled conditions of temperature and humidity. Both these forms, incidentally, are crystalline, and I must respectfully join issue with Prof. Nakaya in his statement that rime, which consists of frozen water droplets, is amorphous. Previous to this he had shown that

* Based on a series of eight papers by Prof. U. Nakaya and his assistants, published in the *Journal of the Faculty of Science, Hokkaido Imperial University*, under the following titles:

(1) "Snow Crystals observed in 1933 at Sapporo and some Relations with Meteorological Conditions" (II, 1, No. 5, Feb. 1934).

(2) "Classification and Explanation of Snow Crystals observed in the Winter of 1933–34 at Mt. Tokai and at Sapporo" (II, 1, No. 6, Dec. 1934).

(3) "On the Electrical Nature of Snow Particles" (II, 1, No. 6, Dec. 1934).

(4) "Simultaneous Observations of the Mass, Falling Velocity and Form of Individual Snow Crystals" (II, 1, No. 7, Oct. 1935).

(5) "On the Correspondence of Snow and Rime Crystals" (II, 1, No. 7, Oct. 1935).

(6) "On the Artificial Production of Frost Crystals, with reference to the Mechanism of Formation of Snow Crystals" (II, 1, No. 7, Oct. 1935).

(7) "Notes on Irregular Snow Crystals and Snow Pellets" (II, 1, No. 8, April 1936).

(8) "General Classification of Snow Crystals and their Frequency of Occurrence" (II, 1, No. 9, Dec. 1936).

hoar crystals (which result from the sublimation of water vapour upon fixed objects as opposed to the moving nuclei of snowflakes) correspond in form with the flakes. In other words, we get needle, plate and dendritic forms of hoar just as we do of the snowflake (see Fig. 1). Arguing by analogy, he assumes the following facts for snow: that at the highest supersaturation the needle type develops, next the dendritic, then an 'intermediate' form, then the plate, the pyramidal, the prism, in that order, and, at the lowest supersaturation, prisms with one side extended in a plane. Nakaya notes that this rare type of snowflake, although occasionally seen at Sapporo, has apparently never been recorded elsewhere.

The most surprising result is that the needle and prism appear to occupy different ends of the scale, indicating not merely different conditions of formation but perhaps even a basic difference in type. This is, I think, quite contrary to general belief, and further proof will no doubt be forthcoming. Two different types of needle are described—a single elongated form, and a bundle of thin pillars. The latter, Nakaya believes, indicates the advent of warmer conditions.

Full justice cannot be done to this line of research in the confines of a brief account, but its results, if substantiated, ought to prove of great meteorological value. Nakaya realizes this in the following words: "The delicate form and design of a snow crystal must form by developing step by step while it is falling through the various strata of the atmosphere, and the authors consider that the structure of the atmospheric layers may be inferred to some extent by investigating in parallel the structure of snowflakes." With this I cordially agree; before having the advantage of seeing Nakaya's work, I had written, "An elaboration [of the conditions under which snowflakes grow] might prove of the greatest value to meteorology", although, as Nakaya says elsewhere, no simple relationship has yet been found; nor do I think that the problem can be solved until captive balloon ascents for the investigation of the upper air can be systematically made.

Nakaya's views on the subject of irregular or malformed snowflakes are most stimulating. Although stressing the exquisite symmetry of ordinary snowflakes, he points out that absolute and complete symmetry is never in fact attained, and that complete malformations are far more common than previous writers, Bentley for example, have led us to believe. Nakaya describes, *inter alia*, flakes deformed by the subsequent attachment of a second nucleus on which further growth takes place. Other deformations are, he says, due to the supply of water vapour from a 'one-sided direction', due, I imagine, to the flake

falling irregularly. These irregular crystals are observed to fall in great frequency for a few minutes and then cease entirely. From this Nakaya has been led to think that these irregularities are not merely chance occurrences, but are caused by definite and, ultimately perhaps, ascertainable causes. I suggest that another factor may be responsible for the malformation of snowflakes. Dewar showed that electrical stimuli have a strong accelerating influence on the sublimation of water vapour. Is it not possible that these in some way, as, for example, by the sudden advent of a new electrical charge, might cause irregular growth?

Nakaya also states that "a snowfall usually consisted of several types of snow and sometimes almost all types of flake were found in a single snowfall. Occasionally only dendritic plane flakes were observed at a given moment. These would continue for a short time, and then another type would begin to mix with them; after some time, a third type would take its place; and so on". A graphic table shows these happenings in detail. The investigator everywhere emphasizes that his results are those found in Hokkaido only. I have, however, on many occasions observed this sequence of types in the Alps.

Nakaya commences the paper which deals with the classification of snowflakes, and which gives the impression of being the *raison d'être* of these researches, with notes on previous classifications such as those of Nordenskiöld, Hellmann and Pernter, which divided the flakes into plates, columns and their combinations. Humphreys added triangular plates and twelve-sided plates. "These classifications," Nakaya writes, "are inclined to attach too much importance to the regular crystals or the simpler form. The feature of the present classification is that we regard all the flake types as of equal importance, such as irregular [plane] crystals and those consisting of a spatial assemblage of plane branches, both of which are, as a matter of fact, no less frequently observed among the natural snow crystals." This last point, which I have italicized, is stressed throughout Nakaya's work.

THE GENERAL CLASSIFICATION OF SNOW CRYSTALS

(In this case Nakaya's nomenclature has remained unaltered. *Grasspel* is, of course, our soft ball.)

- I. Needle crystal.
 - (1) Simple needle.
 - (2) Combination of needles.
- II. Columnar crystal.
 - (1) Simple column.
 - (a) Pyramid.
 - (b) Bullet type.
 - (c) Hexagonal column.
 - (2) Combination of columns.
 - (a) Combination of bullet crystals.
 - (b) Assemblage of short columns.

III. Plane crystal.

- (1) Regular crystals developed in one plane.
 - (a) Stellar form.
 - (b) Plane dendritic form.
 - (c) Crystal of areal extensions.
 - (d) Plate.
 - (e) Plate with extensions at corners.
 - (f) Stellar crystal with plates at the ends of branches.
- (2) Crystal developed from two nuclei.
- (3) Malformed crystal.
- (4) Spatial assemblage of plane branches, with a stellar base.
- (5) Spatial assemblage of plane branches, radiating type.

IV. Combination of column and plane crystals.

- (1) Column with plane crystals.
- (2) Twelve-sided crystal.
- (3) Combination of bullets with plane crystals.

V. Columnar crystal with extended side planes.

VI. Crystal with cloud particles and Graspel.

- (1) Crystal with droplets.
- (2) Thick plate.
- (3) Graspel-like snow.
- (4) Graspel.

VII. Amorphous snow particle

What Nakaya terms a "bullet" is very much like the cup crystals so often found in hoar deposits, but never hitherto recorded in falling snow*. I also suggest that the "amorphous snow" consists, in reality, of wind-comminuted snow particles. Nakaya is able to confirm the belief that columnar crystals fall when the upper air temperature is low, but states, as I have always maintained, that temperatures at the surface have little or no bearing on this.

This classification—or perhaps it should be called grouping—will probably in time give place to one based on more essential crystallographic factors, and even, perhaps, on varying internal structures of the ice, but it certainly goes further,

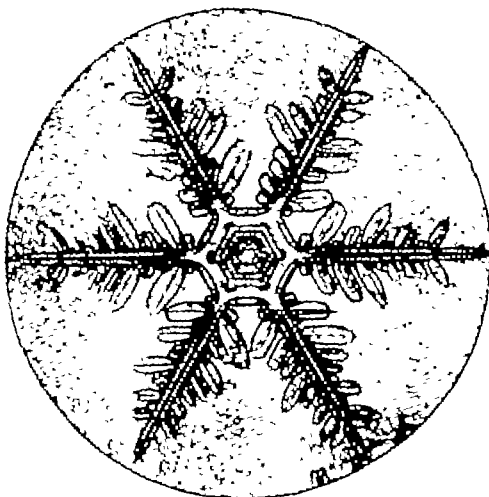


Fig. 2.

PLANE DENDRITIC SNOWFLAKE. MAGNIFICATION, 27.5.

and gives us a far better idea of the problem, than any that have preceded it.

Among what might be called the by-products of the researches the following point is of special interest, namely, that the mean thickness of a large number of dendritic flakes measured is

0.011 ± 0.0015 mm. and is remarkably constant, the smallest being 0.009 mm. and the largest 0.015, although the diameters of the flakes measured varied from 2.35 mm. to 5.0 mm.

On the subject of the formation of soft hail, Nakaya found that it has a very low density, and

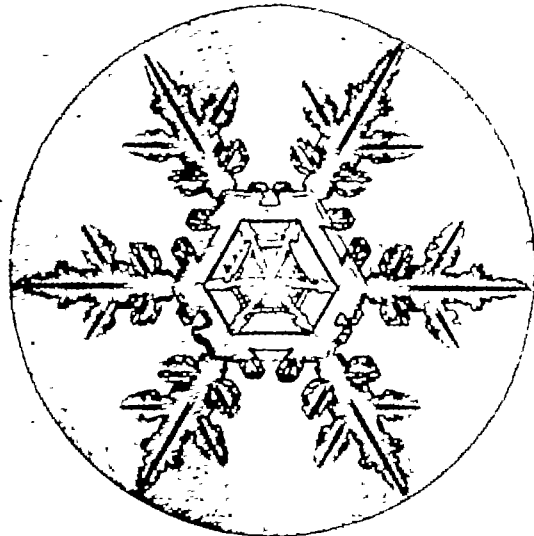


Fig. 3.

HEXAGONAL PLATE WITH DENDRITIC EXTENSIONS. MAGNIFICATION, 36.2.

therefore possesses large interstitial air spaces. He repeats the fairly well-known fact that all degrees of development of soft hail can be found, from snowflakes decked with a few frozen cloud-droplets to assemblages of ice pearls entirely hiding the flake. The satisfactory theory of the development of conical soft hail units put forth by Prof. Köhler* had probably not been seen by Prof. Nakaya.

Some space is devoted to the sizes of snowflakes. I believe, however, that conditions often favour continued growth during travel over a very long continued distance, so that size is largely dependent on length of travel and is thus fortuitous. Nevertheless, the notes on the relative sizes of the various types are interesting.

Dealing with the electrical nature of snow, Nakaya found that "the number of the negative particles in general far exceeded that of the positive, being 63% of the total 1474 particles observed". When (frozen) water droplets were attached to the particles, the charge was predominantly positive.

Referring to the subject of the fall of individual flakes in relation to their mass and shape, a series of averages is tabulated as follows:

	Diameter (mm.)	Mass (mgm.)	Velocity (cm/sec.)	Ratio of velocity to that of corresponding rain-drop*
Needle	1.53	0.004	50	1/2
Plane dendritic	3.25	0.043	31	1/6
Spatial dendritic	4.15	0.145	57	1/5
Sundry small flakes	3.15	0.054	50	1/4
Flake with droplets	2.45	0.176	100	1/5
Soft hail	2.13	0.80	180	1/2.5

Each of the eight papers is illustrated with carefully captioned photomicrographs, from which those in this article have been reproduced. Nakaya's technique of photographing snowflakes is exquisite and far superior to any that I have seen. While following the general method employed by W. A. Bentley, he gains both in accuracy and, incidentally, in artistic effect by not trimming the margins of the flakes, and by reproducing the photographs on a light instead of a dark background. Remarkable and beautiful as was Bentley's work¹, its re-publication has lost in scientific value by the omission of the degree of magnification and of meteorological conditions obtaining at the time of the collection of the flakes. Nakaya's work is a continuation of and improvement on Bentley's.

What we must now hope is that Prof. Nakaya

will continue his researches. Some of his results are only tentative, and some of his later work admittedly negatives his earlier, so that a summarized version of the results of the whole eight papers in the light of his most recent experiments would add greatly to their value. Be all that as it may, there is no doubt that the work in total adds very considerably to our knowledge of the nature of falling snow.

G. SHLIGMAN.

¹ "Snow Structure and Ski Fields", p. 36 (Macmillan, 1936).

² *Ibid.*, p. 40.

³ Nakaya has since written that this form is a modification of the hollow cup crystal.

⁴ Studien über die Nebelfrontablagerungen auf dem Partehakko. "Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland", 2. Abt. 1, Meteorologie und Geophysik, Lief. 1, 1-76. (Stockholm, 1923.)

⁵ According to Schmidt, W., *Sitz. Ber. Wien*, 118, 71 (1909).

⁶ "Snow Crystals", by W. A. Bentley and W. J. Humphreys (McGraw-Hill Book Co., Inc., New York, 1931).

Mendel, Morgan and Genetics

By Prof. E. W. MacBride, F.R.S.

THE modern science of genetics has acquired an enormous extension. As Prof. McDougall has said, it has swept over North America like a whirlwind. Everywhere chairs in genetics have been established, nay more, in some places special chairs in 'Drosophily' devoted to the exclusive study of this type-animal. Its votaries claim that in this science are to be found the solution not only of all the questions of the origin, propagation and improvement of our domesticated animals and cultivated plants, but also of the origin of species and evolution. Nevertheless, as time went on, the fair prospects of the science darkened. The hope of getting an unlimited number of new and valuable varieties was disappointed. As one of the professors of this science has ruefully expressed it, "The qualities that mendelize are not those which are of any value to farmers and those which farmers value do not mendelize." Anyone who reads, as I do, the minutes of the Agricultural Research Council, which contain an account of all the agricultural experiments seeking Government aid which are being carried out in Great Britain, must be struck with the fact that Mendelism is scarcely ever mentioned.

If 'genetics' be defined as the study of heredity free from presuppositions, then this study will be readily acknowledged to be a most important branch of the science of biology. But in practice, 'genetics' means the interpretation of hereditary phenomena according to fixed rules or postulates which were worked out by the late Dr. W. Bateson in Great Britain and by Prof. T. H. Morgan in the United States.

The discovery by Mendel of the facts of alternative inheritance and their rediscovery by Bateson and Correns were hailed as the greatest advance in biology since the publication of "The Origin of Species". The first question to be asked is whether what Bateson called 'unit-factors' and which are more frequently termed 'genes' have really the significance which has been attached to them. Mendel himself did not suppose that the phenomena of alternative inheritance covered more than a small part of heredity, but the persistent effort of all subsequent geneticists has been to crush all cases of heredity into this mould.

Bateson, who had the advantage of a broad education in biology at a time when in fame and brilliance the Cambridge School was at its zenith, really did most, especially in his later years, to clarify the position. He showed that alternative characters or 'allelomorphs', as he termed them, were related to each other in such a way that the dominant was characterized by something which was absent in the recessive. This definition was afterwards altered to stronger and weaker expressions of the same character. The classical experiments on peas will illustrate this point clearly. Yellow peas are dominant to green peas. But all peas when immature are green; the yellow pea on ripening transforms its chlorophyll into etiolin whereas the green pea stops short in its development. Similarly, round peas are dominant over wrinkled peas. Again, all young peas are round: in dominants, the round form is retained

owing to the transformation of an adequate amount of sugar into starch, but in the wrinkled peas less starch is found and an amount of sugary solution remains, and when this dries up in ripening, a shrinkage occurs which leads to a wrinkled seed-coat. When, therefore, two parents mate and each has some of the specific characters in their dominant form, this merely means that some of the specific characters are more strongly marked in the mother and some in the father. It is sometimes possible to mate two forms such as a regular sea-urchin and a heart-urchin which have been distinct for millions of years, and in the offspring the paternal influence may sometimes show and at other times the maternal. In picking out a recessive as a new variety to be propagated, we are really selecting a weakened form. As he grew older, Bateson became more and more convinced that an increasing number of cases of inheritance could not be brought under the Mendelian laws at all.

But the great extension which 'genetics' has attained in recent years is undoubtedly due to Morgan. He has, with a certain amount of justice, been termed the founder of the science of genetics. As is well known, in the ripening of the nuclei of the sexual cells a stage occurs which is known as 'meiosis'. In this stage, the paternal and maternal chromosomes approach each other in pairs and appear to come into actual contact with one another; they then separate, and half go to one pole of the nucleus and half to another. The nucleus then divides and the number of chromosomes is thus reduced to one half: the sexual cell is now ready to unite with another one with a similarly reduced number of chromosomes and so in the zygote the full number is restored. Now, according to Morgan, when meiosis takes place, the pairing chromosomes are very long and spirally twisted, and Morgan assumes that they break and exchange portions of their substance. If, then, the Mendelizing factors are based on discrete material particles situated in definite positions in the chromosome, the transference of dominant characters from one partner to another could be accounted for. Further, if two factors were situated near each other in the chromosome, it might be expected that the break would occur in such a manner that the separated piece would contain both factors. In this way, the association of two factors in inheritance was explained. The farther apart the position of the factors in the chromosome the more seldom would they be included in the same broken-off piece, and by the relative frequency of their association enthusiasts have attempted to construct a map of the chromosome and even to reckon the distance of two factors (in 'centimorgans') from each other.

It may appear to some readers that this whole theory is a rather risky castle of cards to erect on the basis of certain very dubious assumptions; and it is one of the main purposes of this article to show that these assumptions are incorrect, and consequently the whole chromosome theory falls to the ground. The question which we wish to put is whether the appearances of two long chromosomes slightly curved around one another are really an expression of meiosis or not. In my opinion, this question has been definitely decided in the negative by two researches, namely, "The Spermatogenesis of *Lepidosiren paradoxa*" (*Quart. J. Micro. Sci.*, 57, 1911) by Dr. W. E. Agar of Glasgow (now professor of zoology in the University of Melbourne) and "The Meiotic Phase in Vertebrates" by Prof. C. E. Walker of the Department of Cytology in the University of Liverpool. The latter research was published in two papers, namely,



Fig. 1.
THE 'FIRST' MEIOSIS
OF *LEPIDOSIREN*

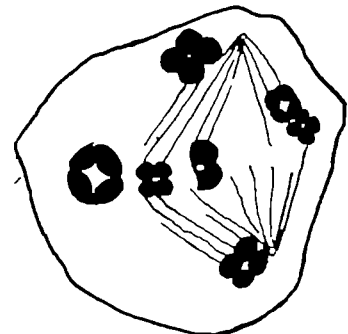


Fig. 2.
THE 'SECOND' MEIOSIS
OF *LEPIDOSIREN*

"The Meiotic Phase in *Triton vulgaris*" (*Proc. Roy. Soc.*, B, 98; 1925) and "The Meiotic Phase in Certain Mammals" (*Proc. Roy. Soc.* B, 99; 1926).

Agar's researches were suggested to him by his teacher, Prof. Graham Kerr. This was a stroke of genius on Prof. Kerr's part. He argued thus: if so much importance is attached to minute details in the ripening process of the nucleus, would it not be essential to study them in the largest nuclei available? He knew well that the nuclei of the sexual cells of the testes in *Lepidosiren* were gigantic, so large indeed that it is impossible to include one of them as a single microtome section.

Agar found the ripening process beginning with the apparent apposition of two long chromosomes in the manner described by Morgan, and as he was at the time an orthodox geneticist, he interpreted it in the same manner. But to his amazement, when the putative meiotic partners separated, they shortened and condensed and the same partners then underwent a *second meiosis* during the ripening of the same nucleus! The so-called first meiosis as described by Agar is shown in

Fig. 1; the second in Fig. 2. In the 'second' meiosis it can be seen that the chromosomes are reduced to short rounded nodules, and any supposition that they could break and exchange pieces of substance is obviously ludicrous.

But Agar's supposition that the same two partners could undergo meiotic pairing twice in the same ripening cycle is clearly incredible, and the account given by Dr. Walker unravels the mystery. By his researches, which were begun on the newt in his first paper and continued on several mammals in his second paper, he has proved conclusively that Agar's 'first meiosis' is not a meiosis at all but a belated ordinary division of the nucleus. This begins in the telophase of the preceding division of the sexual cell. When this division is complete and the daughter nuclei are passing into the resting phase, the telophase 'filaments' can be seen to be split. In the resting phase this split disappears. But in the subsequent stage of activity, when long thin threads begin to be differentiated (the so-called leptotene stage), the split reappears and the separating chromosomes have been mistaken for meiotic partners. The pictures drawn by enthusiastic geneticists of long chromosomes with nodular thickenings opposite each other as proofs that similar 'genes' attract one another, are simply the expression of the division of moniliform chromosomes.

If, then, it is impossible to talk of 'genes' being in any particular chromosome—or of breaking and crossing over—it is difficult to see what remains of modern 'genetics'. As readers of NATURE are well aware, I am convinced that functional heredity, in other words, the handing on in some degree of habits acquired in one generation to the next, has been finally proved to be true, and this principle once admitted is sufficient to explain evolution and the origin of natural races and species. But the question of the origin, nature and inheritance of mutations, otherwise 'sports', remains to be dealt with. On this subject a great deal of light has been thrown by Prof. Mohr, of the University of Oslo, in a paper entitled "Über Letalfaktoren mit Berücksichtigung ihres Verhaltens bei Haustieren und beim Menschen" (*Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 41; 1926). He shows that in *Drosophila* and in other forms an astounding number of mutations are what he terms 'lethal' or 'sub-lethal'. In *Drosophila*, the so-called 'modifying' factors which by themselves produce no outward visible effect and indeed whose existence is assumed in order to force the facts into the Morgan scheme, produce no effect on the viability of the insect. These he places in fanciful comparison at the red end of the spectrum. As we pass towards the yellow and green we encounter

mutations which make a marked difference in the appearance of the insect, and these decrease the viability until in the blue we encounter the sub-lethal mutations which injure their carriers so much that they can only be reared in a cross with a normal form. We finally reach the lethal factors in the violet, which even in a cross cause the death of their carriers. He shows further that such mutations are distributed over all the chromosomes and that new lethal factors are continually coming into being.

The obvious conclusion is that all mutations are of the physiological nature of damage to the growing powers of the germ, and when we consider the known artificial means of producing mutations, such as X-rays, heat, etc., applied to the eggs, this conclusion is so clear as scarcely to require statement. These agents kill the majority of eggs subjected to their influence: some resist them unaltered and some are half-killed and grow up to produce the mutations. Beneficent mutations which could survive in the struggle for existence are figments of the imagination.

Johannsen's demonstration that in a 'pure line' fluctuating variations are non-heritable marks one of the great advances in evolutionary knowledge, for it destroyed the basal assumption of the classical Darwinian theory that heritable variations in all directions are constantly occurring, some of which may *chance* to fit the environment and so be preserved. It was he who invented the term 'gene' as the cause of a mutation. About this word he says ("Some Remarks about Heredity," *Hereditas*, 4, 1923): "I introduced the word 'gene' when I was possessed by the antiquated spirit shown in Galton's, Weismann's and Mendel's viewpoints. Here we shall try to exterminate in genetics the term 'unit-character' because it indicates a notion inadequate and noxious for genetics. The most important part of the genotype does not seem able to segregate into units; as yet we are operating with characters which are superficial in comparison with the fundamental specific organic nature of the organism. However we try to analyse a genotype into factors we must remember that the characters of the organism, that is, its phenotypical features, are the reaction of the genotype *in toto*. Mendelian units *per se* are powerless. Are the experimentally demonstrated units anything more than expressions for local deviations from the original normal state of the chromosomes? *The Weismannian distinction between germ-plasm and soma, that is, absolute independence, does not exist in reality.* 'Gene' has nothing to do with De Vries's expression 'Pan-genes' and their behaviour as units; the phenotype is the reaction of the genotype (nature) with the ambient conditions (nurture)."

Obituary Notice

Prof. Hans Reck

PROF. HANS RECK, professor in the Institute of Geology and Palaeontology of the Friedrich-Wilhelm University, Berlin, died suddenly of heart-failure at Lourenço Marquez on August 4, at the age of fifty-one years. He was on his way from Natal to Lake Eyaasi, Tanganyika Territory, to examine the locality where Dr. Kohl-Larsen discovered a human skull in 1935 (NATURE, 138, 1082; 1936).

Hans Reck was born in Würzburg on January 24, 1886. He studied geology at the Universities of Berlin, of Munich, where he graduated as Ph.D. in 1910, and of London, at University College. During his undergraduate years he visited Iceland in company with his future wife, Fräulein Ina von Grumbkow, who survives him. In 1912 he was appointed leader of the Tendaguru Expedition of the University of Berlin; in 1913, leader of the Geological Expedition to Central Africa sponsored by the Royal Prussian Academy; at the end of 1913, leader of the Olduvai Expedition of the Universities of Berlin and Munich; and during the years 1915-19 he held the post of Government geologist in German East Africa.

After the Great War, Reck had not the same opportunities for work in the foreign field. Nevertheless, he twice visited Santorin, in 1925 and 1929. He was a member of the second Olduvai Expedition, in 1931, under the leadership of Dr. L. S. B. Leakey, and in 1932 visited South Africa to collect fossil reptiles. He left Germany at the end of September 1936 to carry out researches in the Cameroons, South Africa, Tanganyika and Kenya Colony; this trip was interrupted by his untimely death.

Reck's work on the geology of East Africa is

inadequately represented by a number of scattered papers. As editor and part author of the "Wissenschaftliche Ergebnisse der Oldoway-Expedition, 1913", he had the satisfaction of seeing the palaeontological results published in full; but the difficulty of raising funds caused many delays, and his account of the geology, which was to appear at a later date, was left unfinished. Nor did he issue any technical description of the giant caldron volcanoes, every one of which he had climbed. Nevertheless, he was a great pioneer in this field, and his influence on post-War research cannot easily be estimated.

Most of Reck's published work relates to volcanoes, on which he was a leading authority. He appears as a *Mitautor* in the first part of the *Zeitschrift für Vulkanologie* (1911), and as joint editor in 1923. In addition to many papers and numerous reviews contributed to the *Zeitschrift*, he published in 1923 "Die Hegan Vulkane" and "Physiographische Studien über vulkanischen Bomben". An exhaustive monograph on Santorin, completed just before he began his last journey, is in the press.

Tall, fair, and blue-eyed, Reck was a Bavarian of the finest type. His sunny disposition and upright character endeared him to all who had the privilege of his friendship. Himself incapable of an ungenerous thought or act, he was unable to understand them in others. In addition to his scientific pursuits, he found time to form a small but choice collection of Arab art, to become a gifted pianist, and to cultivate the delightful literary style which appears in "Oldoway, die Schlucht des Urmenschen", and in "Buschtaufel", a volume of light-hearted stories of the campaign in East Africa and of life as a prisoner of war in Egypt.

A. TENDHILL HOPWOOD.

News and Views

Mr. C. C. Paterson, O.B.E.

MR. CLIFFORD C. PATERSON, director of the Research Laboratories of the General Electric Co. Ltd., has had the honorary degree of doctor of science conferred on him by the University of Birmingham "in recognition of his many contributions and services to electrical science". Dr. Paterson, who is now fifty-seven years of age, was for sixteen years a member of the staff of the National Physical Laboratory, where he established and administered the Electrotechnics and Photometry Divisions of the Laboratory until 1918. He then accepted the task under Lord Hirst of initiating the G.E.C. Laboratories at Wembley. These have now grown so much in size and influence that they have a personnel of 500 and cover a floor area of about 170,000 sq. ft. Dr.

Paterson's activities have not been confined to the Wembley Laboratories. He was president of the Institution of Electrical Engineers in the year of the Faraday celebrations (1931). He has been president of the International Illumination Commission, the Illuminating Engineering Society, and this year of the Institute of Physics; he is also a vice-president of the Royal Institution and of the Royal Society of Arts. He has been Faraday lecturer of the Institution of Electrical Engineers, Huxley lecturer of the University of Birmingham, and is this year Guthrie lecturer of the Physical Society. Whilst Dr. Paterson's activities in engineering and science have covered a wide range, his chief personal contributions and scientific papers have been in the fields of light and lighting.

Palaeolithic Man in Brittany

IN view of recent reference to the fact that evidence of a Palaeolithic Age had not been found in Brittany (see *NATURE*, Aug. 21, p. 329), it is of interest to note that M. R. Mazères records in the current number of *L'Anthropologie* (47, 3-4) that he has found a number of flint implements of that period, when examining the quaternary deposits of the cliffs in the bay of St. Brieuc (Côte-du-Nord). The deposits include a lower and upper loess. Of these the lower, a gray loess attributed to the Riss glaciation, is ravined by interglacial deposits of marine origin, with an abundance of *Buccinum reticulatum*, and evidence of a superimposed raised beach at an altitude 8-9 metres, which would warrant an attribution to Mousterian, or Tyrrhenian II. Above this, and at times associated with traces of the raised beach, is the upper loess, showing evidence of two periods of deposition. In the earlier deposits of this phase were found a dozen flint implements of Mousterian facies, with flakes of diabase and other stone of the same technique in working, and the tooth of a reindeer. The use of stone other than flint is attributed to the scarcity of the latter material in the neighbourhood. The later deposits yielded two well-made carinated scrapers of flint of Middle Aurignacian type. In the same horizon, but at another site, were found a reindeer tooth and the tooth of one of the Bovidae. The attribution of the upper loess to Wurm I and Wurm II is thus confirmed by the character of the contained implements. M. Mazères points out that, modest as these finds are, they serve to indicate the existence of a palaeolithic culture in Brittany. This is now apparently recorded for the first time; but M. Mazères recalls that in 1926 Prof. Milon and the Abbé Leclerc found a mammoth tusk in the loess to the north of Pléneuf, near the location of the present finds, and with it were flints which have not been studied.

Recent Archaeological Excavations in Great Britain

THE continued examination of the neolithic barrow at Chilham, Kent, known as Julaber's Grave, which is in course of excavation by Mr. R. F. Jessup on behalf of the owner, Sir Edmund Davis (see *NATURE*, August 7, p. 228), has brought to light further evidence regarded as confirming local tradition. The occurrence, among other finds, of equine bones and teeth (*The Times*, August 16) seems to afford some foundation for the belief that the remains of one hundred horses and one hundred men were buried in the barrow. An examination of the teeth, however, suggests that the horses may have been buried there at various times in a period of centuries. Excavation has ceased for this season, but will be resumed in July next. A five weeks' season of excavation at Milber Camp, Newton Abbot, conducted by the Devon Archaeological Society under the direction of Mr. F. C. Cottrill, leads to the conclusion that the camp was constructed in the last century before the Roman invasion for the purpose, it would appear, of commanding the junction of two important tracks, and that it was abandoned when the Romans built

a bridge over the river at Teignmouth. Among the finds brought to light in the course of the excavation were a polished stone axe, a sling stone, decorated spindle whorls and pottery. The site was reoccupied in the Middle Ages, probably by shepherds.

Two food vessels, attributed to a date of about 2000 B.C., are reported to have been unearthed by workmen employed in the Fife Redstone Quarry, Belmullo, near St. Andrews. They were found at a depth of three feet below the surface on the side of a hill. They stand about six inches high, have a diameter of about four inches, and are ornamented with a decoration of cord impressions. Operations at the Mease Lake Village, near Glastonbury, in Somerset, were resumed for the current season on August 23. Dr. A. Bulleid and Mr. H. St. George Gray are again in charge of the excavations, acting on behalf of the Somerset Archaeological and Natural History Society. The work of investigation this year will be confined to the central portion of the main group of dwellings of the East Village, upon which operations have been concentrated for the last four years. Until four years ago the West Village had been the principal site of excavation. A monograph has been prepared and is about to be published on the results obtained in the period between 1910, when the systematic examination of this site began after the close of investigations at the Lake Village of Glastonbury, and 1933, when excavation on the West Village was brought to an end. About half this part of the site had then been investigated. The excavations this year will be carried on for a period of four weeks.

Excavations on the Roman Site at Wroxeter

THE Committee of the Wroxeter Excavation Fund has issued an appeal for funds to enable it to continue excavation on the Roman site of Uriconium. Previous investigations have covered about ten acres of a total area of 200 acres. Excavations were undertaken last year on a small scale by the Shropshire Archaeological Society. It is proposed to continue these excavations. Generous assistance has been given by Sir Charles Marston, who is president of the Shropshire Archaeological Society, and subscriptions have been promised by the Society of Antiquaries of London and All Souls' College, Oxford. The excavation again will be directed by Miss Kathleen Kenyon, who was in charge last year. The objects of this season's operations will be the further examination of the so-called Baths building by excavation on its north side, and the identification and excavation of the east gate of the city. It is anticipated that these investigations will throw light on three important problems: the history of the defences, the plan of the city, and the line of Watling Street, which is here in dispute. Donations should be addressed to the secretary of the Fund, Mr. A. E. Cooper, 28 Claremont Hill, Shrewsbury.

Industrial Research in India

THE report of the Industrial Research Bureau, Government of India, for 1936-37, covers the work of the Industrial Research Council and the research

work at the Government Test House as well as the work of the Bureau (Delhi: Manager of Publications, 1937. 14 annas; 1s. 6d.) The Industrial Research Council is an advisory body, consisting of representatives and non-official nominees of the central, provincial and leading State Governments, which meets once a year to discuss policy in the co-ordination and development of research. Programmes for road research have been approved by the Council, and the development of the manufacture of casein plastics has been considered both by the Council and by the Bureau. Industrial standardization and the compilation of a list of researches in progress or contemplated in industrial laboratories are also receiving attention, and a number of prizes have been awarded by the Council for papers bearing on industrial development. The research branch of the Government Test House which deals with the research programmes suggested by the Council and other problems referred to the Bureau has completed a preliminary investigation on the characteristics which affect the setting of red lead paint. For accelerated weathering tests on various paints the weatherometer, modified to give test conditions approximately to outside weather conditions at Alipore, has been used.

SPECIAL apparatus has also been developed in India for accelerated life tests on dry cells and considerable attention has been devoted to the use of vegetable oils for internal combustion engines. A process has been developed for rendering castor oil miscible with mineral oils of known suitability for use in such engines, and the effects of various anti-oxidants have been investigated. Steady progress has been made with the work of modifying the Morris and Lister engines and of equipping them with accessories to render the operating conditions fully controllable. Another section has been responsible for important investigations on the properties of petrol-benzole mixtures and the effect of changes in the composition of the benzole. A number of investigations on sand, lime, surkhi, clay, etc., have been initiated. Good progress has been made with the design of the equipment for the proposed road test track at Calcutta. Separate chapters in the report deal with work on glass and on oils and soaps, the former including the improvement of glass furnaces and a survey of glass-making materials.

Research in the Iron and Steel Industry

At the request of the Board of Trade, the Import Duties Advisory Committee has conducted an inquiry into "The Present Position and Future Development of the Iron and Steel Industry", and its report, which is full of interest, has now been issued (Cmd. 5507. London: H.M. Stationery Office, 1937. 2s. net). The report is essentially concerned with economic conditions, but its authors recognize that both the present and the future of the industry are closely bound up with scientific control and research. They express their satisfaction with the provision made for research and their hope that it will be further

extended in the future. The total industrial subscription to the Iron and Steel Industrial Research Council for 1936-37 is estimated as £30,000. As the capital of the concerns estimated to be responsible for 86 per cent of the country's output of steel in 1936 is given as £126.7 millions, this cannot be considered an excessive allowance. Several of the large steel concerns have their own research laboratories, involving a considerable expenditure, and these have actively collaborated in the investigations of the Council, thus making an indirect contribution. Full particulars of the research organization were furnished to the Committee by the Department of Scientific and Industrial Research in writing, but the seventy-three witnesses examined orally did not include a scientific metallurgist or a director of a research laboratory, and one would have welcomed a fuller appreciation in the report of the fact that the economies to be effected by scientific improvements—as, for example, in the field of refractories—are as important as the improvements in organization to which the report, thorough as it is, is almost entirely devoted.

Far Eastern Conference on Rural Hygiene

A CONFERENCE for Far Eastern countries on this subject was opened on August 3 by the Governor-General at Bandoeng, Java. This Conference was arranged by the League of Nations Health Organisation under the presidency of Dr. T. Offringa, director of the Netherlands Indies Public Health Service, with Dr. J. Rajchman, medical director of the League Health Committee, as secretary, assisted by Dr. C. L. Park, director of the Eastern Bureau of the Health Organisation. The Conference is meeting in five sections, in which the following subjects will be discussed: (1) health and medical services: the advantages and disadvantages of training 'semi-qualified' or assistant doctors to assist the qualified medical staff, and possible alternatives; (2) rural reconstruction and collaboration of the population, with the view of improving conditions of life in rural districts, a policy favoured by the Government of India and other countries; (3) sanitation and sanitary engineering, including housing, water supply, latrines, refuse disposal and fly control; (4) nutrition, a subject of importance in the East, for it has been estimated that 75 per cent of the population of Asiatic countries exist on a diet below the standards fixed by European science; (5) measures necessary to combat specific diseases, such as malaria, plague, tuberculosis, hookworm infection, yaws and leprosy, and mental diseases; also drug addiction.

The Science Museum

BEYOND the usual statistical information regarding the number of visitors and attendances at lectures, notes on special exhibitions, on acquisitions and the progress of the five main divisions of the Museum, the annual report of the Advisory Council of the Science Museum for 1936 is of especial interest as it contains a review of the growth and activities

of the Library, which is being developed as a National Library of Science. During the year, the Library was used by 22,000 readers, while the issues on loan of books and periodicals to Government departments, scientific and technical societies, colleges, etc., was 21,000. The Library receives more than 9,000 current periodicals and the contents of these are all indexed, references to these and to other matters now running into millions. There are about 250,000 books in the Library. "The two main functions of the Library," the report says, "may broadly be stated as the acquiring of documents and making them readily available", the latter consisting of cataloguing the volumes, maintaining indexes of their contents, provision of the volumes to readers, loan service, supply of bibliographies, supply of photostat copies, and Library publications. There have been many valuable additions to the collections in the Museum, and during the year under review special exhibitions were arranged illustrating the progress of research at very low temperatures, the scientific aspects of smoke pollution of the atmosphere and the developments in electric illumination.

Overhead Costs in Business Management

ONE of the most difficult tasks for a business management, whether the concern be large or small, is the adequate control of overhead costs. The usual classification of overhead expenses into salaries, rent, rates and taxes, legal expenses or the like is quite inadequate, because responsibilities cannot be tied up with the expenditure on these items, and generally there is no method of measuring the value obtained from the expenditure. In a valuable and thought-provoking report entitled "The Control of Overheads" (Mansfield House, 376 Strand, W.C.2. 5s.), prepared by a committee of the Management Research Groups, the subject is examined with the aim of securing effective control through localization of responsibility. To secure this, the report recommends the division of all overhead expenditure into a series of functions or services, each of which would be in charge of one person, thus permitting the fixation of responsibility. In order to assess the value of the work done by each section of the organization, its cost must be related to the volume of the work done and to the value or quality of that work; and for this purpose various ratios or 'yard sticks' are suggested in the report. The essential requirement is that responsibility for functional costs should be invested in persons, and to ensure that personnel shall cover each of the functions, it is most desirable that an organization chart should be constructed. Budgetary control is an excellent method of reviewing expenses in advance and making comparisons immediately results are available. Costs, however, may be rendered useless as a means of measuring efficiency because of plant working under capacity owing to insufficiency of orders. The report, therefore, recommends that the costs be 'purified' of the cost of idle plant by the abstracting and debiting of all such expenses to a non-productive account, which is carried straight on the trading account.

Economics of Wages and Price Levels

IN an address before the Economic Reform Club, London, on June 30, entitled "The Economic Reforms Required for Lasting Prosperity and Peace" which has now been issued in pamphlet form (Economic Reform Club, 61 Great Cumberland Place, London, W.1. 9d.), Mr. A. G. McGregor stresses the supreme importance of reform in wages regulation in securing a steady purchasing power of the pound. He urges that the method of adjusting wages by industrial dispute should be abolished and replaced by direct government control to adjust wages in accordance with the price level. This would in the first instance involve raising wages and salaries to a level which would bring consuming power in step with productive power, and thereafter the wages board would maintain the proper relation between wages and price level. He stresses the point that bankers should be relieved of all responsibility over the general price level and outlines the functions of a rational banking policy designed to accommodate industry and commerce with the necessary funds but under rules which eliminate any monetary influence on the price level. He contends that if wages and salaries are controlled in the way indicated so as to secure a satisfactory equilibrium between consuming power and productive power, economic liberty is no more affected than individual freedom in general by the ordinary government responsibility for maintaining law and order, and also that the higher wages and internal consuming power would assist the export trade.

Purchasing Power with a Managed Gold Standard

IN a pamphlet entitled "A Managed Gold Standard" (W. Haffer and Sons, Ltd., Cambridge), E. A. Meyer urges that unemployment and economic distress are due to lack of purchasing power. The State's lack of purchasing power has necessitated higher taxes, which have further decreased the citizen's purchasing power. This lack of purchasing power is due to lack of counters, or money, used for exchanging one man's labour for another's, caused by the inability of an inflexible money standard to keep pace with a continuous rise in prices. He advocates accordingly a managed gold standard based on the monopolization by the State of the note issuing bank of the standard (gold), and the fixation of the standard's money value by an international commission which should revise this value periodically according to the need of the world's productive ability to ensure the standard's flexibility. The managed standard will instantly increase the purchasing power of the State by increasing its right to issue counters without risk of devaluation, and this increased purchasing power by permitting decreased taxation will increase the purchasing power of the citizen as well as thus stimulating industrial and commercial prosperity. Unemployment will be further diminished or eliminated by the increased ability of the State to initiate public works. The managed gold standard could be introduced if a few countries only agreed to do so, since other countries would be bound to follow.

The Television Cable

In the Engineering Supplement to the *Siemens Magazine* of June, Mr. A. Rosen describes the London television cable which joins the Alexandra Palace studio to Broadcasting House and goes thence to the Whitehall Telephone Exchange. Success is being achieved and provincial cities are looking forward to having broadcast television services. It is probable that eventually there will be a network of television cables interconnecting the studios and transmitters throughout the country, similar to the grid of the programme circuits which now exists for sound broadcasting. Television is analogous to telephony. In telephony the voice sounds are converted by the microphone into equivalent alternating currents; these are transmitted to the receiving loud-speaker, where they are converted back to the voice sounds. Similarly the visual image is converted by the television camera into equivalent electric currents which are carried to the receiver where the cathode ray tube converts them back to the visual image. In both cases the transmission between sender and receiver can be effected over a metallic circuit, or by a radio link or by a combination of the two methods.

THE chief points of difference between the two transmissions concern the band of frequencies which have to be transmitted. In telephony, for music it suffices to transmit currents of frequency lying between 50 and 10,000 cycles to get excellent results. The television camera generates a much wider band of frequencies. In the Marconi-E.M.I. system, the frequencies range from zero to more than two million cycles. This necessitates the use of a correspondingly high carrier frequency for radio television transmission. The B.B.C. is to be congratulated on its notable achievement in televising the Coronation procession. This was the first successful high-definition relay in the world. The E.M.I. and Siemens gave valuable assistance to the B.B.C. in carrying out this enterprise. The author states that for trustworthy transmission between points more than 25 miles apart cables are necessary. Radio links also are liable to be affected by 'man-made' disturbances such as the radiations produced by the ignition systems of motor cars.

The Electrification of the Rigi Railway

It is now sixty-six years ago since the first rack railway in Europe, the Rigi railway, between Vitznau on the Lake of Lucerne and the top of the Rigi, was opened. It will be electrified in the autumn of the present year and will be brought into line with the latest modern requirements. The new motor-coaches will be light and comfortable, and the increase in speed will shorten the trip considerably. Fewer employees will be required as the preliminary work done in starting up the steam locomotives will be done away with and because it is easier to supervise electric vehicles. One-man control also suffices in the motor-coaches. When peak track conditions occur some of the existing steam locomotives can be used, and these are kept as a useful stand-by. The

electric equipment of the motor-coaches will be built by Brown, Boveri and Co., Ltd., Baden, while the mechanical part and coachwork will be constructed by the Swiss Locomotive Works at Winterthur. Direct current will be used at a pressure of 1,500 volts and the average running speed will be about nine miles per hour. On the up-grade, the highest running speed is about eleven miles an hour and on the down-grade about seven miles an hour. The difference in altitude between the Vitznau and Rigi Kulm stations is about 4,300 feet, and the steepest gradient is 25 per cent. In the *Brown Boveri Review* of March, diagrams of the new coaches are shown. The braking devices comprise electric resistance braking as service brake on the down-grade and two hand brakes independent of one another and actuated by spindle from either driver cab. When the brake is applied on the up-grade it prevents the coach running backwards should the current fail. There is also an overspeed brake which operates on a brake drum on the motor and only acts on down-grade running. In emergencies it is put into action by a safety device.

The House-Rat in the United States

ALTHOUGH the black rat (*Rattus rattus*) still predominates in the southern States, particularly in Florida and the States bordering the Gulf of Mexico, throughout the States in the temperate zone it has been displaced by the brown rat (*Rattus norvegicus*), which appears to have been introduced about the beginning of the American Revolution, in 1775. Now the rat population is enormous—in Texas some years ago 153,720 rat tails were collected in six weeks; in Georgia, Alabama and Texas during the typhus fever control campaign in 1934, it was estimated that 7,500,000 rats were destroyed on 747,608 premises treated, or approximately two rats for every person living on the premises. The total economic damage done by these pests is enormous. In the course of one of its inquiries, the Biological Survey received 14,650 replies from farmers co-operating in rat campaigns, and the annual losses therein reported averaged \$5 dollars a farm, while a computation of the grand total of loss throughout the United States each year is 180 million dollars. In addition, rats are seriously concerned in the conveyance of certain diseases among human beings and domestic stock, and in an effort to arouse co-operative measures of rat-control, the U.S. Department of Agriculture has published an eighteen-page circular (No. 423, Jan. 1937) on "The House Rat".

Migrations of Salmon

At a meeting of the Washington Academy of Sciences held recently, a discussion on the homing migrations of salmon was opened by Prof. Henry B. Ward. According to a report by Science Service, of Washington, D.C., he said that the return of salmon, generation after generation, to their ancestral breeding grounds, is a response to definite stimuli, amongst which he regards temperature as being the most powerful. Swiftness of current has also some effect in guiding the fishes, although relative acidity of the water seems to have no influence. But if it be

admitted that salmon return to the streams where they were born—and there is much evidence supporting that view—it cannot be admitted that either the temperature of a particular stream or the swiftness of its current remains constant. It is difficult to understand, therefore, just how these variable factors can guide migrating salmon, not to a specially cold or swift stream, but to a particular stream the one outstanding character of which is that they were born there.

U.S. Zoological Expedition to Far East

A PARTY of scientific workers from Harvard and Johns Hopkins Universities has set out with the intention of making a survey of the birds and mammals of Siam, Borneo and Sumatra (Science Service, Washington, D.C.). The results should be of special significance, for the programme includes study of the social life of some of the most interesting of the higher monkeys. In the jungles of Siam, the habits of the gibbons will be observed for three or four months by Dr. Carpenter; other members of the expedition will carry out parallel observations in British North Borneo on orang-utans, gibbons and proboscis monkeys; while, later, in the mountains of northern Sumatra, orang-utans will be studied in the national park recently set aside by the Netherlands Government to protect this rapidly disappearing animal. It is expected that the study of the social habits of these creatures may throw light upon the problems of man's social and physical evolution.

Radio-Therapeutic Treatment of Cancer

THE Ministry of Health has issued an important publication on cancer treatment entitled "Cancer: Memorandum on Provision of Radio-Therapeutic Departments in General Hospitals", by Lieut.-Colonel Smallman (Reps. on Pub. Health and Med. Subjects, No. 79. London: H.M. Stationery Office. 9d. net). A principal reason for the preparation of this memorandum is the growing use of radium and X-rays in the treatment of cancer, in substitution for, or in conjunction with, surgery. As a result, hospitals in which cancer patients are treated need to be specially equipped and staffed for this part of their work. The memorandum emphasizes the importance of team work, and that the radio-therapeutic department should be in close touch not only with the surgical department, but also with other departments (gynaecological, pathological, etc.) provided by the hospital of which it should form an integral part. It concludes that a general hospital should contain some three hundred beds if it is to make reasonably full use of radiation treatment facilities. Plans are given for the lay-out of a radio-therapeutic department, the various features of which are explained in the text. The memorandum discusses how those hospitals which cannot provide full cancer treatment facilities can be enabled to make use of other hospitals in which full facilities exist. Appendixes contain the recommendations of the British X-Ray and Radium Protection Committee and of the Radium Commission on the care and custody of radium.

Physics at Harvard

THE volume of "Contributions" from the Physical Laboratories of Harvard University for 1935 is again of quarto form and consists of reprints without change of pagination, of fifty-seven memoirs by members of the staff, fellows and students which have appeared in scientific periodicals such as the *Physical Review*, the *Proceedings of the American Academy*, the *Review of Scientific Instruments*, during 1935 and the first two months of 1936. The quarto form allows the inclusion of the large double column pages of *Industrial and Engineering Chemistry*, but gives very wide margins to the single column pages of the *Proceedings of the Academy*. Work on the physical properties of materials at high hydrostatic pressure accounts for seven or eight of the memoirs, and special interest is attached to Prof. P. W. Bridgman's method of securing measurements at 50,000 atmospheres pressure in steel vessels which normally rupture at 20,000 atmospheres. Atomic physics accounts for about a dozen memoirs, of which that on the quantum theory of valence by Prof. Van Vleck and Dr. Sherman, a fellow of the National Research Council, reprinted from *Reviews of Modern Physics*, may be mentioned. The whole volume bears evidence to the active part Harvard is taking in the advance of knowledge.

Field Work of the Smithsonian Institution in 1936

THE preliminary survey of recent field work of the Smithsonian Institution ("Explorations and Field-Work of the Smithsonian Institution in 1936," Washington, D.C., 1937; pp. 100) covers nineteen investigations, beginning with Dr. G. C. Abbot's "Exploring Solar Power Possibilities" and including research in geology, paleontology, zoology, botany and anthropology, the last-named predominating with seven investigations, mostly archaeological. Of these last, Dr. Hrdlička's explorations of sites on Kodiak Island, Alaska, and the Aleutian Islands have attracted no little attention, not only on account of the exceptionally large number of antiquities brought back by this year's expedition, but also by the collection of mummified human remains from Kagamil. Dr. Henry B. Collins, jun., by his excavations at Bering Strait, has succeeded in determining beyond question the place of the Thule culture in the cultural succession at this gate of entry of man into the American continent—an important contribution to the Eskimo problem—and also has arrived at the conclusion that there is little hope of discovering any trace here of the passage of early man prior to the Eskimo, owing to physiographic changes. Further investigations by Dr. Frank H. Roberts, jun., on sites of the Folsom culture in Colorado and on a new site in Iowa discovered in 1935, the easternmost occurrence noted of the true Folsom stone point, have yielded new data bearing on the occurrence of this early type of the American stone age. It is now established that Folsom man was contemporary with the extinct camel, and also that he lived before, as well as at the same time as, the thick growth of vegetation which preceded the present condition of

aridity in the south-western area. This points to an antiquity even higher than that indicated by previous evidence.

Liverpool Naturalists' Field Club

THE seventy-sixth Annual Proceedings of the Liverpool Naturalists' Field Club, recently issued, covers the year 1936. The botanical notes include a summary by Mr. J. D. Massey of ninety new plant stations in the area recorded in the past four years since the compilation of Dr. Green's last "Flora of Liverpool", while Mr. W. S. Laverock, the botanical referee, describes the finding of deadly nightshade (*Atropa belladonna*) at Eastham, adder's tongue fern (*Ophioglossum vulgatum*) near the Manchester Ship Canal at Mount Manisty, young sycamore trees with variegated foliage at Irby woods, and other incidents of the field meetings of the year. The year's ornithological records, compiled by Mr. Eric Hardy, the ornithological referee, include a water-pipit, ruffs, a part-albino pied wagtail, curlew-sandpiper, little stint, greenshanks, green-sandpipers and a very late (November 28) yellow wagtail at Liverpool Sewage Farm, the latter (after a fog spell) a day later than the previous latest record in Britain; crossbills in the Ainsdale-Froshfield pinewoods in winter, a sculp wintering at the Botanic Park, Liverpool, puffins, fork-tailed petrels and mergansers in the Dee Estuary, a redwing summering in Knowsley Park and the nesting of the Canada goose and little grebe at Kirkby Dam, lesser black-backed gull and curlew at Simonswood, oyster-catcher and rock-pipit by the Ship Canal below Eastham, shoveller at Burton, grasshopper-warbler at Ince and Gayton in Wirral, and blackcap in Knowsley Park. The long-tailed duck is reported in full summer plumage feeding on crabs in West Kirby marine lake in mid-May. There are also the results of surveys carried out in the area for the British Trust for Ornithology, etc. The Committee reports an increase in membership during the year, the formation of a junior section, and an appeal for the Ornithological Fund.

Review of Agriculture

THE Royal Agricultural Society of England (16 Bedford Square, London, W.C.1) has published its ninety-seventh volume, which includes, as last year, the "Farmers' Guide to Agricultural Research". The latter consists of a review of research work in various branches of agriculture, each section being contributed by a recognized authority on the subject. The journal also contains a number of special articles on important questions such as housing the agricultural worker, labour, power and equipment in arable farming, the improvement of hill grazings and the technique of modern field experiments. On the animal side are articles dealing with the control of sheep ticks and systems of housing for pigs. The series on notable farm enterprises is continued, the Cambridge University Farm and Mr. Clyde Higgs's dairy farms being described in this number. The economics of farming are represented in an article on changes in beef imports before and after the Ottawa Agreement. The price of the journal is 15s.

British Scientific and Technical Books

A SELECT list of standard British scientific and technical books has been issued by the Association of Special Libraries and Information Bureaux. The list has been compiled at the request of the British Council and is planned as a guide in selecting books for a library. It is limited to about 300 works and is not a complete bibliography of the subjects covered, books out of print being omitted. Agriculture and medicine have been deliberately omitted, and the main purpose of the list is to assist in the choice of a collection of British scientific and technical books. Under each main section the books, so far as possible, are placed in a logical sequence of subjects, and it is intended that the ASLIB book list should provide a convenient means of keeping the select list up to date. The list contains a foreword by Sir William Bragg and an introduction by Sir Richard Gregory. The price of the list is 2s. to subscribers of the ASLIB book list and 2s. 6d. to non-subscribers.

Preliminary General Catalogue of Comets

VOL. 1, No. 4 of *Publications of the Kwasan Observatory* contains a catalogue of comets from the year 487 B.C. to the year A.D. 1936. The number of comets listed is 467, and in each case the best available orbit with its reference source is given. The present catalogue is the revision of a catalogue published in 1931 by Prof. Issai Yamamoto in the *Astronomical Yearbook of the Oriental Astronomical Association*, printed in Japanese. This revised edition of the catalogue by his son, Prof. A. S. Yamamoto, who contributes a preface in English, will be very useful to all students of cometary orbits. A more comprehensive general catalogue is in course of preparation by these authors.

Memorial to Sir Walter Morley Fletcher

AN account of the memorial to the late Sir Walter Morley Fletcher, secretary of the Medical Research Committee and Council in 1914-33, printed for the trustees of the memorial fund by the University Press, Oxford, has been issued to subscribers to the fund. It is illustrated with two plates, one of Miss Dora Clarke's posthumous portrait bust of Sir Walter Fletcher, photographed from the clay model, the other of a corner of the library of the National Institute for Medical Research with the finished bronze in position. After meeting the cost of this personal memorial, the balance of the fund is to be applied for a Walter Fletcher Memorial Laboratory at the Farm Laboratories of the National Institute at Mill Hill. The printed account contains appreciations of Sir Walter Fletcher by Prof. G. M. Trevelyan and Sir Gowland Hopkins.

Rehabilitation of Persons Injured by Accidents

THE Inter-Departmental Committee on the Rehabilitation of Persons injured by Accidents, set up jointly by the Home Office, Ministry of Health and Scottish Office, has issued an interim report (H.M. Stationery Office. 4d. net). This report deals particularly with the organization of "fracture clinics".

The object aimed at is the covering of the country with a network of services, for the most part attached to existing hospitals, and based upon a report issued by the British Medical Association in 1935. The need for such a service will be appreciated when it is stated that more than 201,000 new cases of fractures were treated at voluntary and municipal hospitals in Great Britain during 1935.

Science and the Life of the Community

At the meeting of the General Assembly of the International Council of Scientific Unions last May, a resolution from the Royal Amsterdam Academy of Sciences was adopted (with some modifications) for the appointment of a committee to examine various questions concerned with the practical application of scientific results in the life of the community. That committee has now been constituted as follows: Prof. J. N. Bronsted (Copenhagen), Prof. J. M. Burgers (Delft), Prof. S. Chapman (London), M. Establier (Paris), Prof. B. Nemeš (Prague), M. François Perrin (Paris) and Prof. F. J. M. Stratton (Cambridge).

Return of a Large Sunspot

THE leader sunspot of the extensive group, visible from July 22 until August 4, has returned to view, the following component having in the meantime disappeared. The area of this leader spot was about 1000 millionths of the sun's hemisphere on August 20, and on the following day, although the spot was not very far on the disk, it could be seen with the naked eye. The date of central meridian passage is August 25.3, and the sun's west limb will be reached on August 31. Since the spot is situated in fairly high latitude (33° north), its drift backwards in longitude is very marked as compared with the angular rotation of the standard meridian (Carrington's) used in computing sunspot positions and which is given by the mean of sunspots in solar latitude 15°–16° north and south.

The Night Sky in September

ON September 23 at 11^h U.T., the sun enters the sign Libra (the autumnal equinox). In the latitude of London, the night is then more than 4½ hours longer than at the time of the summer solstice. The moon is new on September 4 at 22.9^h and full (the Harvest Moon) on September 20 at 11.5^h. Conjunctions with the planets take place as follows: with Venus on Sept. 2 at 3^h; with Mercury on Sept. 6 at 5^h; with Mars on Sept. 12 at 18^h; with Jupiter on Sept. 15 at 6^h and with Saturn on Sept. 21 at 1^h. An occultation of the star ξ Sagittarii (magnitude 3.6) occurs on September 14, the disappearance being visible from Greenwich at 18^h 37.5^m. On September 24, Venus approaches the bright star Regulus. A close appulse of Mars to the 9th magnitude star C.D. 11856 will be visible from South Africa on September 7 at about 17.6^h U.T. During the month, Finlay's comet in the constellation Virgo continues to move southwards. The following ephemeris is given by Dr. A. D. Maxwell's orbit of the comet:

	R.A.	Dec.
Aug. 31	14 ^h 6.5 ^m	+ 6° 3'
Sept. 4	8.6	+ 1 48
8	10.2	— 1 37
12	11.3	— 4 24
16	12.3	— 6 45
20	13.2	— 8 45
24	14.0	— 10 30
28	14.8	— 12 3
Oct. 2	15.7	— 13 27

There is a faint comet, discovered by Hubble on August 4, in the south-east region of Aquarius. Positions for Encke's comet (passing from Aries to Triangulum) and for comet Grigg-Skjellerup (passing from Ophiuchus to Serpens) will be found in the "B.A.A. Handbook". β Persei (Algol) is now becoming well placed in the late evening for observing the variability of its brightness. The change in light is best seen about 1.5 hours before and after the following times: Sept. 5^d 03.5^h, Sept. 8^d 00.3^h, Sept. 10^d 21.1^h, Sept. 28^d 02.0^h and Sept. 30^d 22.8^h. Meteors, the radiant of which is a little south-east of α Persei, may be looked for from September 7 until 15. The night sky during this month offers an unequalled range of various objects within reach of binoculars or small telescopes. In the middle of the month about 21^h, the cluster of the Pleiades will be seen rising in the north-east. (All times are given in U.T.: add 1 hour to convert to Summer Time.)

Announcements

THE bicentenary of the birth of Luigi Galvani will be celebrated on October 18–20 by the town and University of Bologna and the Italian Society of Physics.

DR. MAX WESTENHÖFER, professor of general pathology and pathological anatomy in the University of Berlin, has been elected an honorary member of the Medical Association of Kinesiology at Buenos Aires.

DR. WERNER KUHN, extraordinary professor of physical chemistry at Karlsruhe, has been appointed full professor at Kiel in succession to Prof. Schwarz, who has been transferred to the chair of chemistry at Königsberg.

IN the famous Bialowieza National Park in Poland, a census of the game animals was carried out during the winter 1936–37, and the following count was made: stags 35, deer 78, wild boar 50, wolf 4 (temporary immigrants), lynx 7, fox 8, badger 10, otter 4, marten 5, polecat 19, hare about 30, woodgrouse 30 (*Kwartalny Biuletyn Informacyjny*, 29; 1937).

AN informal meeting to discuss how far scientific workers can help towards the planning of the land of Great Britain, which is one of the important topics of discussion this year at the meeting of the British Association, will be held at Nottingham by the Research Co-ordination Committee (LePlay House, 35 Gordon Square, W.C.1) at the suggestion of the Association of Scientific Workers.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 366.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Biological Effects of the Rays produced by a Cyclotron

BIOLOGICAL effects of neutron-rays from a cyclotron have been reported, on the change of blood pictures in living rats by Lawrence and Lawrence¹, on the retardation of the germination of wheat seedlings by Zirkle and Aebersold², and on the fatal dose of the sarcoma 180 by Lawrence, Aebersold and Lawrence³. They compared the effects of fast neutrons with those of hard X-rays, and found that neutrons are, in fact, biologically, much more effective than in the case of X-rays.

Apart from these questions of the action of neutrons, we have been engaged in making experiments on histological changes in the organs of a mouse, irradiated with rays produced by bombarding a beryllium target with 2.8 MeV. deuterons from the cyclotron in this Institute.

Healthy male mice weighing 13-17 gm. were chosen for use because of their small size, which made irradiation possible in the limited space available in the cyclotron. A glass cylinder, 2 mm. in wall thickness, 46 mm. in diameter, and 106 mm. in length, was divided into two parts by a glass plate inserted along the axis, one animal being put in each of the partitions. The cylinder was placed in the observation chamber of the cyclotron, and the two mice were irradiated simultaneously under the same conditions. The animals were kept at an equal mean distance of about 8 cm. from the beryllium target. The irradiation was continued for four hours with mean deuteron current of 0.4 microampere.

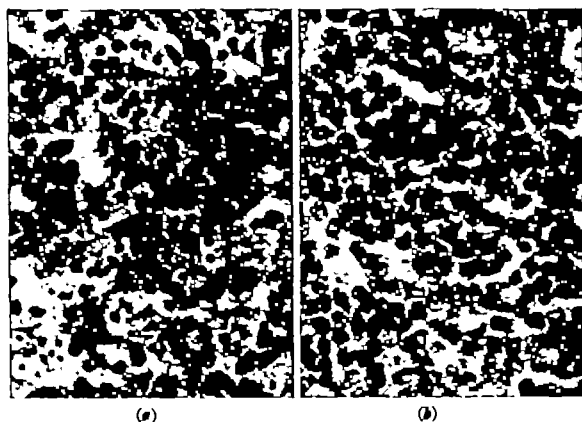


FIG. 1.

(a) IRRADIATED SPLEEN; (b) NON-IRRADIATED SPLEEN.

As was shown in the laboratory of one of us, histological change of the spleen in the rat, irradiated with X-rays, can be observed best about ten hours after the beginning of irradiation⁴.

Therefore ten hours after the beginning of irradiation the animal was dissected; the spleen and testes

were taken out, the former being fixed in Helly solution and stained with hamatoxylin and eosin, while the latter was fixed in Champy solution and stained with Heidenhain's iron-hamatoxylin as usual.

Fig. 1a shows a follicle of the spleen in the irradiated animal, and Fig. 1b the same part of the non-

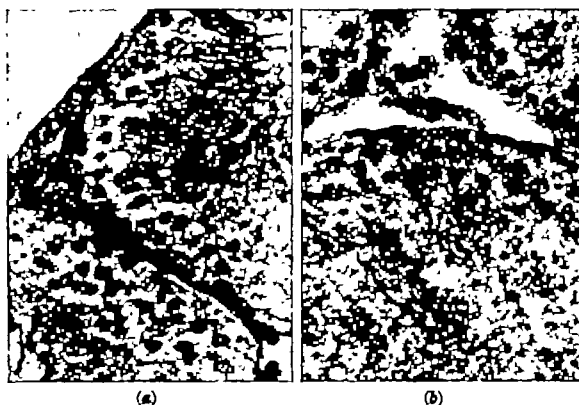


FIG. 2.

(a) IRRADIATED TESTIS; (b) NON-IRRADIATED TESTIS.

irradiated one; in the former, one can observe the remarkable decrease in the number of lymphocytes. Moreover, a large number of strongly stained dots in the same picture shows the destroyed particles.

In testicles, cells in the various stages of the spermatogenesis are more or less affected and destroyed, but interstitial cells, Sertoli's cells and spermatozoa are relatively intact. Further, one can observe in Fig. 2a that there is a diminution in radiosensitivity in passing through the various stages from spermatogonia to spermatozoa.

In conclusion, our thanks are due to Prof. S. Nishikawa and Dr. Y. Nishina for their interest in this work, to Mr. T. Yasaki and Mr. S. Watanabe for their assistance in the physical work, and to Dr. W. Nakahara for his hospitality in keeping our mice. We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipments used for the cyclotron, and Mitsui Ho-onkwa Foundation and Tokyo Electric Light Company for financial support.

Nuclear Research Laboratory,
Institute of Physical and
Chemical Research,
Tokyo. July 13.

M. NAKAIZUMI.
K. MURATI.
Y. YAMAMURA.

¹ Lawrence, J. H., and Lawrence, H. O., *Proc. Nat. Acad. Sci.*, **23**, 124 (1936).

² Zirkle, R. H., and Aebersold, P. O., *Proc. Nat. Acad. Sci.*, **23**, 124 (1936).

³ Lawrence, J. H., Aebersold, P. O., and Lawrence, H. O., *Proc. Nat. Acad. Sci.*, **23**, 534 (1936).

⁴ Motida, N., Sano, T., and Koonuma, N., *Nippon Rōnigō Gakkaishi* (Japanese J. Radiobiology), **14**, 201 (1936); Motida, N., Koonuma, N., and Sano, T., *Nippon Rōnigō Gakkaishi*, **14**, 471 (1937).

The Magnetic Field acting upon Neutrons inside Magnetized Iron

F. Bloch¹ has recently discussed the nature of the magnetic forces between electron and neutron and suggested a quantitative investigation of the magnetic scattering of slow neutrons. We have tried an alternative way of getting some information on these forces by studying the precession of slow neutrons inside magnetized iron, in order to decide whether the magnetic field H or the magnetic induction $B = (1 + 4\pi\kappa) \cdot H$ (κ being the susceptibility) determines the angle of precession².

In two previous letters³, evidence has been given of the precession of polarized slow neutrons passing through a magnetic field which is perpendicular to the direction of polarization. In consequence of the inhomogeneity of the thermal neutrons (C-neutrons) this precession leads to depolarization, the slower neutrons precessing more because they stay longer in the field. Polarized C-neutrons originating from paraffin cooled down to 90° K. should be practically depolarized after passing through 7 mm. of a field of 35 gauss. On the other hand, a field of 2.8 gauss along the same path will give an average precession angle of about 15° only and very little depolarization of the neutrons.

In our experiment, C-neutrons at 90° K. were allowed to pass through an iron polarizer and an antiparallel iron analyser, both magnetized to 14,000 gauss. The stray field outside those two iron bars was less than one gauss. A long coil was interposed between polarizer and analyser, its axis, the fields in the iron bars and the neutron beam being mutually perpendicular. The path of the beam within the coil was 7 mm. Currents producing 2.8 or 35 gauss inside the coil were switched on alternately. Taking more than 600,000 counts with a boron chamber (50 per cent of which were due to C-neutrons) we obtained (0.83 ± 0.26) per cent more counts with 35 gauss in the coil than with 2.8 gauss. This is the order of magnitude to be expected for the polarization effect according to our previous experiments.

An iron sheet of 0.15 mm. thickness was then placed inside the coil and the magnetic circuit was closed by connecting the ends of the sheet by means of an iron yoke. Another 600,000 counts were taken using the same currents as before. The difference between the number of counts with the high and the low field was only (-0.05 ± 0.24) per cent this time. It is seen that the polarization effect had disappeared.

We conclude from this experiment that the lower field is sufficient to depolarize the neutron beam entirely when the iron sheet is interposed. Since the path of the neutrons within the iron sheet (where depolarization must have occurred) was only 0.15 mm., the precession of the neutrons inside the iron has to be accounted for by an 'effective field' of ~ 600 gauss or more. The field strength H in the iron was 2.8 gauss only, the induction B was ~ 15,000 gauss; hence B , or at least $0.03 B$, must have acted upon the neutrons inside the iron.

Institute of
Theoretical Physics,
Copenhagen.
August 5.

O. R. FRISCH.
H. VON HALBAN, JUN.
JÖRGEN KOCH.

The Initial Stages of Glycolysis in Muscle Extracts

We have already made a preliminary report¹ on the preparation from rabbit muscle, by a method involving repeated extraction with phosphate solution, of solutions of the glycolytic enzyme system, which appear to be more free from associated co-enzymes than are extracts prepared by other methods. The extracts convert starch to lactic acid in the presence of muscle *Kochsäft*, but do not do so in the presence of adenosine triphosphate, magnesium ions, cozymase and a trace of hexose diphosphate; an account of their properties, with the evidence of a participation of a new co-enzyme, will shortly be given in detail elsewhere.

In view of the current interest in the earliest stages of the transformation of polysaccharide in muscle extracts², we should like to direct attention to the behaviour of the extracts referred to above, in the presence of the co-enzymes, namely, adenosine triphosphate and magnesium ions, which have been regarded by most workers as effecting the initial phosphorylation in the chain of reactions. The points of interest are as follows:

(1) When magnesium ions alone have been added as co-enzyme, no esterification of phosphoric acid has ever been observed.

(2) When in addition to magnesium ions adenosine triphosphate is also present, rapid esterification takes place, and the ester formed consists at first wholly of an easily hydrolysable ester with the properties of the hexose-1-monophosphoric acid recently described by Cori and Cori³. In the later stages of the incubation the total amount of esterification increases more slowly and the easily hydrolysable ester is gradually converted into hexose-6-monophosphate. No other ester appears to be formed under these conditions.

(3) The rate of formation of the easily hydrolysable ester is roughly the same over a range of adenosine triphosphate concentrations from M/1,000 to M/10,000, is slightly less with M/50,000 and reduced to about one quarter with M/200,000 adenosine triphosphate. The amount of adenosine triphosphate required is therefore much less than that necessary for glycolysis as a whole to take place with optimal speed, and the amount of ester formed is far in excess of that which could be formed by simple transference of phosphate from the added adenosine triphosphate to the starch. If the mechanism were of this kind, continuous rephosphorylation of adenosine diphosphate or adenylic acid would have to take place, and no means of bringing this about seems to be present. No lactic or pyruvic acid is formed, so that the possibility of rephosphorylation from phosphopyruvic acid is ruled out. Adenylic acid itself brings about no esterification.

(4) The conversion of the hexose-1-monophosphate into hexose-6-monophosphate is much accelerated by the addition of a trace of hexose diphosphate.

The results described above are not in agreement with those reported from Parnas's laboratory⁴, where esterification in the absence of any added co-enzyme was observed, or with those of Lehmann and Needham⁵, who were able to confirm the findings of the above-mentioned school. The possibility that starch behaves differently from glycogen in this respect is being investigated. But since an easily measurable esterification is produced even by

¹ Bloch, F., *Phys. Rev.*, **51**, 904 (1937).

² The equivalent problem of the deflection of electrons inside magnetized iron has been discussed by O. F. v. Weizsäcker, *Zem. f. Phys.*, **17**, 806 (1933).

³ *NATURE*, **130**, 756 and 1021 (1937).

M/200,000 adenosine triphosphate, one hesitates, in view of the well-known difficulty of eliminating co-enzyme completely from the enzyme system, to accept the evidence for esterification without co-enzymic intervention which has so far been provided.

L. P. KENDAL.
L. H. STICKLAND.

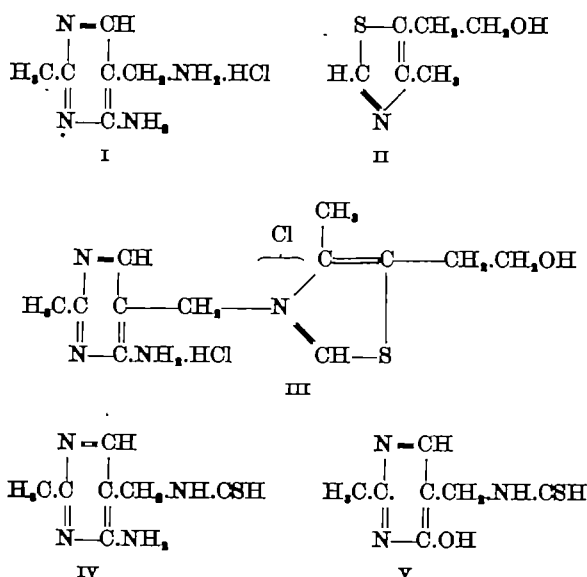
Department of Experimental Pathology
and Cancer Research,
School of Medicine,
Leeds.
July 28.

- ¹ Kendal and Stickland, *J. Soc. Chem. Ind.*, **55**, 1030 (1936).
² Needham, *Ann. Rev. Biochem.*, **6**, 401 (1937).
³ Cori and Cori, *Proc. Soc. Exp. Biol. and Med.*, **34**, 702 (1936).
⁴ Ostern, Guthke and Tarnakowec, *Z. physiol. Chem.*, **243**, 9 (1936).
⁵ Lohmann and Needham, *Biochem. J.*, **31**, 329 (1937).

Growth Factors for *Phycomyces*

DURING the last three years, Schopfer has published several papers¹ showing that vitamin B₁ is a growth factor for *Phycomyces*. This mould can now be grown on a synthetic medium composed of glucose, asparagine, inorganic salts and the vitamin. During the last two years, he has described² an alternative growth factor ('MP') which differs from the vitamin in being resistant to heat (128° C. for 20 hours causes only 75 per cent loss of activity) and resistant to alkali; it is oxidized by hydrogen peroxide.

Knight^{3,4} has shown that his growth factor for *Staphylococcus* consists of three parts, two being the pyrimidine (I) and thiazole (II) components of vitamin B₁ (III), and the third being nicotinic acid or its amide. Very recently Schopfer and Jung⁵ have stated that vitamin B₁ can be replaced as a growth factor for *Phycomyces* by the pyrimidine and thiazole components.



Through the kindness of Dr. Todd, I had also been able to test four synthetic compounds (I, II, IV and V) as growth factors for *Phycomyces*. On a medium composed of glucose, asparagine and inorganic salts, no growth is obtained when these four compounds are added singly. But I and II together give a very large growth (cf. Schopfer and Jung), IV and II a

fair growth, while V and II give no growth. Further, a neutral solution of vitamin B₁, autoclaved for two hours at 125° C., still acts as growth factor for *Phycomyces*, although the compound is destroyed. The activity of compounds I and IV is not destroyed by this treatment, even in presence of N/10 NaOH; hydrogen peroxide, however, destroys the activity. This supports Schopfer's suggestion that his factor 'MP' consists of degradation products of vitamin B₁. There is no doubt that vitamin B₁ itself, as well as its constituents, is a growth factor, since a solution sterilized by filtration through glass instead of by autoclaving remains active. Vitamin B₁ diphosphate ('co-carboxylase' of Lohmann), which was kindly supplied by Prof. Lohmann, is about as active as the vitamin itself.

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June 29.

- ¹ Schopfer, *C. R. Acad. Sci.*, **200**, 1965 (1935).
² Schopfer, *Z. Vitaminforsch.*, **4**, 187 (1937).
³ Knight, *Nature*, **136**, 623 (1937).
⁴ Knight, *Chem. and Ind.*, **56**, 445 (1937).
⁵ Schopfer and Jung, *C. R. Acad. Sci.*, **204**, 1500 (1937).

Constituents of Vitamin E Concentrates from Rice- and Wheat-Germ Oils

THE pioneer work of Evans and his collaborators on the anti-sterility factor (vitamin E) has culminated in the isolation from the unsaponifiable fraction of wheat-germ¹ and cotton-seed² oils of three apparently isomeric oily alcohols α -, β - and γ -tocopherol of approximate formula C₅₅H₁₀₂O, all of which show high vitamin E activity. The use of the unsaponifiable fraction of rice-germ oil as a source of vitamin E was advocated by Kimm³, who later⁴ prepared from a purified concentrate a β -naphthoate, m.p. 156°, which yielded on hydrolysis a product alleged to have very high vitamin E activity.

By acylation of purified concentrates from the unsaponifiable portion of rice-germ oil with *p*-nitrobenzoyl chloride or β -naphthoyl chloride we obtained a complex mixture of oily and crystalline esters. The crystalline esters on separation and hydrolysis yielded three apparently homogeneous crystalline isomeric alcohols of formula C₅₅H₁₀₂O, (a) m.p. 121°–122°, (b) m.p. 113°–114° and (c) m.p. 119°–120°. The alcohol (c) yields a β -naphthoate corresponding in its properties to that of Kimm's active material; but like (a) and (b) it is devoid of vitamin E activity. Of these alcohols, (a) may be polyterpenoid in nature but (b) and (c) are certainly akin to the sterols, being similar in their properties to the tritosterols obtained by Karrer and Salomon⁵ from wheat-germ oil concentrates. In a parallel investigation of wheat-germ oil we isolated in similar fashion β -amyrin and two isomeric alcohols C₅₅H₁₀₂O of the tritosterol type, (d) m.p. 113°–114° and (e) m.p. 175°; of these (d) was also obtained by Karrer and Salomon. Neither (d) nor (e) possessed vitamin E activity.

The purified oils remaining after removal of these crystalline alcohols from both rice and wheat concentrates had a high biological activity, and gave, on thermal decomposition, considerable quantities of durohydroquinone C₁₄H₁₄O₂, which Fernholz⁶ obtained by similar treatment of pure α -tocopherol. On treating the oil from the wheat concentrate with cyanic acid in benzene, a mixture of allophanates

was obtained from which the products described by Evans, Emerson and Emerson¹ could be isolated, in addition to a crystalline allophanate, m.p. 70°, which has not yet been examined biologically.

The above purified oil from the rice concentrate deposited on standing a crystalline substance, m.p. 73°, which appears to be an aliphatic mono-unsaturated alcohol containing approximately 20 carbon atoms. After removal of this alcohol, the oil on saturation with cyanic acid in benzene solution gave a complex mixture of substances from which a small amount of an allophanate, m.p. 135°–138°, having the properties of β -tocopheryl allophanate², could be isolated together with a larger quantity of an allophanate, m.p. 195°–200°; the parent alcohol of the latter substance is being tested biologically.

In view of the formula of the tocopherols and the probability that they may represent mono-alkyl ethers of durohydroquimone³, the occurrence in active rice-germ oil concentrates of the alcohol m.p. 73° may be of some significance. The work on the structure of these various compounds, of which fuller details will be published elsewhere, is being continued.

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July 29.

A. R. TODD.
F. BERGEL.
H. WALDMANN.
T. S. WORK.

¹ Evans, Emerson and Emerson, *J. Biol. Chem.*, **113**, 319 (1936).

² Emerson, Emerson and Evans, *Science*, **53**, 431 (1936).

³ Kimm, *J. Agric. Chem. Soc. Jap.*, **11**, 514 (1935).

⁴ Kimm, *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, **26**, 74 (1935).

⁵ Karrer and Salomon, *Helv. chim. Acta.*, **20**, 424 (1937).

⁶ Fernholz, *J. Amer. Chem. Soc.*, **59**, 1154 (1937).

Para-Cresol from the Urine of Pregnant Mares

Burrows, Cook *et al.*¹ have recently isolated *p*-cresol, along with certain ketones of the sterol group, from the urine of a man with a malignant tumour of the adrenal cortex. The urine (30 l.) was submitted to an initial hydrolysis by boiling with hydrochloric acid, and 0.75 gm. of *p*-cresol was isolated from the non-ketonic phenol fraction.

It should be recorded that in this Laboratory a similar observation has been made in regard to the urine of pregnant mares. Approximately 110 gm. of pure *p*-cresol, containing no detectable trace of *o*- or *m*-isomeride, was obtained from 400 gallons of mares' urine, which had been submitted to hydrolysis—a considerably higher proportion than that reported by Burrows, Cook *et al.* for a pathological specimen of human male urine. The significance of this finding is not yet apparent.

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Burrows, Cook, Roe and Warren, *Biochem. J.*, **31**, 950 (1937).

Artificial Release of Crossing-over in Meiosis and Mitosis

THE experiments with artificial production of crossing-over described below belong to a new series which were finished in the spring of this year; they enable us to carry our analysis much further and bring out a series of facts which are entirely new. The following are the main conclusions drawn from this work:

1. (a) X-ray treatment of *Drosophila melanogaster* males induces not only spermatogonial, but also meiotic crossing-over.

(b) Histological examination of irradiated testes revealed that the early spermatocytes of the first order possess the greatest susceptibility to treatment, whereas the spermatogonia, though also affected, react to a much less extent.

2. (a) The mitotic origin of spermatogonial crossing-over induced by X-rays in *Drosophila melanogaster* has been definitely established.

(b) The presence of inversions lowers somewhat the frequency of spermatogonial crossing-over throughout the non-inverted region of chromosome III. This proves that there is a similarity between regular meiotic and induced mitotic crossing-over.

(c) The frequency of spermatogonial crossing-over is extremely high in the central region (which carries the spindle fibre) of chromosome III. In the remaining regions of the chromosomes there is a closer correspondence with the cytological map than in the case of the normal meiotic crossing-over in females.

(d) The frequency of induced crossing-over is higher for later than for earlier spermatogonial stages.

(e) The frequency of spermatogonial crossing-over is not proportional to the X-ray dose (a comparison at 1,000 r. and 4,000 r. shows a frequency greater than fourfold in the latter case).

3. (a) No oögonial crossing-over was released in female larvae of *Drosophila melanogaster* with a treatment of 2,000 r.

(b) The *Oy* females used in this experiment

$\frac{b}{cn}$

showed nevertheless a statistically significant increase in crossing-over between 'b' and 'cn'. Since only the gonial stages were irradiated, this result must be taken to mean that there exists an after-effect of the treatment on crossing-over.

4. (a) Contrary to the current point of view, which excludes the possibility of crossing-over in the late oocyte of *Drosophila melanogaster*, we were successful in inducing interchange at that stage; this type of interchange we designate as late meiotic crossing-over.

(b) This fact raises certain difficulties for Darlington's and Belling's points of view on the mechanism of crossing-over, whereas it favours the interpretation offered by Sax.

From the above summarized results we may draw the following general conclusions:

(1) Crossing-over is a feature to some extent inherent in both meiosis and mitosis.

(2) The absence of regular crossing-over in the gonial stages of gametogenesis in *Drosophila melanogaster* can be explained by the disadvantages somatic crossing-over would offer; the suppression of crossing-over in the soma means its suppression in mitosis and also in the gonial cells.

(3) The hypothesis of Haldane and Huxley, which is based on the disadvantages that crossing-over would offer in the heterogametic sex, does not sufficiently substantiate the nearly complete absence of normal crossing-over in meiosis of *Drosophila melanogaster* males.

A detailed account of the work will appear in Russian (with an extensive German summary) in the *Biologicheskij Zhurnal*.

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July 13.

Cobalt, and Sheep Diseases

IN New Zealand, Askew and his co-workers have shown that cobalt plays a vital part in the healthy life of sheep and that small supplements of cobalt salts will cure sheep suffering from a type of anaemia. Sheep on Dartmoor are liable to a disease very similar in symptoms to those described by the New Zealand workers, and the usual practice of farmers is to send their flocks to lowland pastures in the autumn for two or three months.

Analyses of the cobalt content of the soils from moorland pastures on which sheep suffer and from lowland pastures on which sheep have been known to recover give striking differences which are statistically significant:

Moorland soils on which sheep suffer have a mean cobalt contents of 3.9 parts per million; lowland soils on which sheep recover, 16.7 parts per million.

The figure for the sickness soils is higher than that given by Kidson¹ for corresponding soils in New Zealand, where it was found that sickness was associated with soils having a cobalt content of two parts per million. In the Dartmoor district this figure would be about four parts per million, although occasionally samples have a slightly higher content.

Analyses of pastures show that those in the sickness areas have a mean content of 0.20 part per million cobalt and those in the recovery areas 0.45 part per million.

An examination of soil and pasture composition is in progress, and the relationship of these to the incidence of disease is being studied.

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¹ Kidson, *N.Z.J. Sci. and Tech.*, 18, 604 (1937).

Effect of Occluded Hydrogen on the Rigidity of Metals

AN investigation of the above effect was prompted by an inquiry into the nature of the earth's interior. The existence of a very definite core of radius half that of the earth seems established beyond reasonable doubt by seismology. The nature of this core is puzzling. Tidal phenomena and the Eulerian nutation demand that this core be less rigid than the crust. The noticeable absence of the shear wave on earthquake records of quakes sufficiently distant for the waves to pass through the core (and this, despite the presence of very pronounced compressional waves of the same quake on the record), was taken to mean that the core could not transmit a shear wave. A liquid core was therefore quite generally held to fit in with all known phenomena. However, during the past few years several seismic investigators, after exhaustive study of records, feel reasonably sure that the shear wave does pass through the core, but with greatly diminished energy. This would seem to imply either that a fluid under high pressure can transmit a shear wave, or that the core of the earth is a solid of very low rigidity. The idea suggested itself that a solid solution might satisfy this picture of a solid of low rigidity.

To test this, a solid solution of hydrogen in palladium was experimented with. The first question proposed was, "Does the occluded hydrogen affect the rigidity of the palladium?" The purpose of this communication is to state that apparently it does. The rigidity was measured by means of a torsion

pendulum. A small magnetized needle was suspended by a palladium wire half a millimeter in diameter. The needle was placed in an oscillating magnetic field of variable frequency. The period of the pendulum was obtained by measuring the frequency of the oscillator at resonance, which was found to be quite sharp. In the formula $\mu = 8\pi l/r^2 T^2$, l , r and T were determined before and after occlusion, which was produced by electrolysis. The results were quite erratic, some of the causes of which will be gone into later. However, there was a noticeable change produced in the rigidity of the metal, namely a decrease of rigidity with increasing occlusion. Some twenty different wires were tried and the change in rigidity measured when the wire was saturated with hydrogen. At first fairly long lengths of wire were used, but eventually it was found convenient to use short suspensions about 2.5 cm. long.

The average decrease in rigidity on saturation was found to be 13.7 per cent. The experiments were carried out *in vacuo*, in hydrogen and in air, but beyond a slight change in amplitude of the pendulum, no measurable change in period was noticed in the three cases. The best absolute value of the coefficient of rigidity of palladium into which no excess hydrogen has been forced was found to be $4.257 \pm 0.030 \times 10^{11}$. All palladium normally contains a certain amount of hydrogen apparently, and if this be driven off by passing a current through the wire, the above figure for the rigidity will be at least 12 per cent higher.

Starting with a piece of uncharged wire, a current of 10 amp. was passed through for a few seconds, heating the wire to redness. The rigidity increased 1.7 per cent. The current was again passed through for about a minute and the rigidity increased a further 8.4 per cent. The wire was then charged with about 400 times its volume of hydrogen. The rigidity decreased 16.6 per cent. Current was again passed through to drive out the hydrogen, this time for several minutes. The rigidity increased 22.8 per cent. The wire was again charged with about 450 times its volume of hydrogen and the rigidity decreased 21.0 per cent. It seems fairly certain, therefore, that the occluded hydrogen causes a decrease in the rigidity of the metal. The investigation is being continued further at Fordham and New York Universities jointly.

Note added in proof: The work of K. R. Koch in this field has not been overlooked, but will be discussed later.

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June 28.

Kinetics of Catalysed Polymerization of Styrene

INVESTIGATIONS of polymerization kinetics have often required rather cumbersome experimental methods, but Hammick and Langrish¹ have recently applied a convenient bromination method for estimating cyclopentadiene and indene to a study of the polymerization rates of these compounds in carbon tetrachloride. We have been using, for some time, a very similar method to follow the kinetics of the polymerization of styrene, catalysed by anhydrous stannic chloride, in carbon tetrachloride and chloroform solutions at 25° C. The amount of residual monomeric styrene in the reaction mixture is determined, at known intervals of time, by quantitative bromine addition to the double bond, using an excess of bromine which is estimated by titration in the usual way. The accuracy of the analysis (better

than 0.5 per cent) is not impaired by the presence of polystyrene; but with polystyrene in the presence of stannic chloride, the excess bromine must be destroyed without delay, in order to avoid a slow attack of bromine on the polymer. The styrene disappearing during polymerization has been proved to be equivalent to the polymer formed by weighing the amount of polystyrene precipitated in methyl alcohol¹. The polymers produced have molecular weights of the order 5,000 as determined by viscosity measurements.

With specially purified materials, the half-conversion period for polymerization may be of the order of one hour; but complex inhibition phenomena can appear if traces of impurity are present. In one series of experiments, with styrene concentrations up to 1.73 *M.*/litre in carbon tetrachloride, and with commercial 'c.p.' stannic chloride at concentrations 0.01–0.2 *M.*, polymerization was preceded by a period of total inhibition (varying from 0.6 to 4.2 hours with decreasing concentration of catalyst), after which polymerization would proceed to completion with a half-conversion period of one to eight hours. Experiments during the polymerization period have shown (a) that moisture produces a retardation inflection in the polymerization curve, (b) that dry hydrogen chloride is a temporary complete inhibitor, the polymerization resuming its course after an interval which may amount to an hour or more. In separate experiments, we have found that hydrogen chloride adds to the double bond of styrene at a measurable rate with a stannic chloride catalyst, and that addition proceeds considerably more rapidly in chloroform than in carbon tetrachloride. This behaviour corresponds with the observation that, in pure chloroform, polymerization was preceded by an inhibition period of 0.15 hr. with reactant concentrations which gave inhibition for 1.3 hr. in carbon tetrachloride. (In unpurified, commercial, 'practical' chloroform there was no initial inhibition.)

It seems probable that inhibition of polymerization by hydrogen chloride, introduced by intent or present as an impurity in commercial stannic chloride, is due to saturation by hydrogen chloride of the double bonds of those styrene molecules which have been activated by the catalyst, polymerization being prevented until the inhibitor has been removed by the addition reaction. If this explanation is correct, it follows, as the simplest interpretation (since hydrogen chloride is a complete polymerization inhibitor within the analytical error), that styrene and stannic chloride probably form a complex, capable of surviving several molecular collisions, which is responsible both for hydrogen chloride addition to styrene and for the chain-initiation step in the polymerization of styrene. Skraup and Freundlich² have provided evidence for the formation of complexes between stannic chloride and certain aromatic hydrocarbons having unsaturated side-chains; and this view of the polymerization catalysis is in accord with recent observations by Gee and Rideal³.

Detailed experiments are in progress.

GWYN WILLIAMS.

Research Laboratories,
Eastman Kodak Company,
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July 19.

¹ Hammick, D. Li, and Langrah, D., *J. Chem. Soc.*, 797 (1937).

² Schulz, G. V., and Husemann, H., *Z. phys. Chem.*, B, 34, 187 (1930).

³ Skraup, S., and Freundlich, L., *Annalen*, 431, 248 (1923).

⁴ Gee, G., and Rideal, E. K., *J. Chem. Soc.*, 772 (1937).

Polarimetric Studies of Oxide Film Formation on Metals

THE polarimetric method¹ has now been applied to the study of the early growth of oxide films on copper and has given results in general agreement with those obtained by other workers using different methods². Typical curves showing the changes in Δ (the relative phase retardation of the perpendicular and parallel components of the incident plane vibration) during heating and cooling of copper mirrors in dry pure hydrogen and after replacement of the hydrogen by pure dry air, are given in Fig. 1.

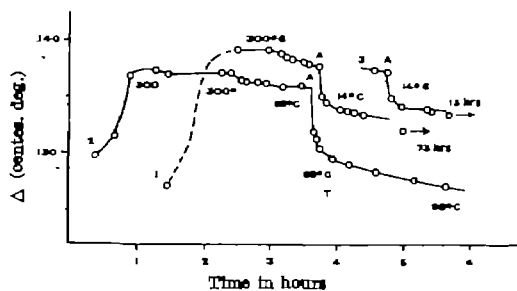


Fig. 1.

A, ADMISSION OF AIR; T, TEMPERATURE RISE DUE TO INADEQUATE CONTROL

Calculations of the film thicknesses corresponding to the optical changes have also been made by means of approximate equations developed in the manner of Drude³, except that in the case of copper it was not found permissible to neglect some of the terms normally dropped. The thickness curves, together with those of Evans and Miley⁴ (dotted) are given in Fig. 2.

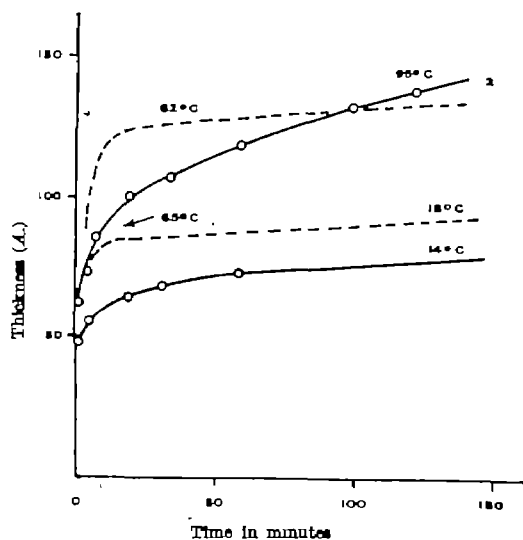


Fig. 2.

These latter would not be expected to be strictly comparable as they refer to oxidation of distorted surfaces beginning during polishing⁴, whilst the present results are for the re-oxidation of reduced annealed surfaces. It is also reasonable to expect differing degrees of activation or sintering and partial poisoning by sorbed hydrogen to have direct influence on the course of oxidation and to give rise to second order effects by modification of the optical constants of the base.

However, from this and other work mentioned, it is clear that the magnitude of the first rapid oxidation, even allowing for a considerably greater real surface, is much larger than would be expected from a sorption-diffusion oxidation theory⁶; and it seems that a controlling mechanism must be sought leading to differential equations of a similar form but involving other physical magnitudes. Detailed results and a discussion of them will be published in due course.

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July 8.

¹ Tronstad, L., *Trans. Faraday Soc.*, **30**, 503 (1933); Winterbottom, A. B., *J. Sci. Instr.*, **14**, 203 (1937).

² Evans, U. B., and Miloy, H. A., *NATURE*, **139**, 283 (1937); Dobinsky, S., *NATURE*, **133**, 31 (1936).

³ Drude, P., *Wied. Ann.*, **36**, 884 (1889); Tronstad, *loc. cit.* (1).

⁴ Evans, U. B., and Miloy, H. A., *loc. cit.* (3).

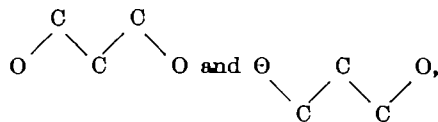
⁵ Bowden, F. P., and Riddler, K. H. W., *Proc. Roy. Soc., A*, **154**, 640 (1936).

⁶ Wilkins, F. J., *Phil. Mag.*, **11**, 422 (1931).

Hydrogen Bridges in Solid Pentaerythritol

Using the method of Fourier series, a quantitative crystal analysis of pentaerythritol, $C(CH_2OH)_4$, has now been carried out, and some of the interesting features of the determined structure will be given below.

Of the alternative space groups O_1-14 and S_4-14 chosen first by one of us¹, the latter should now be regarded as the correct one for this compound. The central carbon atom of a molecule is placed at 000 and surrounded tetrahedrally by the four methylenic carbon atoms at xyz , $x\bar{y}z$, $y\bar{x}z$ and $\bar{y}x\bar{z}$ with $x = 0.165$, $y = 0.140$ and $z = 0.10$, the interatomic distance for the C—C bond being hence 1.57 Å. The four hydroxyl oxygen atoms are also arranged in such general positions with the values of the parameters $x = 0.313$, $y = 0.265$ and $z = 0.00$. From these and above values the C—O bond distance is computed to be 1.46 Å. The oxygen atoms thus lie in the same plane $z = 0$ as the central carbon and besides not far from the base diagonals. If the hydrogen atoms of the OH groups are not taken into consideration, the molecule possesses approximately the symmetry of $D_{2d}-42m$, precisely S_4-4 , with one pair of primary alcohol radicals puckered upwards and the other downwards, namely,



all the bond angles of these atoms being approximately tetrahedral. Such a structure is found in the case of pentaerythritol tetrabromide vapour, in which, according to an electron diffraction study carried out by de Læzlo², the bromine atoms in the molecule form a square.

The most interesting aspect of the structure is the close approach of the hydroxyl groups on adjoining molecules. In the plane $z = 0$, four oxygen atoms, one out of each molecule, constitute a square of length of side 2.55 Å. This is shown by an idealized figure (Fig. 1), though strictly in the actual case the

line joining the central carbon and a hydroxyl oxygen in the molecule makes a small angle with one of the base diagonals.

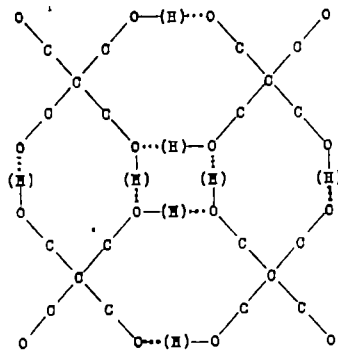


Fig. 1.

The value 2.55 Å. for the above O—O distance, which must be bridged by a hydrogen atom, is considerably less than that assigned by Bernal and Megaw³ to their 'hydroxyl bond', while it is precisely the same as those found in the cases of KH_2PO_4 ⁴ and $NaHCO_3$ ⁵, in which, however, the O—O distance is not between two OH groups but between OH and O. At any rate it is evident that the molecules in a layer parallel to the (001) plane are linked more or less firmly to each other by hydrogen bridges in closed rings, where, according to Huggins⁶, the 'synchronized oscillations' may cause an increased stability of the intermolecular linkage. Such layer-like structure explains in a natural way the perfect cleavage along (001).

A detailed account of the present work will be published shortly.

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July 6.

¹ Nitta, I., *Bull. Chem. Soc. Japan*, **1**, 63 (1928). For a further bibliography of this subject, see P. P. Ewald and C. Hermann, "Strukturbericht".

² de Læzlo, H., *C.R.*, **198**, 2335 (1934).

³ Bernal, J. D., and Megaw, H. D., *Proc. Roy. Soc., A*, **151**, 384 (1935).

⁴ West, J., *Z. Krist.*, **74**, 806 (1930).

⁵ Zachariasen, W. H., *J. Chem. Phys.*, **1**, 634 (1933).

⁶ Huggins, M. L., *NATURE*, **139**, 560 (1937).

Band Spectrum of Thallium Hydride

THALLIUM metal was heated in vacuum resistance furnace, which was filled with hydrogen at 500 mm. pressure. At a temperature of about 1,500° C., some bands in the yellow and red part of the spectrum were emitted. The same bands were also obtained in the emission from a thallium-copper arc burning in hydrogen at high pressure. At low pressure (less than 500 mm. mercury) in the arc no bands were present. With increasing pressure the bands get gradually stronger, and at a pressure of about four atmospheres the yellow and red bands are intense. Under the same conditions in the arc a fainter band system also appears in the blue and violet part of the spectrum.

The spectrum has now been photographed from 8000 Å. to 4000 Å. One of the strongest bands at

λ 5680 is shown in Fig. 1. The band is degraded to the red and consists of two branches, which are designated as *R*- and *P*-branches. Only the first two or three lines in each branch are sharp, and the lines then get gradually wider with increasing *K*-numbers. This widening of the lines, and the fact that no bands appear at low pressure in the arc, indicate that almost

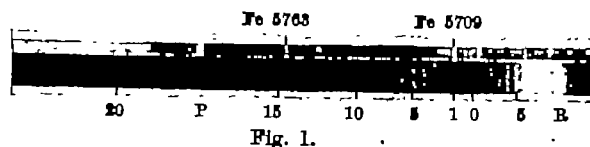


Fig. 1.

every level of the upper state is predissociated. At low *K*-numbers, $0 < K < 9$, the *P*-lines are single. For $K > 9$ the lines are split up in two components with unequal intensity. As no *Q*-lines are present, the band probably is due to a $\Sigma - \Sigma$ -transition. In the thallium hydride molecule, both $^1\Sigma - ^1\Sigma$ and $^3\Sigma - ^3\Sigma$ are possible, but since the lines are diffuse (only the first eight or nine *R*-lines are resolved) it is

at present difficult to distinguish between these two alternatives.

A similar but much fainter band lies at λ 6150 Å. The two bands have a common upper state, and consequently they are designated as $0 - 0$ ($\nu_0 = 17,519.9 \text{ cm}^{-1}$) and $0 - 1$ ($\nu_0 = 16,174.5 \text{ cm}^{-1}$). The following constants have been calculated: upper state: $B_0 = 4.64$; $D_0 = -1.18 \times 10^{-4} \text{ cm}^{-1}$; lower state: $B_0 = 4.78$, $B_1 = 4.62$, $D_0 = -0.45 \times 10^{-4} \text{ cm}^{-1}$.

In the yellow and red part of the spectrum there are also some other bands with a somewhat more complicated structure, which show a characteristic widening of the lines similar to that of the two bands mentioned above. These bands can be followed into the far infra-red part of the spectrum.

Further details concerning the band spectrum of thallium hydride will be published later.

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July 9.

Points from Foregoing Letters

PHOTOMICROGRAPHS showing the effect of irradiation with neutrons upon the spleen and testicles of mice are submitted by Prof. M. Nakaidzumi, K. Murati and Y. Yamamura. A decrease in the number of lymph cells can be observed in the spleen, while in the testicles, cells in the various stages of spermatogenesis are more or less affected and destroyed.

By studying the precession of neutrons within magnetized iron, Drs. O. R. Frisch, H. von Halban, jun., and Jürgen Koch have found that the 'effective magnetic field' which accounts for the rate of precession is a considerable fraction of the magnetic induction *B*, at any rate much larger than the magnetic field strength *H*.

Drs. L. P. Kendal and L. H. Stickland describe experiments carried out with purified extracts of the glycolytic enzyme system; these may throw light on the earliest stages of the transformation of sugar-like substances, from which the muscle derives its energy. Unlike previous investigators, they find that co-enzymes (both magnesium ions and adenosine triphosphate) are needed for esterification.

Further experiments with substances related to vitamin B₁, which stimulate the growth of the mould *Phycomyces*, show, according to H. M. Sinclair, that pyrimidine plus thiazole give a large growth, and thiazole plus the amide of nicotinic acid give a fair growth (in a medium of glucose, asparagine and inorganic salts), but they are not active separately.

A number of substances separated from the unsaponifiable fraction of rice-germ oil (which has high anti-sterility, vitamin E, activity), together with some of their derivatives, are mentioned by Dr. A. R. Todd, Dr. T. Bergel, H. Waldmann and T. S. Work. Most of these compounds are biologically inactive. An aliphatic mono-unsaturated alcohol containing approximately 20 carbon atoms is considered by the authors of some significance, as a possible simpler derivative of the tocopherols (alcohols of approximate formula C₂₀H₃₈O₂) which have been shown to possess vitamin E activity.

Results of X-ray experiments with the fruit fly, *Drosophila*, leading to crossing-over of chromosomes

(producing mutation) are described by Prof. H. Friesen. Crossing-over in males was observed in the spermatogonial process both during normal nuclear division and also during the reduction division (meiosis). The frequency of spermatogonial crossing-over is not proportional to the X-ray dose.

Analysis of soils from Dartmoor, where sheep are liable to a type of anaemia (found to be due in New Zealand to a deficiency in cobalt), shows, according to J. B. E. Patterson, that the soil contains only 3.9 parts of cobalt per million on an average, whilst the soil in the lowland pastures, where the sheep are sent to recover, contains on an average 16.7 parts per million of cobalt.

It is stated by Father J. Lynch that when hydrogen is occluded in a metal, it apparently decreases the rigidity of the metal. In the case of palladium the decrease amounts to as much as 23 per cent.

Dr. G. Williams has used a bromination method for estimating styrene to follow the kinetics of its polymerization in carbon tetrachloride and chloroform at 25° C., with anhydrous stannic chloride as catalyst. Polymerization is rapid when specially purified materials are employed, but may be preceded by a period of temporary total inhibition with commercial stannic chloride as catalyst. Hydrogen chloride can act as a polymerization inhibitor, probably by addition to the styrene double bond.

Curves showing that the changes in the relative phase retardation of polarized light, falling upon copper mirrors, during heating and cooling in hydrogen and in air, are given by A. B. Winterbottom, also the film thickness of oxide corresponding thereto. The magnitude of the first rapid oxidation is much larger than expected from a sorption-diffusion oxidation theory.

A quantitative crystal analysis of pentaerythritol by I. Nitta and T. Watanabe has revealed an interesting layer-like structure. Molecules in a layer are linked more or less firmly to each other by the so-called hydrogen bridges, for which the O—O distance is found to be 2.55 Å. The molecular shape is similar to that of pentaerythritol tetrabromide in the vapour phase.

Research Items

Ancient Man in Devon

FOR some years past Mr. Reid Moir, in collaboration with Mr. and Mrs. MacAlpine Woods, has carried out archaeological investigations in the neighbourhood of Seaton and Beer in south-east Devon. These investigations have been confined to various deposits, ranging from Lower to, possibly, Upper Palaeolithic times, situated at some height above sea-level, but until recently no opportunity had appeared for examining the low-lying beds of the river valleys. Fortunately, however, a sewage plant is being erected on the Flood Plain at the junction of the River Coly with the Axe, and from the spoil heaps from the excavations a large number of flint artefacts have been found. The exposed sections are shallow and of small extent, but the succession of deposits, from below upwards, is clearly as follows: (1) Flood Plain gravel; (2) alluvium, with stones, 2 ft.; (3) alluvium, practically stoneless, 1 ft. 6 in. The surface of the Flood Plain gravel at the site examined is approximately 15 ft. O.D. Judging from what has been discovered in other parts of Great Britain, the stony alluvium resting upon the Flood Plain gravel would contain an assemblage of artefacts dating from Magdalenian—late Palaeolithic—times to the end of the Stone Age, and it is of interest to note that among the specimens recently found by Mr. Reid Moir and Mr. and Mrs. MacAlpine Woods are a number of blades of flint, including some definite and well-made burins. It is possible that these may be of Magdalenian date, and afford further evidence of the former presence of Palaeolithic man in Devon. Other specimens in the series appear to be referable to later epochs, though nothing which can with confidence be assigned to the Neolithic period has yet come to light. The examination of the Colyford site is being continued, and it is hoped that it and the artefacts discovered may be described in the near future.

Potassium and Paralysis

FAMILIAL periodic paralysis, as its name implies, is a hereditary disability characterized by periodic attacks of paralysis usually of the limbs. Aitken, Allott, Castleden and Walker (*Clin. Sci.*, 3, 59; 1937) have recently published observations which promise to illuminate this hitherto obscure malady. A patient was observed who attributed his paralytic attacks to heavy meals. It was found that the attacks could with regularity be produced about five hours after the ingestion of 250 gm. glucose, or by the injection of twenty units of insulin, or most surely by the combined effects of glucose and insulin. Analysis of the blood during and between the paralytic attacks showed that the onset of paralysis was associated with a fall of serum potassium from the normal value of 16–20 mgm. to below 12 mgm. per 100 c.c. serum. The paralysis could be relieved in 15 min. by the ingestion of 12 gm. potassium chloride. A fall in serum potassium occurs in normal individuals when glucose passes from the blood into the tissues, but in periodic paralysis the fall is unusually great, and it is this abnormality which constitutes the essential feature of the disease.

Structure of Protoplasm

DR. A. R. MOORE is probably giving expression to a view very widely spread among biologists when he argues (*Scientia*, 62, July 1, 1937) that the conception of protoplasm as an emulsion, suggested by Bütschli and supported by some of Hardy's experimental results, was quite inadequate even to account for the behaviour of the cytoplasm of the cell. A useful purpose is probably served, nevertheless, in passing in review some of the considerations which suggest a more 'structural' basis. Thus in some merogonic hybrid embryos of echinoderms the tempo of cleavage of the cells of the hybrid is clearly determined by the parentage of the cytoplasm—not of the nucleus. In sea-urchin eggs, as the result of centrifugal action, it may be possible to obtain cells, clear of all dense inclusions, which behave quite normally on fertilization, but this clear hyaloplasm, although without visible structure, almost certainly has a structural framework conserving its role in the transmission of hereditary characters. The phenomena of flow in protoplasm is shown to be consistent with the presence of fibrillar elements; in this way alone would it seem possible to explain the behaviour of plasmodia of Mycetozoa, which will flow through hard paper filters with average pore size of 1μ though they are destroyed when forced through sieve pores less than 0.20 mm. in diameter. Dr. Moore's conclusion, that protoplasm contains polar particles or chains of molecules which, when occasion requires, link themselves into structural features, not only agrees with modern views of the mechanism of wall deposition at the surface of the plant protoplast, but also reconciles very generally the contrast between the mobility of the cytoplasm and the necessity for a structural framework to account for its performance in cell division and heredity.

Researches on Indian Fishes

IN *Current Science*, 5, No. 7, 1937, there are two interesting articles on fishes. The first is entitled "Geographical Distribution of Indian Freshwater Fishes and its Bearing on the Probable Land Connections between India and the Adjacent Countries" by Sunder Lal Hora, assistant superintendent, Zoological Survey of India, Calcutta. It is a summary of the remarks made at the Hyderabad meeting of the Indian Science Congress, during a joint discussion between the Sections of Geology, Botany and Zoology, on Wegener's theory of continental drift with special reference to India and the adjacent countries. The evidence provided by the distribution of the freshwater fishes of India indicates an eastern origin of the fauna and its subsequent dispersal to the west. The close relationship between the Indian and the African freshwater fishes can only be explained on the assumption of a land connexion between the two countries. The absence of the Schilbeidae from Ceylon and their presence in Africa suggests that Ceylon may have become separated from India at a stage earlier than the severance of the land connexion between Africa and India. In the second paper, P. Sen, entomologist, Bengal Public Health Department, "On the Food Factors of the so-called Mosquito-

Destroying Fishes of Bengal—*Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*", shows that the plankton flora and fauna form the main food of *Panchax* although they also eat insect larvae, that *Trichogaster* eats plankton with filamentous algae, and that *Barbus* and *Esomus* are also essentially vegetable feeders. Thus *Panchax* alone of the four eats insect larvae, and these only form a small portion of the food. There is apparently no justification in assuming that these fishes would eat the *Anopheles* larvae except in very small numbers.

Inheritance of Leukemia in Mice

LEUKEMIA is a tumorous condition in which the leucocytes of the blood multiply rapidly. The symptoms are very similar or identical in mouse and man. There is often enlargement of the spleen and lymphatics as well as an enormous increase of the number of leucocytes in the blood. Dr. E. C. MacDowell (*J. Hered.*, 28, No. 4) has described experiments on the inheritance of leukemia in mice which are of particular interest in their bearing on the relation between intrinsic and extrinsic factors. By brother-sister matings through eighteen generations, a genetically uniform leukemic strain of mice was obtained. In a total of more than 600 mice, however, 10 per cent always failed to develop leukemia. But the offspring of the negative mice developed the disease with the same frequency of 90 per cent. It is concluded that the 10 per cent negatives represent the balance between the genetic constitution of this particular strain and the particular environment in which they developed. When a negative strain is crossed with a male from the leukemic strain, the F_1 show an incidence of nearly 45 per cent, and when F_1 males are back-crossed to the neutral strain the incidence of leukemia is again halved. When the leukemic heredity is derived from the mothers, the incidence of leukemia in the offspring is significantly higher in all cases. By careful analysis and variation of the laboratory environment, it will probably be possible to determine which extrinsic factors are effective. It is also significant that the role of extrinsic factors varies with the intrinsic factors present.

Research on Wood-destroying Insects

THE *Journal of the Royal Society of Arts* (85, 407; 1937) contains a report of a lecture given by Dr. R. C. Fisher of the Forests Products Research Laboratory on the above subject. Special reference is made to the death watch beetle (*Xestobium rufovillosum*), and it is pointed out that there appears to be a definite relation between the presence of fungal decay in timber and the occurrence of this insect. It was also shown that the temperature and moisture content of timber are important factors in determining the rate of development of the beetle. Warm, dry conditions and the absence of fungal decay are unfavourable for this insect. Damage is usually most severe at, and often confined to, the built-in ends of timbers in buildings where ventilation is poor and where conditions are favourable for the accumulation of moisture and consequent risk of decay. The outstanding conclusion of recent biological studies is the importance of the presence of fungal decay. Experiments are in progress to determine exactly how fungal decay renders timber suitable for infestation. Also the fact that *Xestobium*

can continue to live and develop very slowly in decay-free timber has to be taken into consideration. Reference is made to frequent reports in the press, and by authorities seeking funds for repairs, of damage caused by the beetle to churches and other buildings. The result has been a general impression that the creature has increased its activity during the last few years. This idea, however, is erroneous, and the apparent spread of the beetle can be best explained by the increased interest taken in its occurrence, which leads to more thorough inspection of old timbers in buildings.

Cytology of the Genus *Poa*

J. M. ARMSTRONG has examined the chromosome numbers of twenty species of the grass *Poa*, with the result that previous suggestions are confirmed and extended: (1) that polyploidy is associated with species formation; diploid to dodecaploid species are described, the basic chromosome number being seven; (2) that aneuploid species are also present; three aneuploid species have chromosome numbers suggestive of a $9n$ origin (*Canadian J. Res.*, 15, June 1937). An interesting examination is made of the possibilities of the maintenance of a certain aneuploid strain with 54 chromosomes. In view of the obvious difficulties in the way of maintaining constant such an aneuploid strain through normal sexual fertilization, an apogamous origin of embryos from sporophytic tissue in the ovule seemed likely and has frequently been suggested. Armstrong, however, shows that the fertility of the pollen mother cells is surprisingly high and that polyembryony frequently occurs, but that the embryo sacs may all arise from megaspores produced after the normal reduction division. The author points out that the univalent chromosomes appear regularly to be included in the nuclei after reduction division. Four univalents are concerned, and in view of the high chromosome number their presence may not disturb the genetic balance if they undergo random segregation. Such random segregation would give 6 out of 16 pollen grains with 2 univalent chromosomes and, in view of the frequent occurrence of polyembryony, with good opportunities of meeting female nuclei with 2 univalent chromosomes also. Such gametes would contain 27 chromosomes in all and their union might maintain the strain by ordinary sexual reproduction; the author concludes that this is the method in which the aneuploid 'Mammoth' strain of *Poa pratensis* is reproduced.

Fulgurites from Witsands, Kalahari

AMONG the sand-dunes on the south-east border of the Kalahari desert, A. D. Lewis (*S. Afr. Geog. J.*, 19, 50; 1936) estimates that there are not fewer than 2,000 fulgurites ('lightning tubes') over an area of eight square miles. Curiously, however, the natives say that storms are not frequent and they have never seen the dunes struck by lightning. The friable tubes of fused silica are mostly found as broken fragments lying in the hollows between the dunes, and only rarely are they seen *in situ* projecting a few inches above the surface of the sand. Five tubes extending vertically downwards were excavated, but without reaching the lower end. The longest recovered (as fragments) measured 8 feet and showed some branching with a variable form and diameter (0.2–0.5 in.) along its course. Larger tubes (up to 2 in.)

have collapsed with the formation of longitudinal ribs. In one case threads of fused silica extend across the cavity, suggesting that the tube again expanded while still in a plastic condition. The sand surrounding the longest tube was seen to be "darkened as if burnt". Some previous records mention that the loose sand adjacent to the fulgurite is iron stained, suggesting that iron was vaporized from the fused silica. The author accepts, though apparently somewhat reluctantly, the view that these tubes were formed by lightning. One of his alternative suggestions is that they were formed by meteorites; this being supported by the statement that lechatelierite (silica-glass) has been found in meteorites—a statement that is quite incorrect.

The Baffin's Bay Earthquake of 1933

LATE on November 20, 1933, a strong earthquake was recorded at stations all over the world. The early estimates made at Kew, Strasbourg and elsewhere showed that the epicentre lay in Baffin's Bay, and, about a week later, it was reported that the shock was felt in western Greenland. The earthquake is one of much interest, for we have no record of any other in this part of the world, and the epicentre was so situated that the numerous stations in Europe, North America and Japan all lay within moderate distances from it. In response to circulars issued by Dr. A. W. Lee of the Kew Observatory, 99 records were placed at his disposal, more than two thirds of them from stations lying between 25° and 40° from the origin, and these are studied by him in a recent valuable memoir (*Meteorol. Office, Geophys. Mem.*, No. 74; 1937). The closest representation of the travel of the P waves to distances of 25° – 50° is, he finds, given by a table based on one prepared by Gutenberg and Richter, the resulting position of the epicentre being lat. 73.3° N., long. 70.2° W., and the time at the origin 23h. 21m. 31.5s., G.M.T. The surface waves were very large, showing that the focal depth was not considerable. Indeed, from the average length (about 4 sec.) of the interval between the arrivals of the P and sP waves, it follows that the depth was about 10 km. below the surface. The apparent velocity of the P waves was uniform for epicentral distances from 25° to 40° and again from 45° to 50° , the velocity changing by 17 per cent from 40° to 45° . There are discrepancies between the observations of S and the existing tables. A new table for S for distances 25° – 50° was, however, computed from the travel-times for P on the assumption that Poisson's ratio is constant for the rocks traversed by the waves, and the agreement between the observations and this table is satisfactory.

The Tenham Meteoric Shower of 1879

IN 1935, a collection of 102 complete meteoric stones, of aggregate weight about 108 lb., was presented to the British Museum by the widow of Mr. Benjamin Dunstan, formerly Government geologist of Queensland, who had been collecting information of the history and composition of the meteorites. This collection, described by Dr. L. J. Spencer in No. 156 of the *Mineralogical Magazine*, represents a remarkable shower that fell in 1879 at Tenham in a remote district of south-west Queensland. Thirty years ago, two large stones and one small stone (total weight, 134 lb.) from this district were acquired for the British Museum. Dr. Spencer relates the

history of these three "Warbreccan stones", which are almost certainly three belonging to the original collection made by Mr. M. Hammond, an eye-witness of the fall and who was alive in 1936. A chemical analysis of specimen stones made in the Government Chemical Laboratory at Brisbane in 1913 shows that their composition is that characteristic of the stony variety, that is, masses of crystalline rock with a small metallic content, as distinct from the type composed largely of metallic iron. This collection from the Tenham shower is stated to be the most complete example of a meteoritic shower in the British Museum collection of meteorites. Dr. Spencer describes schematically the passage of a stony meteorite through the earth's atmosphere, its stage of incandescence commencing at a height of about 100 miles; the subsequent explosion of the meteorite due to intense surface heating and to air pressure, followed perhaps by a second explosion and the fall to earth of the resulting shower of stones, the velocity of which is checked generally to that of an ordinary falling body—about 70 metres a second. In the case of a large mass of metallic iron, it will survive disintegration more easily and may arrive at the earth's surface with much greater velocity.

The Cannizzaro Reaction

THE mechanism of the Cannizzaro reaction, in which an aldehyde, for example, benzaldehyde, reacts with water in the presence of an alkali to give an acid and an alcohol ($2R.CHO + H_2O = R.COOH + R.CH_2OH$) has been investigated by using alkali dissolved in deuterium oxide, D_2O (Bonhoeffer and Fredenhagen, *Naturwiss.*, 25, 459; 1937). No deuterium was found in the CH_2 group of the alcohol. This means that the hydrogen from one aldehyde group is transferred directly to the carbon atom of the other aldehyde molecule (possibly after the two molecules have combined to give an acetal compound), without a dehydration of a hydrated aldehyde molecule and transference of molecular hydrogen.

Tests for Random Observations

W. O. KERMAK and A. G. McKendrick (*Proc. Roy. Soc. Edinburgh*, 57, 223; 1937), starting from an investigation of the fluctuation in the death-rate from ectomelia in mice in an experimental epidemic, have arrived at simple tests which will help to decide whether a series of numbers is random, that is, due to mere chance, or evidence of a real cause. A series which conforms to these tests is not necessarily random, but is likely to be so. On the other hand, failure to conform is evidence of non-randomness. The calculation depends on the runs and gaps, the average lengths and standard deviations of which are compared with what would be expected from pure chance. One obvious limitation of the tests is that they make use only of qualitative relationships and do not take into account exact magnitudes, so they do not make full use of the information available. On the other hand, there is the compensating advantage that no assumption is made about the law of distribution of the observations. These tests are applied to some examples, including Tippett's random numbers, telephone numbers, duration of measles epidemics, Swedish death-rates, Edinburgh rainfall and Edinburgh temperature. The results work out as might be expected in most cases, but the Edinburgh climate seems to defy prediction.

The First International Acoustical Conference

THERE is scarcely any subject which, during the last few years, has assumed greater commercial and social significance than acoustics. Alongside has come the steady growth of noise—that is, unwanted sound—which in its many aspects is beginning to stir the consciousness of the public to such an extent that it is demanding measures for relief in the more outstanding cases. Acoustics has furthermore developed a large specialized terminology, and the need for agreed measuring units and standards has become more and more pressing.

In Great Britain such questions have been dealt with by a British National Committee under the auspices of the British Standards Institution. Under the chairmanship of Dr. G. W. O. Kaye, this Committee has developed and classified an extensive glossary of acoustical terms*, particular attention being given to units and standards, among them the scales and units of loudness and energy-level. As regards these latter, which are of especial importance, considerable divergencies have unfortunately prevailed in the practices of different countries, not only as regards the scales, units and zeros of the standard reference tones, but also in the listening techniques and phraseology employed. In its work, the British Committee kept in mind the desirability of eventual international agreement in such matters and to this end set up specifications dealing with the standard reference sound (a sinusoidal plane progressive wave of a frequency of 1000 cycles per second), and the arbitrary zero of reference (0.0002 dyne per sq. cm.). The "phon" (a name we owe to Barkhausen) was adopted as the unit in the subjective scale of equivalent loudness, while the use of the "decibel" (a name which originated in America) was restricted to the scale of the associated energy or pressure level.

In July of this year, the first international conference on acoustics was summoned in Paris under the auspices of the International Electrotechnical Commission (I.E.C.), some sixty delegates from

thirteen countries assembling under the presidency of M. Duval, president of the French Electrotechnical Committee. Substantial agreement was reached in the several sections set up to deal with vocabulary, fundamental units and methods of measurement, electro-acoustics, and noise abatement. Chief interest centred in the questions of fundamental units and methods of measurement, and it is satisfactory to learn that the proposals eventually adopted are in complete agreement with the specifications submitted by the British delegation under the chairmanship of Dr. Kaye. The "phon" and the "decibel" are accordingly accepted as international units, so that an important contribution to international acoustical measurements has been achieved. Particular mention should be made of the helpful and conciliatory outlook of the United States and German delegations, of whom Dr. Harvey Fletcher and Dr. Gratzmacher were the respective chairmen.

An inquiry into the present position of objective noise meters indicated that while great progress had been made, there was not enough experience available to approve at the present juncture the specification and standardization of a 'universal' noise meter which will measure on the phon scale any and every type of sound. Other points dealt with included the standardization of methods of testing microphones and loud-speakers, the different procedures adopted in various countries for measuring acoustic absorption coefficients by the reverberation method, the methods used to investigate the transmission of air-borne and impact sounds in buildings, and the steps taken in different countries for reducing noise.

The pronounced success of the Conference owed much to the valuable preparatory work of the I.E.C. and the co-operation of M. Valensi, secretary of the Comité Consultatif International Téléphonique. It was agreed at the final plenary meeting that the work of future conferences should be administered by the Federation of National Standardising Bodies known as the International Standards Association, the I.E.C. concurring and actively collaborating.

* "British Standard Glossary of Acoustical Terms and Definitions" (London: British Standards Institution, 1936) 2s. 6d. net.

Concentration of Solutes in Vacuolar and Cytoplasmic Saps

By Dr. E. Phillis and Dr. T. G. Mason, F.R.S.

IF 25–30 gm. of mature leaves of the cotton plant are rolled up, wrapped in cloth, the wad placed between two disks about 2 in. in diameter and the whole put in the jaws of a small vice, sap is expressed on the application of pressure. As the sap flows out of the wad, much of the leaf is squeezed out from between the disks. To obtain more sap, the tissue must be collected into a ball and again wrapped up in the cloth. On the application of pressure, sap is again expressed. This process can be repeated three or four times; but a point is reached when even

under the greatest pressures that can be obtained in the vice, the yield of sap amounts to only a few drops. If now the residue from which sap has been expressed is frozen at -16°C . and then thawed, much more sap can be obtained on the application of very small pressures.

It was observed by Dixon and Atkins¹ that the concentration of solutes increased in successive fractions. They also discovered that preliminary treatment of the leaf by freezing or by exposure to anaesthetics greatly increased the concentration of

solutes over that in sap expressed from untreated tissue. Typical results from our own experiments for calcium, magnesium and potassium are shown in Table 1.

TABLE 1. SAP EXPRESSED IN VICE.

		No. of fractions			Frozen residue
		1	2	3	
ml. sap from 100 gm. fresh wt.		11.2	11.4	12.7	23.6
Concentration (mgm. per 100 gm. water)	Calcium	490	535	568	848
	Magnesium	54.4	57.3	61.2	99.7
	Potassium	201	218	238	264

It will be seen that much sap was released and that there was a marked increase in the concentration of solutes as a result of freezing the residue. The usual explanation (Walter*) for the increase in concentration in successive fractions is that pressure has two effects, one being the expression of water through the cytoplasm and its membranes, solutes being retained in the vacuole, and the other the bursting of cells and consequent liberation of vacuolar solution. The change in concentration in successive fractions is assumed, therefore, to be due to filtration of water and concentration of the vacuolar solution. The increased concentration resulting from freezing is generally interpreted as due to the breakdown of impermeable membranes and the release of the vacuolar sap. It is very commonly assumed by botanists (Searth and Levitt*) that the cytoplasm in mature leaves contributes but little sap and that the bulk of the sap expressed even from previously frozen tissue comes from the vacuole. Perhaps it is also true that many botanists still believe that the continuous phase of cytoplasm is water (cf. Stiles*), and that some of this water may be expressed, particularly after coagulation of the cytoplasm which is assumed to occur as a result of freezing.

Somewhat to our surprise, we have observed that if leaves are carefully placed one on top of another between the relatively large plates of a hydraulic press, the concentration of sap in successive fractions does not necessarily increase as the pressure is increased. The concentrations are also found to be lower than when leaves are pressed in the usual way in the vice. In the hydraulic press, using carefully arranged leaves, they are not squeezed out from between the plates, and the shearing forces that arise in the vice, as leaves are redistributed in the wad as its shape is changed, are negligible or absent. The presence or absence of shearing forces appears to be crucial. The results for a duplicate sample of leaves to that used in Table 1 are shown in Table 2.

TABLE 2. SAP EXPRESSED BY HYDRAULIC PRESS.

		No. of fractions			Frozen residue
		1	2	3	
Pressure (lb. per sq. in.)		6,000	10,000	16,000	16,000
ml. sap from 100 gm. fresh wt.		13.1	13.5	11.6	23.5
Concentration (mgm. per 100 gm. water)	Calcium	420	414	424	886
	Magnesium	46.9	44.5	46.5	107.2
	Potassium	163	181	176	253

It will be seen that there is again a great increase in concentration when the residue is frozen and pressure applied. Of outstanding importance is the fact that the concentration remains nearly constant and does not rise as the pressure is increased. There is thus no support for the view that water is filtered under pressure through the cytoplasm. Other causes for the increase in concentration in the vice must therefore be sought. It will be noticed that even the first fractions in the vice exceeded those in the hydraulic press. If the results are graphed, it will be seen that the curves for the two methods of expressing sap diverge from a common origin. It is noteworthy that even under pressures so high as 16,000 lb. per sq. inch, only approximately half the sap was expressed.

The meagre proportion of the total sap present in the leaf that can be expressed by these high pressures does not indicate that the continuous phase of cytoplasm can be water, as is generally assumed, for as much water can be expressed from a gelatin gel under a pressure of 2,000 lb. per sq. inch as is liberated* by freezing at -20°C . It must be borne in mind that nearly half the volume of the mesophyll cells in cotton, excluding the cells' walls, consists of cytoplasm. This is contrary to what is usually believed to be the case (cf. Stiles*); but Iljin's* measurements show that cotton is by no means exceptional in this respect. It would seem that the continuous phase of active cytoplasm, as Lepeschkin* suggests, is a liquid, composed probably of proteins, lipoids and water. This liquid, as we have previously* suggested, would appear to have solubilities and diffusion constants quite different from those of water, and to be dependent for its origin and maintenance on respiratory energy. With such a concept of the composition of the continuous phase of cytoplasm, the results already described would be explained as follows.

When the leaf is pressed in the hydraulic press, the vacuolar sap escapes through fissures in the cytoplasm. The continuous phase of the cytoplasm, for which Lepeschkin has proposed the term 'vitaid', is not decomposed by this direct pressure into its component parts. In the vice, on the other hand, shearing forces are operating. We thus assume that the 'vitaid' molecule is decomposed by comparatively small shearing forces though able to withstand direct pressures of considerable magnitude. Thus in the vice a gradual decomposition of the 'vitaid' molecule occurs. It is broken up into proteins, lipoids and water, while the solutes which were in solution in it are now dissolved in the water and escape with the vacuolar sap, which in the leaf of the cotton plant is considerably more dilute than the sap that is produced as a result of the decomposition of the 'vitaid' liquid. The great increase in concentration and the large amount of sap produced when the residue from the hydraulic press is frozen is due to the decomposition of the 'vitaid' liquid by the shearing forces that arise as a result of the formation, and perhaps the disappearance, of ice in the vacuole and the intercellular spaces.

Some confirmation of this hypothesis is furnished by the following experiment, the results of which are shown in Table 3. If the residue from the hydraulic press from which all the sap available at a pressure of 14,000 lb. per sq. inch has already been expressed, is divided into two portions, one of which is frozen and one of which is gently rubbed between the fingers and thumb, it will then be found that further

sap can be expressed from each portion merely by squeezing in the hand. The volume obtained after rubbing, as might be expected, is slightly less than that after freezing, for the shearing is less thorough. The concentrations in the two residue saps were approximately equal in this experiment, although in other experiments, those in the finger-rubbed fractions have been slightly below those in the frozen fractions. The maximum pressures used give no indication of the ease of expression of sap. From the fresh tissue, no sap was obtained below a dial reading of 4,000 lb. per sq. inch hydraulic pressure, while with both the residues, most of the sap was expressed before the needle left the zero mark.

TABLE 3. EFFECT OF PREVIOUS TREATMENT OF RESIDUE ON SAP OBTAINABLE UNDER PRESSURE.

	Fresh leaves	Treatment of residue	
		Finger-rubbed	Frozen
Maximum pressure (lb. per sq. inch)	14,000	14,000	14,000
gm. sap from 100. gm. fresh weight	24.4	30.0	36.7

		Fresh (hydraulic pressing)	Residue treatment	
			Finger-rubbed	Frozen
Concentration (mgm. per 100 gm. water)	Calcium	256	718	712
	Magnesium	44.0	104.7	106.8
	Potassium	275	599	604

It is interesting to note that Audus⁶ has found that rubbing a leaf on both sides with a finger stall or merely bending the leaf increases respiration 2-3 fold.

If we are correct in the interpretation of the results, we can form approximate estimates of the

concentrations of solutes in the vacuole and cytoplasm respectively. The vacuolar estimate is obtained from the lowest concentration obtainable by direct pressing. This may be an over-estimate, for slight shearing forces will cause some cytoplasmic decomposition; for example, when brittle leaves are pressed in the hydraulic press, successive fractions of sap show diminishing concentration, due, we believe, to shearing forces developed in the leaf mass during the initial stages of compression. The action of such shearing forces is associated with the presence of chloroplasts in the expressed sap. If the vacuolar sap could be completely expressed the residue should, on decomposition, yield a sap representative of the cytoplasm, but incomplete vacuolar pressing will cause dilution of the cytoplasmic sap and an under-estimate of its concentration. In the leaves used in the experiment just described, the concentration in the cytoplasm must have been more than double that in the vacuole.

Methods used for the extraction of sap invariably include some process which we believe leads to destruction of the 'vitoid'. These processes include boiling⁷, freezing, grinding¹⁸ and treatment with anaesthetics¹⁴. All saps obtained by these processes are, therefore, mixtures of vacuolar sap with that produced on decomposition of the vitoid. It will be necessary in the future, we think, to distinguish between the true (vacuolar) sap and that derived from the destruction of the cytoplasm.

¹ Dixon, H. H., and Atkins, W. R. G., *Proc. Roy. Soc. Dub.*, 13, 432 (1913).

² Walter, H., *Ber. deut. bot. Ges.*, 45, 530 (1938).

³ Searth, G. W., and Levitt, J., *Plant Physiol.*, 12, 51 (1937).

⁴ Bates, W., "Introduction to Principles of Plant Physiology". (London, 1936)

⁵ Jordan, Lloyd D., and Moran, T., *NATURE*, 123, 515 (1933).

⁶ Iljin, W. S., *Bull. de l'Assoc. Russe pour les recherches scientifiques à Prague*, 1 (VI). Soc. des sciences naturelles et mathématiques, No. 4 (1934).

⁷ Lepeschkin, W. W., *Biodynamica*, 19 (1936)

⁸ Mason, T. G., and Phillips, H., *Bot. Rev.*, 2, 47 (1937).

⁹ Audus, L. J., *New Phytol.*, 24, 286 (1935).

¹⁰ Sayre, J. D., and Morris, V. H., *Plant Physiol.*, 7, 261 (1932).

¹¹ Chibnall, A. O., *J. Biol. Chem.*, 55, 333 (1933).

International Congress for Short Waves in Physics, Biology and Medicine, Vienna*

PROF. H. THIRRING, in an address made during the opening ceremony of the Short Wave Congress held in Vienna on July 12-17, referred to the many fields of application of Hertzian waves in research, medicine and radio technology. These fields are to some extent interdependent, and there are in particular medical and biophysical problems which require the collaboration of biologists, physicists and radio-engineers if they are to be solved satisfactorily. Thirring pointed specially to the urgent problem of dosage measurement in short wave therapy and to the fundamental scientific question of the mode of biological action of short waves: specific or thermal. These problems occupied a prominent position in the Congress, and, together with purely physical papers, will form the substance of the

present report; the review articles in the various sections and the fifty or so papers in the medical section will not be dealt with. (Number in brackets in each heading indicates the number of papers presented.)

(1) *Production of ultra-short waves* (11). Most of the papers dealt with retarding field or magnetron circuits devised for production of the shortest waves; the most interesting perhaps was the 14 cm. wave retarding field generator with resonant cavity as frequency stabilizer, demonstrated by Dallenbach, Alderding and Kleinstaub. The demonstration showed the remarkable frequency stability attained and the modulation of the 14 cm. wave. Another retarding field system was described by Meng and Potapenko, who have constructed exceedingly symmetrical micro-tubes for high-order oscillations of wave-length ~ 1 cm. McArthur described a new

* Internationaler Kongress für Kurzwellen in Physik, Biologie und Medizin. Referate und Mitteilungen. (Wien: Brüder Hollinek, 1937).

magnetron, of single (water-cooled) anode type with permanent magnet and concentric tube transmission line, giving 10 watts at λ 4.8 cm. Grookowsky and Ryzko discussed the increased efficiency obtainable with 4-anode magnetron tubes when the usual tungsten cathode is replaced by oxide-coated nickel. The Okabe electron beam magnetron was described by Joji Ito.

(2) *Transmission: Ionosphere research* (12). Van der Pol sketched a theory of propagation of ultra-short waves over the earth, starting from the Maxwell equations, with proper boundary conditions; he showed that 7 m. waves must diffract considerably beyond the horizon, with a strong attenuation which is due to absorption by the ground. Southworth discussed transmission in pipes or cylindrical rods of dielectric. For a hollow metal pipe the diameter must be at least 0.58λ . The resonant cavity is a special case of this system, and may be used as a frequency determining unit or as an impedance matching device, and perhaps as a new means of 'irradiating' laboratory specimens.

Six of these papers dealt with the ionosphere, beginning with a review by Zenneck. Burkard discussed the information concerning the ionosphere and its diurnal and seasonal variations obtained from a statistical treatment of amateur radio reports—as many as 10,000 per month. Reports for the summers 1934 and 1935 (sunspot minimum—single reflection, presumably from F_1) gave 240 km. as the mean height of the layer. Ito Yoji described ionosphere studies during the total eclipse of June 19, 1936, when there was found 47 per cent decrease in electron density in F_1 , but practically no effect on F_2 . Fuchs described a method of determining the absolute temperature in the ionosphere, obtaining the values $F_1 > 400^\circ$, $F_2 > 1,400^\circ$ K., so that the daily division into the two layers is presumably due to gas-thermal effects. Hals described the discovery of the Hals-Störmer echoes, and Fuchs provided an interpretation, as an ultra-violet ionization phenomenon of the upper atmosphere.

(3) *Absorption and dispersion in chemical systems* (4). Potapenko described a new modification of the Drude-Coolidge method for determination of ϵ' and ϵ'' ; together with Keutner, he has used the method for measurement on monohydric alcohols and glycerol, finding, as others have found, approximate agreement with the Debye theory. Williams has measured the absorption of 1.25 cm. waves by ammonia gas, the ray being diffracted from an échellette grating after passage through the gas, and the intensity being determined with a crystal detector.

(4) *Dielectric properties of tissues: heat production in tissue and tissue models* (4). The papers on this subject brought out clearly the large number of factors which must be taken into account in considering the possibility of selective heating of tissues by ultra-short waves. Given fixed values of ϵ (dielectric constant) and κ (specific conductivity) for the various parts of a body, the matter is relatively simple; if, however, both ϵ and κ are strongly dependent on frequency and on temperature, the calculation of the optimal wave-length for selective heating of a certain tissue becomes impossible without complete experimental dispersion curves for all the tissues concerned. In regard to κ , Schaefer and Rajewsky have now extended their measurements on blood to several other tissues, while an admirable series of measurements by K. Oswald shows the dependance of both ϵ and κ on frequency even in the

ultra high-frequency region. A further complicating factor may be the very large effect of field intensity on dipole losses in solutions of *zwitterions*, observed by Schmalzer in the case of tetra-*n*-butylammonium bromide in benzene, although it is not yet known what proportion of the observed high-frequency conductivity of tissues is due to substances of this type.

This complexity in the physical properties of heterogeneous systems makes it important to obtain empirical information concerning selective heating by experiments with 'models', however approximate such information may be. Pätzold described measurements of the relative heating of juxtaposed layers of fat and muscle in the condenser field at λ 6 m. and 1 m., the results of which are in substantial agreement with those calculated from Oswald's data. He has also measured the relative heating of layers of salt solutions in a solenoidal field as a function of position, wave-length and number of coil windings, and further considered the possibility of applying ultra high-frequency energy by 'irradiation', on the basis of *Halbwertschicht* determinations on salt solutions and tissues at λ 4.3 m.

(5) *Physics and chemistry of possible specific (non-thermal) effects* (17). It soon became clear that 'non-thermal' effects might be placed in several categories: (a) Specific electrical and mechanical effects, the existence of which, in principle, can scarcely be doubted, resulting in chain configuration of suspended particles, in decreased degree of dispersion, change in viscosity, etc., dependent on field strength and type of field but not on frequency. These effects were admirably discussed by Krausz-Ergen. (b) Possible specific chemical and biochemical effects, the existence of which has not yet been satisfactorily demonstrated, although frequently asserted. These were discussed by Königer, who suggested possible 'resonance' absorption effects, in the sense of Romanoff's theory. Bateman and Rosenberg discussed the physical conditions which have to be satisfied for the experimental elimination of thermal effects. (c) Possible non-thermal physiological effects on cell suspensions, when thermal effects can be avoided by use of proper experimental conditions. According to Hasché, Leung and Loch, the field has no effect on *B. coli* and *Staph. pyococcus aureus* under most conditions of wave-length, intensity and type of suspension medium, although a few inconsistent observations have been made at λ 3.5 m.; similar negative results were obtained by Ruete with *B. coli* and several moulds, and by Malov, with *Drosophila* (mutation rate and lethal action). The observations of Roth (development of exposed seeds), of Wertheim ('biopositive' effects on yeast) and of Schweinburg (on rabies virus), with their less satisfactory control of heating, do not necessarily contradict these negative results. (d) Effects on large bodies: 'specific' effects opposite to 'heating' effects. Most of the observed physiological effects belong in this category; they could be the result of (a) or (b), or else—more probably—merely thermal effects of a special kind, due to the peculiar distribution of temperature gradients in the body which results from exposure to the field. None of the many experiments of this type described at the Congress contributed essentially to the solution of the problem.

(6) *Measurement of absorbed energy in ultra-short wave therapy* (9). The difficulties of a satisfactory measurement of 'intensity' (watts absorbed/sec.) were enumerated by several contributors, and a number

of modifications of known procedures were described. In particular, Mittelmann has used a method involving the preliminary determination of the effective resistance of the circuit with a secondary transmitter and valve voltmeter, followed by measurement of I or E during treatment with thermo-cross and dynamometer. Riesinger measures the total anode dissipation of his transmitter with ammeter and voltmeter, and the heat dissipation with a photo-cell and a reflecting bimetal strip fixed to the anode, the difference representing the high-frequency energy

generated. It seems, however, uncertain whether this arrangement can be used, as Riesinger claims, as a dose intensity indicator. Schwarz suggested two rapid methods: first, determination of 'spread' of the resonance curve by means of variable condenser and Braun tube; secondly, measurement of true field across the object by small electrometer electrodes mounted in the condenser plates. The papers on the subject gave the impression, however, that the problem is still far from being solved.

J. B. BATEMAN.

The Science of Archives in South Africa*

STUDY and work connected with archives have been recognized as a science, and a scientific system of keeping archives has been evolved; while not only is a high standard of attainment and a wide range of knowledge of scientific method and results demanded of the archivist, but also in certain European countries provision has been made for his technical training.

Archives constitute a fundamental source of historical information, and hence the introduction of the moving picture—the cinematograph film and the 'talkies' have, in the problem of their conservation, forced on the attention of the archivist a number of practical questions, the method of dealing with which has yet to be determined on scientific lines.

In South Africa, prior to the date of the Union, the Cape Province gave attention to this subject more than half a century ago, and the Transvaal since about 1902. In 1919 the Union Government took the first serious step in co-ordinating the archives of the four provinces.

The administration of Union and Provincial Archives was centralized in a chief archivist, and by legislation of 1922 Union and Provincial archive depots were created, the former at the seat of government of the Union, and the latter at the seat of the Provincial administration. The centres thus are in Cape Town, Pretoria, Pietermaritzburg and Bloemfontein, each in charge of an archivist, and the whole administration centralized in the chief archivist. This system secures uniformity of administration, arrangement, classification, inventorying, methods of preservation and general care. It has resulted in straightforward administrative efficiency, and experience has taught that it is the only satisfactory method. Experts in archive economy the world over endorse this system.

The Archives Department is a young branch of the Public Service of the Union of South Africa. Its advance, unspectacular but steady, during the last decade or so, was marked by a persistent claim to recognition as an integral part of the Government machinery and the necessity for its personnel to be men with a certain standard of education and an aptitude for the work.

An archives depot is not static, and must increase in quantity and quality as the years pass. The

Department was conceived, no doubt, as a branch of the service with great possibilities. Its growth was slow at first, and to some extent stunted because it had to overcome many prejudices. When it was given a place in the Government machinery, it had to live down the prevalent conception that it was a warehouse for the storage of records with someone in charge to keep them from deterioration and permit their consultation when necessary. It had to have a proper home and the right kind of vitamins in its food to allow it to develop. But this stripling of a department struggled on, facing all the obstacles which beset it.

South Africa had the advantage of studying the systems of similar institutions of older and more experienced countries. It avoided the pitfalls made by them in the past and took the best from each country and adapted this to suit the conditions in South Africa. Other sections of the British Commonwealth of Nations afterwards gave attention to the organization of their national records, such as the Commonwealth of Australia and the Dominion of New Zealand. The most recent recruit is the Colony of Southern Rhodesia, which created an Archives Department by legislation a few years ago. From the three countries, inquiries came to South Africa regarding the system of keeping archives which was being adopted.

Within the last ten years, the archives at Cape Town, Pietermaritzburg and Bloemfontein have been transferred to their buildings with up-to-date equipment and protective devices at a cost of many tens of thousands of pounds. Steps are being taken to provide a separate building at Pretoria, which will house the Provincial archives and contain the records of the Union Government, when old enough for the transfer so laid down by law.

To illustrate the growth of this branch of the service during the last eighteen years, personnel and salary expenditure have increased from a staff of five and an expenditure of £2,800 in 1919, to a staff of 42 and an expenditure of £11,000 in 1937. The number of researchers and visitors and volumes consulted during the last five years indicates a steady and encouraging increase.

The system for the arrangement and classification of the archives in South Africa is that recognized in Europe, and referred to as the 'principe des fonds', in which the system of classification is based on the department of origin. Experience has shown that this is the only sound one.

* Substance of the presidential address to the South African Association for the Advancement of Science, at the Windhoek meeting on July 5, 1937, by Lieut.-Colonel G. Graham Botha, chief archivist of the Union of South Africa.

Colonel Botha described the duties of the archivist in relation to arrangement, classification, inventory and catalogue, and touched upon the physical defence of archives, covering the repository and accommodation, and their moral defence, referring to their reception and arrangement, in which he must study the administrations concerned, their history and organization, and divide them into classes and subdivisions of these; while the secondary duty of the archivist relating to the special requirements of the student covers the preparation of guides, lists, inventories and catalogues of his archives. Full transcripts must be prepared and published under an editor to meet the needs of the student resident at a distance. He also dealt with the problem of selection and destruction.

Finally, in illustration of his contention that archives are the material of history, Colonel Botha outlined from the records preserved in the archives, the history of the national roads in South Africa; the creation of a national road fund, and the constitution of a National Road Board in 1935, of which the story is disclosed in the archives by records of South Africa's early road system and its administration from the seventeenth century onward.

In conclusion, the science of archives may be likened to a venerable sage, who seeks for the authentic traces of man and his doings in the past and, finding them, preserves and jealously guards them. His eyes are glowing with wisdom drawn from the mass of evidence of man's past accomplishments, his failures and successes, as treasured up by him with tender care; ever ready to reach a helping hand to men of the present day in their struggles to move onward the ship of human progress, often doing so with an encouraging smile and reference to the Solomon of Biblical times: "there is nothing new under the sun"; and he appeals insistently to one and all to view the present unfolding of our grand and wonderful universe in the light of the ages gone by.

Science News a Century Ago

Lyell in Germany

WRITING from Weesl on the Rhine on August 29, 1837, to Darwin, Lyell said, "I write this to you, at least I am beginning it, in a steamboat on the Rhine, so make allowance for the tremulous motion. We came in a steamer from Copenhagen to Lübeck, then in a hired carriage to Hamburgh, across the sand and boulder formation of the Baltic, which for the most part we have been on ever since, although we have crossed the Weser, and Ems, and Lippe. The blocks of red syenitic granite, which I hammered away at in Norway, and which I saw there *in situ* sending its veins into the trilobite and orthoceratite schist, have been carried with small gravel of the same, by ice of course, over the south of Norway, and thence down the south-west of Sweden, and all over Jutland and Holstein, down to the Elbe, from whence they came to the Weser, and so on to this or near this. . . .

"This then was already dry land when Holstein, and all from the Baltic as far as Osnabrück or the Teutoburger Wald hills, was submerged. At Bremen I saw Olbers, aged seventy-two, the astronomer who discovered Pallas and Vesta, and at Osnabrück and Münster I met a warm and German reception from men of whom I had never heard, who had read

my paper on Sweden or something else. I mean by German, that kind of frank expression of enthusiasm for science, or of any emotion, which a well-bred Englishman tries to suppress, at least all outward expression of it, from the dread of being thought ridiculous, or of affecting to feel more than he does, or from *mauvaise honte*. If you ever get sick of that fashionable nonchalance which would blush to admire anything, or at least to confess it, I advise you to plunge into Germany, and you will be soon refreshed and brought back to the right tone again, whether it be literature, science, or any other pursuit you are following. . . ."

The First Steam Frigate

ON August 31, 1837, H.M.S. *Gorgon*, the first steam vessel in the Royal Navy designed as a frigate, was launched at Pembroke. Designed by Captain (afterwards Admiral) Sir William Symonds, the Surveyor of the Navy, the *Gorgon* was 178 ft. long, 37½ ft. beam and 1,108 tons burthen by the rule known as Builders' Old Measurement. She was noteworthy not only as being designed as a frigate, but also as being the first vessel in the Navy to be fitted with John Seaward's direct-acting engine, instead of a side-lever engine, by which a considerable saving of weight was effected. The cylinders were placed directly beneath the crankshaft driving the paddle wheels. They were 64 in. diameter with a stroke of 5½ ft., the engine being of 320 nominal horse-power. The boiler pressure was 5 lb. per square inch. The total weight of the machinery, including the water in the boilers, was 276 tons. Service in such vessels was eagerly sought after by far-sighted young naval officers, and among those who served in the *Gorgon* was Admiral Sir Astley Cooper Key, who as a lieutenant exchanged from the *Curapoa* into the *Gorgon* and in doing so spoke of it as almost a change of profession. "Being in a steamer", he wrote, "has given me a much greater interest in the service than I had before, from having, I suppose, an object in view to which I feel myself suited." On another occasion he wrote, "I study De Pambour and Tredgold daily".

The British Association at Liverpool

IN its issue of September 2, 1837, the *Athenaeum*, referring to the forthcoming meeting of the British Association at Liverpool, said that while there had been no doubt as to the really excellent fruits of the morning meetings, the same satisfaction had not been felt regarding the evening meetings, which had been intended for diffusing among the general body of members "some part of the treasures of knowledge collected and purified in each Section". There was therefore to be a change of plan. "The great want of opportunity for cultivating mutual acquaintance and enjoying friendly discussion—a desideratum felt with increased force at every Meeting succeeding the embryo sitting at York—will be met by devoting at least two evenings to a pleasurable Promenade and Conversations in the magnificent apartments of the Town Hall, which the Mayor and Council have most liberally placed at the disposition of the Association. Thus the evenings may offer an agreeable relaxation after the morning work—the men of abstract and practical knowledge may be mingled together, and both brought into friendly intercourse with those numerous friends of the Association who attend the meetings to gather knowledge, and those whom they esteem as leaders of science."

Societies and Academies

Dublin

Royal Dublin Society, June 22.

H. G. WAGNER and ELIZABETH M. WAGNER: Annual changes in the osmotic value of some arctic and temperate plants. Determinations of the osmotic value of some arctic plants were made at intervals throughout the year in Kangerdlugssuak, East Greenland, during the course of the British East Greenland Expedition, 1935-36. The changes in the osmotic value have been correlated with the climate of the district.

MARGARET MOHAN, J. KEANE and T. J. NOLAN: The chemical constituents of lichens found in Ireland: *Parmelia conspersa*, Ach. While the Japanese and European varieties of the lichen have been found to contain salazic acid, the Irish lichen, collected at Howth, Co. Dublin, has been found to contain stictic acid. All three varieties also contain usnic acid.

J. H. J. POOLIS: A synchronous clock time-marker. The movement of a synchronous electric clock forms a cheap and convenient motor for causing a disk with slits to rotate once per minute and thus provide a series of light-flashes at convenient intervals to form a time base on a photographic film recorder.

H. H. POOLIS: A convenient form of galvanometer shunt for use with rectifier photo-cells. A constant resistance shunt of the telephone attenuator type, giving ratios 1, 5, 10, 50, 100 and 500, with an external resistance 10 ohms on every range with a 10-ohm galvanometer, is very suitable for daylight measurements. The use of spring keys to bring either of two cells into circuit and then to increase the sensitivity by successively cutting out the shunts saves the sensitive galvanometer from accidental damage. A reversing key doubles the sensitivity for small deflections.

Royal Irish Academy, June 28.

K. JESSON and A. FARRINGTON: The bogs at Ballybetagh, with remarks on the development of late-glacial deposits in Ireland. An investigation of the well-known deposits near Dublin containing remains of *Cervus giganteus*. A detailed description of the deposits is given with a list of plants identified in the late-glacial and early post-glacial beds. Pollen diagrams from several points are discussed. Comparison is made with deposits found in other basins, for example, at Balaghan, Co. Cavan, and a general view of late-glacial conditions in Ireland is suggested.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 5; 1937).

G. CESARO and J. MÉLON: The crystalline form of aconite.

P. GÉRARD: The renal elimination of acid colouring matters in *Astacus fluviatilis*.

M. KOURBENSKY: The integration of linear partial differential equations of the first order of two and more than two unknown functions.

N. NERONOFF: Reduction of a plane problem in hydrodynamics to the solution of a system of functional equations (2).

S. ARHND: Direct calculation of the relationships used in positional astrology.

F. E. NISOLI and J. GÉRARD: New determination of the vertex of the cluster in Taurus and of the star stream in Scorpion.

M. G. E. COSYNS: Variation of the specific primary ionization of hydrogen as a function of the energy of the incident electrons.

Geneva

Society of Physics and Natural History of Geneva, June 17.

G. BILLÈRE: The potential of polygons and elementary geometry. The author demonstrates the following propositions: (1) All regular homogeneous regular polygons having the same vertices and the same mass create the same logarithmic potential of the simple layer in the connex domain of the point at infinity. (2) All homogeneous semi-regular polygons, inscribable, having the same vertices, in each vertex the same bisector and the same mass, create the same logarithmic potential of the simple layer in the connex domain of the point at infinity.

G. CARRISSON: Rapid counting of a microbial suspension. The author describes a method, based on the absorption of light by the bacteria, for counting bacteria in suspension. The quantity of micro-organism in 1 c.c. can thus be determined in about ten minutes to approximately 1 in 10⁴. The measurement is made with a Lange photo-electric colorimeter.

Moscow

Academy of Sciences, *U.R.*, 15, No. 2; 1937.

V. S. IGNATOVSKIY: The Laplacean transformation (6).

A. P. DIETZMANN: The *p*-groups.

S. G. NATANSON: The use of the photo-relay in the study of lunar micro-relief.

A. D. PETROV and M. A. CHLOOVA: The catalytic isomerization of normal hexene and octene in the presence of zinc chloride and phosphoric acid.

V. A. DRYATNIN and V. M. IOSIKOVA: The determination of ascorbic acid (vitamin C) in blood and urine.

K. S. MASLOV and I. A. KOROBEKOV: Discovery in Juria of Upper Eocene characterized by its fauna.

J. A. PETROKOVIČ: The phosphorite-bearing horizon of the Mangysplak Triassic.

F. V. ČUCHROV: Antlerite of the Krestovozdvizhenak region in Dzhokagan.

Y. M. OLENOV, I. S. KHARMAO, K. T. GALKOVSKAYA, N. I. KNIASHVA, A. D. LEBEDOVA and Z. T. POPOVA: Natural selection in wild populations of *Drosophila melanogaster*.

L. I. DĖPARIDZE: The anatomical connexion between the acrosc leaf and the pitch-carrying system of the wood in *Pinus* sp.

Rome

National Academy of the Lincei (*Atti*, 24, 393-487; 1936).

L. TONELLI: (1) Problem of Plateau (2). (2) Semi-continuity in the problems of Mayer and of Lagrange.

O. M. CORBINO: Method of calibrating the electrostatic microphone based on its behaviour towards an alternating electromotive force.

O. BARBA: Definite polynomials (1). Fundamental problems.

R. CACCIOPOLI: Branched inverted functional correspondences: general theory and applications to some non-linear functional equations and to Plateau's problem (2).

E. LEVI: Characteristic properties of Laplace's transformation.

G. ARRHENIUS: Isocarene oscillations about the configurations of general equilibrium (2).

E. GUGLINO: Variational problem which assumes prefixed trajectories.

C. JACOB: Bifurcation of a liquid jet due to a circular obstacle.

L. SONA: Transo-circulatory current in presence of an obstacle formed by two crossed laminae.

G. BOAG: Localization of a spherical body by means of Eötvös measurements.

A. BARONT: Electron diffraction study of the graphitization of some industrial lamp-blacks.

A. LANDRELL and E. BOTTE: Crystal structure of the compounds of the rare earths with the metalloids of the fifth group. Phosphides of lanthanum, cerium and praseodymium (1).

G. NATTA and L. PASSERINI: Dimorphism of white phosphorus.

F. RODOLICO: Granular forms of melilitic rocks.

G. NEGODI: Further contributions to the cariology of the genus *Fumaria*.

W. JABLONSKI: Survival and mitosis of free epithelial cells *in vitro*.

G. LOLLI: Thyroid function and experimental alcoholism.

E. SERIANI: The action of morphine on the curve of experimental alcoholism in the normal man.

Sydney

Royal Society of New South Wales, June 2.

ADOLPH BOLLIGER: Compounds of creatinine with alkali hydroxides. In an alcoholic medium, creatinine forms with sodium, potassium and rubidium hydroxide, crystalline compounds which can be readily isolated and which may consist either of one molecule of creatinine, one of alkali hydroxide and one or two of water, or of one atom of alkali and two or three molecules of water.

G. F. K. NAYLOR: A preliminary note on the occurrence of Palaeozoic strata near Taralga, N.S.W. Recent investigations near Taralga have shown that Palaeozoic sedimentation is represented in that area by Upper Ordovician, Upper Silurian and Upper Devonian strata, their respective ages being determined conclusively by the presence of fossils. The general rock pattern conforms to, and is continuous with, that previously determined in the Goulburn district. An interesting point is the finding of black shale containing *Monograptus bohemicus*, interbedded with highly fossiliferous Upper Silurian limestones. This indicates that the latter are of Lower Ludlow age, and owing to the restricted range of that graptolite, may lead to a more exact correlation of N.S.W. Silurian rocks with British and Victorian occurrences than has hitherto been possible.

A. J. BRON: The detection and estimation of α -phellandrene in essential oils. This paper describes an adaptation of the 'diene' synthesis to the detection of α -phellandrene in small quantities, and its estimation in the presence of *p*-cymene, cineol, limonene or α -pinene.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (NOTTINGHAM MEETING).

Wednesday, September 1

At 8.30 p.m.—Sir Edward Poulton, F.R.S.: "The History of Evolutionary Thought, as recorded in the Meetings of the British Association" (Presidential Address in the Albert Hall).

Thursday, September 2

At 10 a.m.—Sir William Bragg, O.M., K.B.E., Pres. R.S., Dr. G. Shearer, Dr. J. D. Bernal, F.R.S., J. T. Randall and H. P. Rookby, Dr. A. J. Bradley, and R. M. Powell and W. A. Wood: "X-Ray Methods and Industry" (Symposium: Section A).

Dr. F. L. Pyman, F.R.S., Prof. H. Horlein, Sir Gilbert Morgan, Dr. W. Kikuth and Prof. R. Robinson, F.R.S.: "Some Aspects of Chemotherapy" (Symposium, including Dr. Pyman's Presidential Address entitled "Researches in Chemotherapy": Section B).

Prof. F. A. E. Crew: "The Sex-Ratio" (Presidential Address: Section D).

H. Wolfe, C.B., C.B.E., H. M. Hallsworth, C.B.E. Dr. O. A. Osor and A. D. K. Owen: "Labour Transference" (Discussion: Section F).

Dr. E. P. Poulton: "Heat Production, Nutrition and Growth in Man—Some New Views" (Presidential Address: Section I).

Prof. E. J. Salisbury, F.R.S.: "The Modern Study of Plants in Relation to Education" (Presidential Address: Section K).

H. G. Wells: "The Informative Content of Education" (Presidential Address: Section L).

J. M. Cole: "State Intervention in Agriculture" (Presidential Address: Section M).

Sir Alexander Gibb, G.B.E., C.B., F.R.S.: "Research in Engineering" (Presidential Address: Section G).

Prof. D. Burns, A. L. Bacharach, Mrs. C. M. Burns, Dr. G. E. Friend, Prof. E. Atzler, Prof. S. J. Cowell: "Contribution of Physiology to the Health of the Individual and the Community" (Discussion: Section I).

At 2.15 p.m.—Prof. J. Ritchie: "The Outlook of Natural Science" (Presidential Address to the Conference of Delegates of Corresponding Societies).

Friday, September 3

At 10 a.m.—Dr. G. W. O. Kaye, O.B.E.: "Noise and the Nation" (Presidential Address: Section A).

Prof. C. R. Harington, F.R.S., Dr. K. Linderström-Lang, Dr. W. T. Astbury, Dr. D. M. Wrinch, Dr. A. Neuberger and J. St. L. Philpot: "Protein Chemistry" (Symposium: Section B).

Prof. L. J. Wills: "Pleistocene History of the West Midlands" (Presidential Address: Section C).

Dame Helen Gwynne-Vaughan, G.B.E., Prof. F. A. E. Crew, Prof. R. A. Fisher, F.R.S., Dr. F. W. Sansome, Dr. C. D. Darlington, Dr. P. C. Koller, E. B. Ford and Dr. J. S. Huxley: "Recent Work in Genetics and Cytology" (Joint Symposium: Sections D and K).

Prof. C. B. Fawcett: "The Changing Distribution of Population" (Presidential Address: Section E).

Prof. P. Sargent Florence: "Economic Research and Industrial Policy" (Presidential Address: Section F). Prof. F. G. Bailey and A. P. M. Fleming: "Training of University Graduates for the Engineering Industry" (Discussion: Section G).

Prof. J. H. Hutton, C.I.E.: "Assam Origins in Relation to Oceania" (Presidential Address: Section H).

Dr. Mary Collins: "Tests in Common Use for the Diagnosis of Colour Defect" (Presidential Address: Section J).

Prof. A. M. Carr-Saunders, Sir Frank Fletcher, Mrs. E. V. Parker, M. A. Deedee and Dr. Graef: "Education for the Community" (Discussion: Section L).

L. Holland, J. Macdonald, J. T. Fitzherbert, Dr. S. E. Wilson, C. J. Jones: "Mining Timber" (Symposium: Section K*).

Discussion on "Anthropology and Administration" (Section H).

At 7.30 p.m.—Prof. J. Walton: "Coal and its Origin" (Popular Lecture at Mansfield).

At 8 p.m.—R. Kay Greenwell: "Rivers and Waterways" (Public Lecture at Lincoln).

At 8.30 p.m.—Dr. R. E. Slade: "Grass and the National Food Supply" (Evening Discourse).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

TECHNICAL OFFICER AND ASSISTANTS (grades II and III) at the Air Defence Experimental Establishment, Bagin Hill, Kent (September 1).

ASSISTANTS (grade III—electrical engineering and photographic equipment) at the Royal Aircraft Establishment, South Farnborough, Hants.—The Chief Superintendent (September 3).

RESEARCH ASSISTANT IN CHEMISTRY (radioactivity) in the University of Manchester—Prof. M. Polanyi (September 6).

DEMONSTRATOR IN HISTOLOGY AND EMBRYOLOGY in the Royal Veterinary College and Hospital, Camden Town, London, N.W.1.—The Secretary (September 7).

UNIVERSITY ASSISTANT IN AGRICULTURAL BOTANY in the University of Aberdeen.—The Secretary (September 14).

PROFESSOR OF BOTANY in the University College of the Orange Free State, Bloemfontein.—The Rector (September 30).

EXAMINER (Chemist) in the A.I.D. Test House, Kidbrooke (Non-Metallic Material Section, Oils and Petrols Sub-Section)—The Secretary [S.2 (d)] Air Ministry, Kingsway, W.O.2 (October 31).

WATERWORKS ENGINEER for the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/5346).

LECTURER IN GEOLOGY in the University of Rangoon.—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, W.O.1.

PROFESSOR OF ANATOMY in the University of Melbourne.—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, W.O.1.

Official Publications Received

Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology, No. 10: The Effects of Light and of Oxygen on the Uptake of Sugar by the Foliage Leaf. By B. Phillips and T. G. Mason. Pp. 231-237+2 plates. (London: Empire Cotton Growing Corporation.) 2s. 6d. [48]

Technical College, Bradford. Diploma and Special Day Courses, Session 1937-1938. Pp. 261+21 plates. (Bradford: Technical College.) [48]

British Non-Ferrous Metals Research Association. Research Report, Association Series No. 440: The Fatigue Resistance of Lead and Lead Alloys (Summary Report). By H. Waterhouse. Pp. 8. (London: British Non-Ferrous Metals Research Association.) 2s. [48]

I.O.L. Game Researches. Advisory Leaflet No. 12: Disease; some Simple Treatments. Pp. 10. Advisory Leaflet No. 13: Partridge Stocks and Mortalities. Pp. 10. (London: Imperial Chemical Industries, Ltd.) [58]

Transactions of the Institution of Chemical Engineers. Vol. 14, 1936. Pp. iv+176. (London: Institution of Chemical Engineers.) [58]

The North of Scotland College of Agriculture. Calendar, Session 1937-1938. Pp. viii+128. (Aberdeen: North of Scotland College of Agriculture.) [58]

Department of Scientific and Industrial Research. Forest Products Research Records, No. 19 (Seasoning Series, No. 4): Methods of Kiln Operation. By B. G. Bateson. Pp. ii+13+4 plates. (London: H.M. Stationery Office.) 6d. net. [58]

River Flow Records. By Capt. W. N. McClean. Series A: River Garry. Sheet No. 1. 1s. 6d. Series B: River Morriston. Sheet No. 1. 1s. 6d. Series C: River Ness. Sheets 1-14. In portfolio. 15s. (London: River Flow Records.) [58]

British Trust for Ornithology. Third Report, Summer 1937. Pp. 38. (London: British Trust for Ornithology.) [58]

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1936. Pp. iv+603+10 plates. (London: H.M. Stationery Office.) 15s. net. [98]

Imperial Agricultural Bureau. Herbage Publication Series, Bulletin No. 19: Production of Grass Seed: an International Exchange of Opinions and Experiences on the Technique of Producing Seed of Gramineous Herbage and Forage Plants. Edited by R. O. Whyte. Pp. 46. 6s. Herbage Publication Series, Bulletin No. 20: Insects and other Pests Injurious to the Production of Seed in Herbage and Forage Crops. By H. F. Barnes. Pp. 31+iii. 2s. 6d. Herbage Publication Series, Bulletin No. 21: The Influence of Climatic Conditions on Type Composition. By Nils Sylven. Pp. 8. 1s. (Aberystwyth: Imperial Bureau of Plant Genetics, Herbage Plants) [118]

Other Countries

Department of Public Instruction, Technical Education Branch: New South Wales Technological Museum: Curator's Annual Report for Year ended 31st December 1936. Pp. 6. (Sydney: Government Printer.) [48]

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 16: The General Theory of the Gradient of Pressure under a Structure on Permeable Foundations, with Applications to the Evaluation of the Gradient at Exit for some Standard Cases. By Jal K. Malhotra and Dr. H. MacKenzie Taylor. Pp. 10. 3 annas; 4d. Research Publication, Vol. 3, No. 2: The Soils of the Race Areas of the Gufunwala and Sheikhpura Divisions of the Upper Chenab Canal. By M. L. Mehta. Pp. 25+iii+4 plates. 10 annas; 1s. Research Publication, Vol. 3, No. 3: A Study of the Soil Profiles of the Punjab Plains with reference to their Natural Flora. By R. C. Hoon and M. L. Mehta. Pp. 47+10 plates. 18 rupees; 1s. 10d. (Lahore: Punjab Irrigation Research Institute.) [48]

U.S. Department of the Interior: Office of Education. Pamphlet No. 70: Per Capita Costs in City Schools, 1935-36. By Lula Mae Comstock. Pp. 24. 10 cents. Pamphlet No. 73: Subject Registrations in Private High Schools and Academies, 1933-34. Text by Carl A. Jensen; Statistical Tables by Lester B. Herlihy and Mrs. Blanche K. Choate. Pp. 30. 10 cents. (Washington, D.C.: Government Printing Office.) [48]

Field Museum of Natural History. Botanical Series, Vol. 9, No. 3: Useful Plants and Drugs of Iran and Iraq. By David Hooper, with Notes by Henry Field. (Publication 387.) Pp. 69-243. 1.50 dollars. Botanical Series, Vol. 17, No. 1: The North American Species of *Bumex*. By K. H. Bechtler, Jr. (Publication 386.) Pp. 152. 1.50 dollars. (Chicago: Field Museum of Natural History.) [48]

Proceedings of the United States National Museum. Vol. 84, No. 3020. Synopsis of the Puerto Rican Beetles of the Genus *Mordellistena*, with Descriptions of New Species. By Eugene Ray. Pp. 359-400. (Washington, D.C.: Government Printing Office.) [48]

Smithsonian Miscellaneous Collections. Vol. 91, No. 27: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. A New Species of Deep-Sea Fish, *Argyropsomus antropeus*, of the Family Sternopachidae. By Leonard G. Schultz. (Publication 3439.) Pp. ii+6. Vol. 96, No. 8: Phototropic Response and CO₂ Assimilation of Plants in Polarized Light. By Earl S. Johnston. (Publication 3440.) Pp. ii+8. (Washington, D.C.: Government Printing Office.) [48]

Carnegie Institution of Washington. Publication No. 480: Delta, Estuary and Lower Portion of the Channel of the Colorado River 1933 to 1935. By Godfrey Sykes. Pp. vi+70+6 plates. (Washington, D.C.: Government Printing Office.) 1.25 dollars. [58]

International Institute of Agriculture. Studies of the Principal Agricultural Products on the World Market. No. 1: World Cotton Production and Trade. Pp. xii+463+20 plates. (Rome: International Institute of Agriculture.) 80 lire. [68]

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 20, Memoir No. 6: The Mesozoic Brachiopoda of the Attock District. By Dr. Helen M. Muir-Wood. Pp. iv+24+1 plate. (Calcutta: Geological Survey of India.) 2.2 rupees; 4s. [98]

Pasteur Institute of India, Kasauli. The Thirty-fifth Annual Report of the Director of the Institute for the Year 1935, Part 2. Pp. 49. (Kasauli: Pasteur Institute of India.) [98]

Annual Report of the Imperial Council of Agricultural Research for 1936-1937. Pp. v+119. (Delhi: Manager of Publications.) 1.2 rupees; 2s. [98]

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1936. By J. P. Mead. Pp. iii+66+5 plates. (Kuala Lumpur: Government Printer.) 1 dollar; 2s. 4d. [98]

Indian Forest Records (New Series). Vol. 1, No. 5: Second Interim Report on Work under Project 8 (Testing of Indian Timbers for Veneer and Plywood). By W. Nagle. Pp. iv+115-141. 14 annas; 1s. 6d. Vol. 3, No. 1: Entomological Investigations on the Spike Disease of Sandal (81) Dermoptera and Orthoptera. By Dr. L. Chopard and N. C. Chatterjee. Pp. ii+30. 1 rupee; 1s. 6d. Vol. 3, No. 2: Immature Stages of Indian Coleoptera (21) Cleridae. By J. C. M. Gardner. Pp. 31-47+2 plates. 12 annas; 1s. 3d. (Delhi: Manager of Publications.) [98]

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 8. Malayan Agricultural Statistics, 1936. By D. H. Grist. Pp. xii+91 tables. 50 cents. General Series, No. 25: Reports of the Research, Economic and Agricultural Education Branches for the Year 1936. Pp. ii+97. 50 cents. (Kuala Lumpur: Department of Agriculture.) [98]

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, Bulletin No. 51: Soil and Plant Material Analyses by Rapid Chemical Methods. II. By Francis M. Hance. Pp. 135-180. (Honolulu: Hawaiian Sugar Planters' Association.) [108]

Field Museum of Natural History. Botany Leaflet 21: Tea. By Llewelyn Williams. Pp. 30. (Chicago: Field Museum of Natural History.) 25 cents. [108]

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Vol. 140

Processes of Organic Evolution

ONE of the difficulties about organic evolution is that it has not been and probably cannot be demonstrated in a strict sense, and although the indirect lines of evidence converge with such unanimity upon the probability of the theory that the scientifically trained mind is convinced, a loophole for doubt remains to the multitudes who must rely upon the dictum of authority one way or the other.

The evolutionist who rests upon his oars, convinced that the stream is running with him, misjudges the set of at any rate one considerable part of the current. "Le problème de l'Evolution paraissait plus près de sa solution, il y a quarante ans, que maintenant", wrote Prof. Caullery, and the critical examination of "le Transformisme" is a noticeable activity of French thought at the moment. In America the anti-evolution or Fundamentalist position is well entrenched. There in June the monthly magazine *Evolution*, described as "A Journal of Nature; For Popular Education in Natural Science, to Develop the Open Mind", reappeared after a lapse of five years due apparently to lack of supporters interested in open minds; and the editor, after interviewing 20,000 persons, says, "I am more convinced that there is a need and a real field for *Evolution* than I was before I started." He was advised if he wished to make a commercial success of his journal to change *Evolution* to some "less offensive" name. In Great Britain the feeling against evolution lies rather under the surface, but it exists, and we recall the surprise with which we listened to the announcement of a University student that she did not propose to answer any examination question upon evolution, because neither she nor her parents believed in it!

When, therefore, Sir Edward Poulton in the course of his charmingly reminiscent presidential address to the British Association on "The History of Evolutionary Thought, as recorded in Meetings of the British Association", which is printed in the Supplement to this issue of *NATURE*, passed lightly over "the subject of organic evolution itself, *as generally accepted*" (our italics), he spoke truly of his scientifically minded audience, for he recalled only one example of opposition to a belief in organic evolution, and that was at the first meeting he attended, in 1881. But the swamping of two thousand scientific workers by a week-end influx of trippers during the Blackpool meeting gave perhaps a rough indication of the number of believers to the masses who do not understand evolution, who do not care, or who are actively or passively opposed. The position, however, is gradually changing. The idea of evolution, as understood to-day, is comparatively new, and the natural death of prejudice, together with the diffusion of knowledge in school and college, and particularly through the far-reaching voice of the radio, are paving the way for the general recognition of a process the idea of which has become a commonplace of scientific thought.

Evolution rests upon two primary or basic factors: the vital characteristic of organisms to produce variations, and the heredity which makes possible the establishment or perpetuation of these variations. Both aspects have been discussed at meetings of the British Association, but the tendency has been for debate to centre upon the secondary or guiding factors, the means by which the course of evolution has been directed. Here there has been controversy enough since natural selection took the field, and particularly since that

discussion in 1887 at Manchester upon "The Hereditary Transmission of Acquired Characters" in which Weismann took part, who all but strangled the idea of the inheritance of acquired characters at its resuscitation.

Into this controversy, Sir Edward Poulton in his address threw himself with gusto and with many recollections of the great debaters of the past, for he himself during the last fifty years has been in the forefront of the battle. Having nailed his colours to the mast, he picked here and there from the meetings of the last half-century opinions or evidences in favour of the efficacy of natural selection, notably from Prof. Alfred Newton and Canon Tristram, and against the inheritance of acquired characters by Ray Lankester.

The recalling of these contentions is a reminder of the difficulty of adducing real proof of any theory of evolutionism, and of the assumptions which the early followers of Darwin permitted themselves. Take the quoted case of Canon Tristram's larks of North Africa, where a sandy area has a long-billed, and a rocky district a short-billed species. The assumption made was that "the shorter-billed birds would be at a disadvantage in obtaining food from sandy areas but at an advantage among the rocks where strength is required". A plausible assumption, but, unbacked by a thorough analysis of the food consumed and the food available, no more than an assumption.

Compare Tristram's evidence with the more complete observation of bill structure made by Joseph Grinnell in Lower California, where in a peculiar area of meagre rainfall and high atmospheric humidity (a humid desert) he found that lesser size of bill was a common feature of birds as different as flycatchers, finches and woodpeckers. It is difficult, but not impossible, to assume that birds of feeding habits so diverse could all benefit by exactly the same kind of modification, so that, for each, environment should select similar variations. It is even more difficult to make the assumption, since other common modifications occur in all these birds, such as deeper coloration and certain proportions of wing and tail. What seems to be clear is that environment has been at work, and has induced the living organism to respond in similar manner, no matter that the stocks were of different pedigree. But does that imply the inheritance of acquired characters? Even here more evidence about food and habits is necessary before any valid conclusion can be drawn.

So it is, unfortunately, with most of the observations adduced in support of particular means of evolutionary progress. Sir Edward Poulton mentioned the work of Weldon and Thompson on the influence of impurities in the sea at Plymouth upon the frontal width of the common shore crab, which, it was suggested, ensured that the water flowing over the respiratory surface was more efficiently filtered. But these observations and experiments, beautifully convincing as they appear to be at first sight, have been criticized so reasonably and ably that the conclusions cannot be accepted with any confidence.

The fact of the matter is that the story of evolutionary thought shows, as regards the processes of evolution, that the first flush of enthusiasm, with its easy evidences and somewhat uncritical observations, has passed, and that science will be satisfied only with careful records or controlled experiments safeguarded so as to convince the open but critical mind. To this new evidence the naturalist, as well as the experimenter, must make his contribution; but for the naturalist also the conditions become more stringent, and, to take another example, the statistical analysis in relation to protective patterns of food taken by a bat will be regarded as valid only when viewed in relation to the abundance of the food items and their availability at the time and place of the bat's collecting; and that is no simple series of observations.

In another way, investigation into the modes of evolutionary progress is likely to undergo modification. Few biologists, nowadays, doubt that natural selection has played a great part in guiding that progress; it is taken to be, as Bateson took it, self-evident. But natural selection merely plays with variations created by the organism; the vital problem lies deeper. Does the vitality of the organism, a thing of wondrous properties, really express itself in non-significant variations left entirely for Nature to carve into line, or does it respond more directly to the environment in such a way that subsequent generations share in the response, or does it even more directly handle its own fate by striking out in determinate lines of its own—it being postulated, of course, that whatever the source of the variations they must afterwards come under the pruning hook of natural selection? There seem to lie the evolutionary problems of the immediate future for the eager student of biology.

Ancient Fauna and Early Man at Bethlehem

THE report on the bone-bearing beds of Bethlehem by Miss E. W. Gardner and Miss D. M. A. Bate, appearing in this issue of *NATURE* (see p. 431), summarizes the results of three years' excavation on a site situated in the highest part of Bethlehem on the highest point of the Judean arch, of which the importance for the physiography and palaeontology of Palestine was established in 1934 by the discovery of the fossil remains of an elephant, the first evidence of the former existence of this extinct species in this geographical region.

Since that date, as Miss Bate shows, the Bethlehem bone beds have yielded evidence of an extinct fossil fauna, which is not only almost entirely new to Palestine, but is also of earlier geological age than any found there hitherto. Further, from the gravels of these deposits have come 'flints', which may prove to be the earliest trace of man in Palestine.

The character of the geological deposits in which the fossil fauna occurs, as is indicated in Miss Gardner's report, is such as to add considerably to the importance of the discovery. The bones were found in water-borne gravels deposited on a cemented scree, or breccia, weathered sub-aerially. The lie of the deposits is such that it is evident that they cannot have been laid down originally in the position in which they are now found. While Miss Gardner exercises a wise discretion in refraining from any premature conjecture as to their origin before excavation is complete, she goes so far as to suggest that the condition of the deposits may be due either to the collapse of the original floor or to the filling of a funnel-shaped hole. These conditions are of prime importance in pointing to movement and physiographic changes, indicating a considerable antiquity.

While the evidence of geology, pending further investigation, is thus reticent as to questions of origin and chronology, the aid of other branches of investigation—archaeology and palaeontology—is invoked to give evidence on the question of dating; and here is brought forward what to many certainly will seem the most startling evidence from this investigation. Miss G. Caton-Thompson, whose experience in dealing with early Stone Age forms in the East entitles her to speak with authority, has found in the vast multiform assemblage of cherts in the gravels, showing

evidence of subjection to a variety of forces, a number of pieces which she holds it difficult to explain except as humanly fashioned tools. Drawing a pregnant comparison with Mr. Reid Moir's 'artefacts' from the Red Crag of Foxhall and the sub-Crag detritus bed flints of Bramhall, she regards many of the Bethlehem 'artefacts' as conforming closely "in shape and edge trimming to the classic type of Harrisonian eolith". She goes on to point out that this is the first time such evidence has been found in a sealed deposit in Palestine—evidence which "is less easily reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man in remote pre-Chellean times".

The archaeological evidence, thus possibly the earliest indication of man's appearance in Palestine, gains in significance when brought into relation with the interpretation of the palaeontological data, as regards geographical distribution and dating.

The crucial point is the occurrence of the diminutive form of horse, *Hipparion*, previously known from various deposits in Asia of Tertiary age, but recently reported from the Pleistocene of India, and now well known from the Pleistocene deposits of East Africa. With it goes the evidence of other members of the Bethlehem fauna, also pointing to an affinity with Asiatic forms of like age. Miss Bate, therefore, in summing up, concludes by suggesting that the Bethlehem fauna in origin is Asiatic and that its age is not later than early Pleistocene, adding that it provides a faunistic link for this period between Asia and East Africa.

It need scarcely be said that if Miss Caton-Thompson's tentative acceptance of the specimens she has selected as artefacts is well grounded, this discovery at Bethlehem will prove of transcendent importance in the consideration of the problem of the distribution of early man. It would be premature to enlarge on this aspect before the specimens have received further expert consideration; but it may be pointed out that these excavations serve to reassert the growing importance of Palestine for the problems of early man, already demonstrated in Miss Garrod's excavations and the investigations of Sir Arthur Keith and Mr. T. McCown on the physical characters of the early forms of man from Mount Carmel.

Scientific Aspect of Chinese Glazes

Chinese Ceramic Glazes

By A. L. Hetherington. (Courtauld Institute of Art.) Pp. x+76+14 plates. (Cambridge: At the University Press, 1937.) 10s. 6d. net.

THIS concise and simply written treatise, which embodies an amplification of a series of lectures given recently by the author at the Courtauld Institute of Art, links together scientific facts and archaeological knowledge concerning the chief glaze effects produced by Chinese potters during a period extending over some two thousand years.

A preliminary chapter is devoted to general considerations on the nature of the glazes, slips and earthenware bodies employed by successive generations of Chinese potters, on the effect of oxidation and reduction upon the colouring materials used in glazes, and on the modifications produced in these colour effects by the relative proportions of acidic and alkaline constituents in a glaze.

It is a striking testimony to the long-sustained art of the Chinese potter that nearly all his earlier colour effects were achieved by the use of only two metals, iron and copper. The old and fascinating 'iron' story, well exemplified by the ceramic ware shown at the Chinese Exhibition in London of 1935, explains the great variety of colour tints induced in glazes by varying amounts of the three iron oxides. Temperature conditions of firing and the presence of alkalis affect the final colour very appreciably. The pale blue ferrous oxide glaze of certain translucent porcelains dating from Sung times, on spectroscopic examination in the electric arc has shown persistent evidence of the lithium spectrum, a fact which points to the

presence of lithia-mica in the original felspathic glaze (Chinese petuntse).

The range of colour produced by ferric oxide is even more extensive than of ferrous oxide, and, as the author has shown experimentally with boric acid and alkali borates, is greatly affected by the acidity or alkalinity of the glaze constituents.

The 'copper' story is equally remarkable, for the colour effects produced by cupric oxide and its reduction product, colloidal copper, are of the highest artistic merit. The author discusses in detail the scientific principles underlying the production of *sang-de-bœuf*, *chün-yao*, *flambé* and *peach-bloom* glazes, this section being illustrated by several coloured plates.

Under the heading of other glaze effects, a section is devoted to the use of cobalt, manganese and gold. The first two metals are utilized as colouring materials in the form of their oxides; whereas the *famille rose* wares owe their characteristic tints to the use of minute amounts of colloidal gold. This chapter contains also references to opalescence and to crackle, the latter effect being a special and popular feature of Chinese porcelain, which often develops on ageing a delayed crazing or double crackle.

This book, which contains fourteen plates, concludes appropriately with an informative glossary of Chinese and other technical ceramic terms. A selected bibliography is also included of works on Chinese ceramics, among which are to be noted two earlier publications by Mr. Hetherington on the porcelain factories and ceramic wares of China. To these authoritative treatises the present book forms a useful complementary volume.

G. T. MORGAN

The Future of Statistical Mechanics

Statistical Mechanics:

the Theory of the Properties of Matter in Equilibrium. By Prof. R. H. Fowler. Second edition, revised and enlarged. Pp. x+864. (Cambridge: At the University Press, 1936.) 50s. net.

PROF. R. H. FOWLER'S monumental work on statistical mechanics has, in this the second edition, in his own modest words, been rearranged and brought more up to date. But the new volume is much more than a revision, in that it is explicitly based on quantum mechanics from the outset; the first dynamical equation found written in

the formal presentation is a wave-equation. Prof. Fowler states in justification that although classical mechanics is used to derive the quantum mechanics by a process of generalization. "once the laws of quantum mechanics have been thus guessed, as they must be before we can discuss the theorems of statistical mechanics, quantized systems naturally come first. In 1935 this attitude hardly needs apology". In consequence of this, the concluding chapter of the first edition, dealing with quantum statistics, has been incorporated in the new exposition from the start, and what is

effectively the opening chapter is now doubled in length. Otherwise there is no change of general structure. But a comparison of the two editions shows that the chapter of the first edition entitled "Thermionics" is now more than four times as long, and contains a treatment of the electron theory of metals and of semi-conductors; that the chapter on dielectrics and magnetic constants has been similarly extended, and now includes an account of ferro-magnetism; lastly, there is a new concluding chapter on "co-operative" and other phenomena. The number of references is almost doubled. It is difficult to over-estimate the amount of work involved in thus re-writing and extending what was already an encyclopædic work.

The fascinating introductory chapters raise a number of interesting questions in the mind of the reader. One is that of the physical origin of the extreme generality of statistical mechanics. It is a logical structure, based on certain laws of quantum dynamics which are themselves inductions from certain special sets of phenomena; but, as Prof. Fowler remarks, the structure is "not visibly constructed to fit the facts", that is, the facts concerning phenomena in the domain of large numbers of interacting systems. "Results have been at each stage deduced from the general theory, and checked by comparison with experiment". But the comparisons with experiment are far more than a checking of the results. The comparisons with macroscopic thermodynamics do more than test the formulæ derived: they permit the *identification* of symbols introduced abstractly, as part of the mathematical apparatus, with entities known physically in a different guise. One example is the identification of the abstract symbol Ω with the factor $e^{-1/kT}$, where kT is known physically from the more concrete dynamical theory of gases; a second is the identification of a symbol with the thermodynamic entropy; a third is the identification of a set of symbols with the thermodynamic partial potentials. The structure exists independently of these identifications: the identifications permit us to recognize the correspondence of the abstract scheme with Nature. Some of Gibbs's theorems in pure thermodynamics were known as logically unexceptionable results before the corresponding phenomena were fully studied. How comes it that statistical mechanics is in an even more powerful position?

It is impossible to answer such a question in a review. But it may be recalled that a necessary, if not a sufficient, condition that a logically correct structure shall 'correspond' with Nature is that it shall also be epistemologically correct. There must exist some ground for our direct acquaintance with the entities introduced, in the sense used in the theory of knowledge. In some way, statistical

mechanics must be, also, epistemologically 'sound'. Yet in the first dynamical equation used by Fowler, already mentioned, there occurs the symbol ψ , whose epistemological status is, to say the least, doubtful. This dynamical equation of motion is, however, preceded by a dynamical *statement*, concerning the structure of a Hamiltonian, based on classical mechanics, all the terms in which are assumed directly knowable by observation. The Hamiltonian, in this case that for an ideal linear oscillator, is the *definition* of an oscillator as required for the purposes of the theory. In other words, we make clear to the reader what we are talking about by tacitly supposing a correspondence between the crude physical picture of an oscillator and the terms in a mathematical expression. Out of such axiomatic definitions mathematical physics arises, but here there is a jump from the axiomatic definition to the associated wave-equation. In cruder forms statistical mechanics existed before wave-mechanics was known, though it still had to make certain appeals to a quantum theory. There would seem possibly to be scope for a treatment which is confined to the properties of assemblies of large numbers of systems and originates from axiomatic definitions concerning such alone.

Prof. Fowler mentions the well-known consideration that the fact that a particular mechanism leads to a state of complete equilibrium in agreement with experimental facts is no evidence for the particular mechanism discussed. It is merely evidence that the laws of the mechanism have been correctly and consistently written down. It follows that there are certain restrictions on the laws of the mechanism, for they might have been incorrectly written down. An example of such a restriction is the principle of detailed balancing. It would be interesting to know the complete set of restrictions which statistical mechanics imposes. Are they merely that the mechanism must obey the laws of dynamics assumed as a basis for statistical mechanics? If not, how much less restrictive a dynamics is all that is necessary?

Prof. Fowler takes a somewhat pessimistic view of the future of statistical mechanics when he writes that "developments in the near future seem likely to consist mainly of applications to more and more complicated models . . . designed to account for more and more subtle properties of matter in equilibrium". Two possible lines of development offer themselves, both suggested by remarks of the author himself. One is in the statistical mechanics of non-enclosed assemblies. Prof. Fowler writes: "All assemblies whose equilibrium states can be discussed are necessarily *enclosed* assemblies. An unenclosed assembly to which all space is accessible does not in general

possess an equilibrium state about which anything significant can be said". But is this true? It would be highly interesting to obtain theorems of statistical mechanics valid in an unenclosed finite space or in an expanding sphere of inaccessible boundary. The latter case would have the added charm that the number of systems that it would be necessary to consider would be truly infinite and not merely 'large'.

Again, the part of an assembly which for the greater part of time has practically an independent existence is called a *system*, and statistical mechanics is in part the study of the equilibrium states of assemblies of such quasi-independent systems. But the dynamics of a system, still more of an assembly, seems to be an aspect of the relation of such an assembly or system to the rest of the matter in the universe; the laws of dynamics are derivable from a study of such relationships. If so, in what sense are the systems 'independent'? They are formally independent *given the laws*, but not independent when the dynamical laws themselves are subject to examination. This gives one an uneasy feeling that the present status of statistical mechanics is uncertain, and that a thorough-going treatment would indeed contemplate at one blow the interactions of *all* the particles in the universe. Is it not possible that some features of the distribution of spiral nebulae in the whole universe, their mean separations, masses and proper motions, could be studied by the methods of statistical mechanics?

The other line of development is the problem of steady states which are not equilibrium states. Consider, for example, the one-dimensional flow of heat through a gaseous assembly maintained in a steady non-isothermal state by the imposition of plane boundaries kept at given unequal temperatures. The gas must settle down into a steady state of maximum entropy subject to the given boundary conditions. Such a non-equilibrium steady-state is composed of independent systems interchanging energy, and indeed handing on energy across each plane section at the same rate. If, therefore, the boundary conditions of given temperatures could be stated in molecular language, the whole problem could be treated as a maximum or average problem by the usual methods of statistical mechanics. The trouble comes in in the precise formulation of the boundary conditions at the two ends in kinetic language when they are merely given in thermodynamic language. Since we know that the whole phenomenon is a 'transport' phenomenon, involving the sizes or free paths of the systems, we cannot hope to solve the problem without some discussion of mechanism. But the mechanism that is relevant is surely mainly the mechanism of transfer at the two end-boundaries, and it is just because the problem suggests the hope of a statistical calculation throwing light on mechanism that this problem is so attractive. I believe the problem to be in fact tractable.

E. A. M.

Plant Protection

The Scientific Principles of Plant Protection: with Special Reference to Chemical Control. By Dr. Hubert Martin. Pp. xii + 379. (London: Edward Arnold and Co., 1936.) 21s. net.

IN these days of selected races, artificial fertilizers and other specialized conditions, plants are proving alarmingly susceptible to attack, and there has in consequence grown up a technique regarding their protection and a science to correspond where mycologist and entomologist, chemist and physicist, meet on equal ground. 'Plant doctors' abound and there are numerous remedies varying from the spraying with copper preparations, which make the vineyards of the Rhine look so unnatural, to the use of other and beneficial insects to control the malevolent. The late Prof. H. E. Armstrong pictured for us the golfer salting his way over the greens with copper arsenate followed by the bodies of earthworms.

Like Sir Albert Howard, he preached the supreme value of good nutrition based on an organic compost and believed that the outbreaks of disease are due to lack of organic manure; that, in short, properly fed plants, like properly fed animals, would be largely resistant to disease and the road to health is through organic protective foods.

Evidence is accumulating in favour of this view and it is one which plant growers cannot afford to neglect in the future. In the meantime, farmer, fruitgrower and gardener have to face the ravages of blights and pests on their new varieties of plants, due in part to the fact that massing favours the spreading of chance infection: it is a fact that the more intensive the cultivation the greater the risks. Most of these were practically unknown a few years ago and so there has been an urge to find remedies to combat them. Dr. H. Martin, of Long Ashton, one of the most active and successful

horticultural research stations, has long been regarded as an expert on the subject and the present book is a second edition, though since it has been rewritten and reset, since every phase of the subject has developed during the intervening eight-year period, it may virtually be regarded as a new book.

It is a well-balanced production with the material arranged in logical order—plant resistance is in the foreground, the factors which make plants susceptible come next and then follow several chapters on biological control, fungicides and insecticides; weed killers, fumigants, seed and soil killers, complete the list, though Dr. Martin has also something to say about traps.

A goodly list of chemicals is paraded before our eyes, as numerous as the nostrums in the druggist's

shop, and it is no wonder, in the words of Sir Daniel Hall, that "great commercial firms have embarked upon the manufacture of suitable materials for sprays and washes and have themselves promoted investigation in their desire to produce useful remedial preparations".

At the foot of the plants is the soil, which receives more than its share of the remedies, with an effect on its own fauna and flora which can only be imagined. The worms certainly object, but to-day Darwin's famous book on earthworms is out of date, and probably green-keepers do not read it.

The fact that the other side of the picture has been emphasized here must in no way be allowed to detract from the excellence of Dr. Martin's book or the economic importance of the application of the methods he describes. E. F. A.

Gases and Metals

Gases and Metals:

An Introduction to the Study of Gas-Metal Equilibria. By Dr. Colin J. Smithells. Pp. vii + 218 + 4 plates. (London: Chapman and Hall, Ltd., 1937.) 18s. net.

THE behaviour of metals towards the common gases is important to many industries, but investigators who have been concerned with its various aspects have had little contact with each other, and the subject has not hitherto been adequately treated from a theoretical point of view. Dr. Smithells's book is therefore extremely welcome, and its wide scope and original outlook make it a most valuable addition to metallurgical literature.

The work is divided into three chapters, which deal respectively with the adsorption of gases on the surface of metals, the diffusion of gases through metals, and their solution in metals. In each chapter there is a short general introduction and a brief description of the experimental methods, followed by a comprehensive survey of the most reliable results. No emphasis is placed on technical considerations, the data being discussed with the single purpose of defining the general laws which are obeyed, with the view of gaining an insight into the physical nature of the processes.

A sharp distinction is made between physical adsorption, which depends on van der Waals's forces alone, and activated adsorption, in which binding forces of a stronger nature are involved. Much importance is attached to the observation that only those gases which undergo activated adsorption by a given metal can dissolve in and

diffuse through it, from which it is concluded that activated adsorption is a necessary preliminary to diffusion and solution, and that for all these processes some degree of chemical affinity between the gas and the metal is necessary. This thesis is elaborated in the second chapter, which contains the results of the author's and Ransley's work on diffusion, and is the most vigorous and satisfying part of the book.

In the section dealing with solution, ample recognition is given to the work of Sieverts and his collaborators, and the absorption of hydrogen by palladium, which bulks so disproportionately in the literature, is relegated to its proper place as a somewhat unusual borderline case.

This chapter contains a most valuable collection of data, but more is known of the relations between compound gases and metals than appears in this account, and the ferrous metallurgist, in particular, will feel that the equilibria which control the refining of molten steel, and its carburization or decarburization in the solid state, have received less attention than they deserve. Yet in the present state of knowledge, these relations could not have been described in the comprehensive style accorded to the rest of the book. If the metallurgist finds that reactions between compound gases and metals have not been considered as fully as their practical importance would lead him to expect, the omission will come as a salutary reminder that the experimental work which would render a satisfactory treatment possible has, for the most part, not yet been done.

N. P. A.

La civilisation Ainou et les cultures arctiques
Par Prof. George Montandon. (Bibliothèque scientifique.) Pp. 273+48 plates. (Paris: Payot et Cie., 1937.) 40 francs.

PROF. MONTANDON visited the Ainu of Yezo, or Hokkaido as the Japanese now term it, in 1919. On his return he brought back a great stock of observations and an ethnographical collection, now housed in the Trocadéro in Paris, which one of the foremost authorities on the Ainu at that time pronounced to be the most complete that had ever left the island. In publishing the results of his observations in a volume which appeared not long after, Prof. Montandon promised that a more extended study of Ainu civilization would follow. This promise is fulfilled in the present volume, in which the author has reviewed and analysed critically in the light of his own observation all the information available relating to the culture of this primitive and isolated outpost of the white race.

The study falls into two parts. In the first part, Ainu civilization is described in detail as a unitary manifestation of cultural development. In the second part it is brought into relation with the cultures of the various peoples of northern Asia—Yakut, Yukagir, Gilyak, Eskimo, etc.—and as a result of an analysis of the distribution of cultural traits, an attempt is made to arrive at an estimate of the character of the original Ainu culture. As might be expected, Prof. Montandon's conclusion is that everything in Ainu civilization which can be assigned to an Ainu origin is of extremely primitive character, and belongs to the stage of the food-gatherer and the primitive hunter and fisher. All else is of extraneous origin; this, perhaps, might throw light on the remarkable distribution of the Ainu blood groups, which in its combination of mixed characters Prof. Montandon finds disconcerting.

Prof. Montandon's work is a valuable contribution to the critical literature of ethnology, as well as a welcome survey and record of a civilization which in recent years has suffered much change.

The Development of Modern Medicine: an Interpretation of the Social and Scientific Factors Involved. By Prof. R. H. Shryock. Pp. xv+442+8 plates. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1936.) 18s. net.

THE object of this fascinating work, the author of which is professor of history at Duke University (Carolina), is to portray certain major aspects of medical development against a background of intellectual and social history in general from the commencement of the seventeenth century down to the present time. In the eighteenth century it is shown that physics at first did not keep pace with physiology, and it was not until the latter part of this century and the beginning of the nineteenth that medicine began to make further progress. An important step in advance was the successful attempt to correlate clinical and post-mortem observations, in which Boerhaave, Haller and most of all Morgagni were pioneers. The second half of the eighteenth century

was notable for contributions made to public health, such as the establishment of hospitals and dispensaries, child welfare, the control of drunkenness, work on naval and military hygiene, vaccination and other sanitary reforms.

Among the more important advances in modern times stress is laid on the collection of statistics, the influence of French medicine in Europe and the United States, medicine in Germany, preventive medicine and the economic aspects of medical practice.

Materie und Strahlung (Korpuskel und Feld)
Von Prof. Dr. Ludwig Hopf. (Verständliche Wissenschaft, Band 30.) Pp. viii+162. (Berlin: Julius Springer, 1936.) 4.80 gold marks.

IN some respects, this is a remarkable little book. The preface warns the reader that it is more difficult to present a tolerable account of modern physics without mathematics than with them: furthermore, he must not expect easy going. The theme throughout is the 'field' and corpuscular aspects of matter, and, very properly, this leads up to a climax in the more recent attempts at a synthesis by Heisenberg, and by those concerned with electron waves.

The author's treatment is naturally at its best in the earlier chapters dealing with classical physics. Here, the use which is made of diagrammatic representation appears to great advantage, especially for the gas laws, Brownian movement and electromagnetism. In quantum physics and wave mechanics, wherein direct appeal to the eye is scarcely possible, the method is perhaps not quite so happy, since the writer depends to a great extent upon direct illustration.

The philosophical outlook is characteristic and stimulating; it is woven into the fabric of the book with considerable skill. Altogether, this is a type of contribution to the literature of physics seldom seen in Great Britain, and on that account alone well worthy of careful study.

F. I. G. R.

Die medizinisch-naturphilosophischen Aphorismen und Kommentare des Magister Urso Salernitanus
Nach Handschriften Lateinisch und Deutsch herausgegeben von Rudolf Creutz. (Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin, Band 5, Heft 1.) Pp. 192. (Berlin: Julius Springer, 1936.) 26.60 gold marks.

IN addition to an introduction by Dr. Paul Diepgen, professor of the history of medicine in the University of Berlin, this volume contains the aphorisms on medicine and natural philosophy of the thirteenth century physician and ecclesiastic Urso of Salerno, otherwise known as Magister Urso, followed by his commentaries in the Latin text. Dr. Rudolf Creutz has provided a full German translation of the aphorisms and an abbreviated translation of the commentaries. The historical significance of Urso, as Prof. Diepgen points out, lies in the fact that he deals with the same problems as Arnold of Villanova in the fourteenth, and Paracelsus in the sixteenth, centuries. All three writers were penetrated with Platonic and neo-Platonic ideas and reconciled their religious views with their outlook on natural science.

Observational Evidence for the Distribution of Matter in Space

By J. H. Reynolds

IT is often found necessary by mathematical physicists to make some generalized assumption which in detail is obviously not in accord with experience and observation. This procedure is, of course, quite legitimate, and much important work has been done with such an assumption implicit throughout; and so long as it is recognized that it is still no more than this when the mathematical work is done, no exception can be taken. But when a mathematical assumption is brought down from its idealized condition to a pedestrian 'fact of observation', it is time for the 'fact of observation' to be put through its paces.

Such has happened quite recently in the columns of NATURE to the assumption that matter is uniformly distributed throughout space. It is a very desirable condition for the mathematical physicist to postulate, as it is impossible to work with an irregular distribution; and within the limits mentioned, it has been made the basis of some very interesting and far-reaching researches. But it is now stated that it is an observed 'fact', based on the equable distribution of the 'spiral' nebulae in space, and it is this statement which requires verification.

Fortunately, the observational material which is now available is sufficiently complete and homogeneous for us to form definite conclusions as to the spatial distribution of the spiral nebulae, and those of the same class which show no spiral form and are known as elliptical and irregular nebulae. This observational material, however, is limited to something over a thousand objects, and comes to an end at some distance roughly corresponding to 13×10^6 light years. Beyond this limit it is neither complete nor homogeneous, and it has only been possible to investigate selected regions photographed with the great American reflectors.

There are two criteria which can be adopted for estimating the distances of the nearer extragalactic nebulae—the angular diameters and the integrated magnitude of luminosity. Both are subject to a considerable degree of uncertainty, for there is known to be a large spread in linear dimensions and in integrated brightness. This is apparent in the nearest two spiral systems, the Andromeda Nebula and M33. The first is condensed into stars in the outer regions with a patchy background of hazy nebulosity, the inner parts consisting of bright nebulosity increasing greatly in

luminosity to a star-like central nucleus. The diameter of the major axis of the apparent ellipse on reflector plates is 160'. M33, on the other hand, is much more stellar in general composition and only the central regions are nebulous, with little increase of brightness in the nucleus. The major axis is 65' on reflector plates. (The angular dimensions are those measured visually on negatives exposed in large reflecting telescopes. It has been found that these dimensions are considerably increased if recording microphotometers are used. The excess usually consists of very faint and featureless nebulosity.)

From the criterion of the Cepheid variables found in the outer regions, the distances of both can be estimated with reasonable certainty at between 700,000 and 800,000 light years (about 240 kiloparsecs) in each case, although the diameter of the Andromeda Nebula is two and a half times that of M33.

The difference between the integrated magnitudes of the two systems is still more striking. According to a list of extra-galactic nebulae by Shapley and Ames (*Harvard Coll. Ann.*, 88, No. 2), the integrated magnitude of the Andromeda Nebula (M31) is about 5, M33 being 8. The ratio between one magnitude and the next being 2.512, M31 as a whole is sixteen times as bright as M33. But even this relative luminosity seems to be an understatement, for in a recent paper by Redman and Shirley (*Mon. Not. Roy. Ast. Soc.*, 97, 416) the integrated luminosity of M31 is given as 3.5 mag. (photographic), while the surface brightness at the centre is at least 14.8 mag. per square second of arc, compared with the fainter 20.3 mag. per square second of arc at the centre of M33. The dispersion in absolute magnitude can therefore be much greater than the dispersion in linear dimensions, judging from these two systems at about the same distance. For this reason I have preferred the criterion of angular diameter in my work on the spatial galactic distribution of the nearer systems.

In this kind of research there can only be one division of the celestial sphere which is fundamental, namely, that in which the great circle of the galaxy forms the equator, and all investigations into the distribution of the extragalactic nebulae have been based on this. Let us take first of all the extragalactic systems which lie within a radius of 700 kiloparsecs (2.275×10^6 light years).

If we include the two Magellanic Clouds and the irregular nebula N.G.C. 6822, we find within this radius nine systems are in the south galactic hemisphere against four in the north. This result is based on Cepheid variables in the nearer objects and the detection in the more distant nebulae of faint stars which Hubble assumes cannot exceed -6 absolute magnitude: in the case of N.G.C. 55, 247 and 300, photographed at the Helwan Observatory, Egypt, the distances are based on large angular diameters only. Seven of the nine southern systems are also probably nearer the galactic system than any of the four northern objects.

Past a radius of 1,000 kiloparsecs (3.25×10^4 light years) the large preponderance of systems

The small scale brought the linear size of the nebulae on the plate down to something near that of star disks, which could be directly compared with stars of known magnitude. It was assumed that the plates gave essentially complete information as to the nebulae brighter than 13.2 magnitude, and this information was comprised in a detailed catalogue of 1,249 objects. It was further assumed that all these were included within a radius of 3,000 kiloparsecs; this estimate was based on integrated magnitudes alone, but if recorded angular diameters of the spiral class are taken as a criterion of distance instead, it would appear that this estimate would have to be increased to at least 4,000 kiloparsecs.

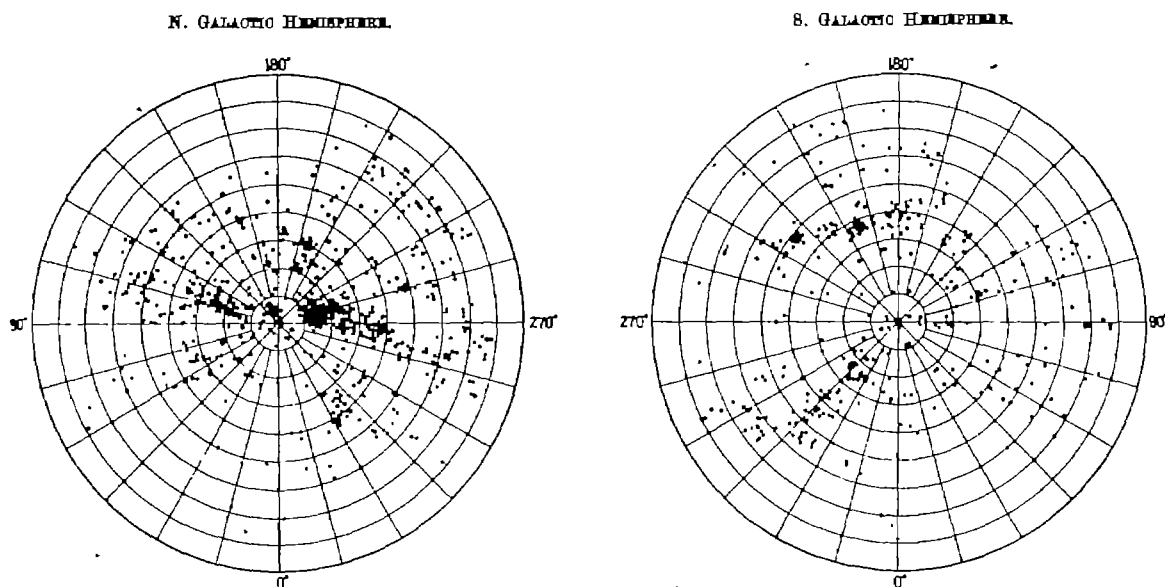


Fig. 1.

DISTRIBUTION OF THE BRIGHTER EXTRA-GALACTIC NEBULAE IN THE NORTH AND SOUTH GALACTIC HEMISPHERES. OPEN CIRCLES REPRESENT THE 291 NEBULAE BRIGHTER THAN PHOTOGRAPHIC MAG. 12; DOTS REPRESENT THE 734 NEBULAE OF PHOTOGRAPHIC MAGNITUDE 12-13. FROM *Harvard College Annals*, 88, No. 2 (1932).

passes to the north galactic hemisphere. They are now so far distant that no stars can be detected even with the 100-inch reflector at Mt. Wilson; the criterion of integrated luminosity has therefore been adopted both in Hubble's work and in Shapley's investigations at the Harvard College Observatory. The luminosity ratio between one magnitude and the next being 2.512; this represents a difference in distance of 1.585 per magnitude.

It is to Shapley and Ames that we owe the most complete and reliable evidence as to the galactic distribution. The whole sky was photographed with two 2-inch lenses at centres regularly spaced, the scale of the plates being 10 minutes of arc to the millimetre, and the magnitude limit for 90 minutes exposure lying between 13.5 and 14.0.

The plates included those nebulae of large angular diameter above $10'$ which lie within 1,000 kiloparsecs and have already been dealt with, and when all the nebulae brighter than mag. 13 were plotted in the two galactic hemispheres it was found that those in the northern hemisphere were just about double the number of those in the southern. Not only so, but also the effect of longitude found in previous investigations without such complete information was fully confirmed. The diagram here reproduced (Fig. 1) is from Shapley's paper, and includes 1,025 nebulae down to mag. 13.

The great condensation in and towards the Virgo region between galactic longitudes 250° and 270° and its prolongation beyond the north galactic pole has been known for many years, and the irregularities in the south galactic hemisphere are

also marked. The lack of extragalactic systems within 10° of the galactic equator in both hemispheres is well accounted for by the known existence of vast clouds of obscuring matter in the galaxy. This corresponds to the 'belt of avoidance', the limits of which have been investigated by Hubble over three quarters of the great circle. In some parts the limits of the 'belt of avoidance' approach within a few degrees of the great circle, and faint small nebulae have been photographed in these regions: in other longitudes the limits reach much farther away, and in some parts extend so far as 30° .

The evidence for the whole sky is therefore not complete by something like a fifth, although there is no reason to think that this missing fraction would seriously affect the results.

The distribution of some of the fainter and therefore presumably much more distant nebulae was investigated by Hubble in 1934 (*Mt. Wilson Cont.*, No. 485). He eliminated the brighter ones which are included in Shapley's catalogue, and the material consisted of about 44,000 nebulae distributed over three quarters of the sky north of -30° Dec. Almost all these are very faint, with a limiting magnitude of 20. A similar piece of work was undertaken about the same time from plates obtained by the Crossley reflector of 36 inches diameter, on which 15,000 small nebulae were counted up to mag. 19. In neither case was the south circumpolar region represented between -30° and -90° , and the plates examined covered only about 2 per cent of the total area available, each plate being taken as a sample of the distribution in that particular region, and covering presumably, in the case of the 100-inch reflector at Mt. Wilson, about a quarter of a square degree of good definition. At the Lick

Observatory, the scale of the 36-inch reflector plates was much smaller owing to the shorter focal length, and so covered about three times as much; here 489 plates were examined. The frequency curve of successive photographic magnitudes (Nm) was computed on the assumption that the numbers increased according to an equable distribution of the nebulae in space. Hubble found that the observed frequency curve of $\log Nm$ closely approximated a Gaussian error curve, which would agree with the assumption of equable distribution, if a reasonable dispersion in magnitudes with distance was allowed.

Bok in 1934 again investigated the question, using Hubble's observational material. He calculated the form of the frequency function for the number of systems per unit area of the sky, on the assumption that they are distributed at random. Hubble's observed frequency curve was then compared with the curve of calculated random distribution after ample allowance for dispersion in the limiting magnitudes had been made, and Bok came to the conclusion that this brings out very clearly that the distribution of the faint and distant systems is also not at random. He therefore agrees with Shapley that the general distribution is not homogeneous, and that the tendency to clustering is one of the chief characteristics of the extragalactic universe, so far as we have been able to plumb its depths.

There seems to be little doubt, therefore, that while the uniform distribution is a useful assumption of mathematical necessity, it is certainly not a 'fact of observation'. The evidence of the nearer systems within a radius of 4,000 kiloparsecs is directly contrary to the assumption, while beyond this limit the evidence is quite insufficient to arrive at a definite conclusion in its favour.

The Nutritive Value of Pasteurized Milk

MUCH controversy has arisen over the question whether the bulk of milk sold in Great Britain should be pasteurized or not. There is no doubt that many epidemics have been caused by the consumption of raw milk, which there is presumptive evidence would not have taken place if the infecting bacteria had been destroyed by pasteurization before the milk reached the consumer. On the other hand, experimental evidence has been brought forward to show that the nutritive value of milk is impaired by pasteurization, although in other experiments no significant change in nutritive value could be demonstrated.

The problem is that of producing a 'safe' milk at an economic price; up to the present, the average consumer has refused to pay the higher price of milk obtained from disease-free cows and produced under conditions reducing the risks of contamination to a minimum. However, even under the best conditions, there is always the risk of a worker suffering from an infectious disease contaminating the milk he is handling and so spreading the disease over a wide area, so that adequate heat treatment of the milk may prove the only safeguard, but this can only be recommended with confidence if the nutritive value is not impaired

by the heating process, or only impaired in a manner which can easily be remedied.

Towards the end of 1934, an informal conference was called by the Milk Marketing Board's Advisory Committee on Milk Publicity, at which representatives of Government Departments, the Medical Research Council and the Milk Marketing Boards were present: the object of the conference was to consider what further investigations were required on the nutritive value of milk. The conference entrusted the task of conducting these investigations to a special committee—the Milk Nutrition Committee—of which the first report, dealing with the results of work on rats and the direct chemical estimation of vitamin potency, has recently been published*. Investigations in schools and with calves will be reported in the near future.

The greater part of the work described in this report has been carried out by Dr. S. K. Kon and his colleagues at the National Institute for Research in Dairying, Shinfield, near Reading: the experiment on the availability of the calcium and phosphorus of pasteurized milk was duplicated at the Rowett Research Institute, Bucksburn, by Dr. D. W. Auchincloss. The same general plan was followed in all the experiments: the samples of raw milk were drawn from the tip tank of the pasteurizing plant after careful mixing, and those of the pasteurized milk were taken after cooling when about half the vat had been emptied. The pasteurization was carried out under commercial conditions by Messrs. Emerson and Chanin, Reading, or at the headquarters of the Aberdeen Milk Pool. The temperature of pasteurization was frequently checked and bacteriological and phosphatase tests were carried out on the milks; in addition, daily estimations of fat and total solids were made during part of the experimental period. The milks were compared as sources of calcium and phosphorus, protein and vitamin B in experiments on rats, and as sources of vitamin A and carotene and vitamin C by chemical tests. The results of these experiments can be quite briefly summarized: pasteurized milk is as good a nutritive agent as raw milk, except in the case of vitamin B₁ and vitamin C.

Since the results of these experiments are of considerable importance, it may be advisable to describe them in more detail, especially as the assessment of the value of the evidence adduced must depend ultimately on the investigators' attention to detail. For the determination of the availability of the calcium and phosphorus in the

milks, a complete metabolism experiment was carried out, Kon employing two dozen animals and Auchincloss a dozen. The animals were housed in metabolism cages, in which the excreta could be collected, and the feeding dishes were designed to prevent any scattering of the food. The rats were grouped in pairs according to sex and litter, and the amount of basal diet offered was slightly in excess of that consumed by the animal with the smaller appetite; one animal received raw milk and the other the same amount of pasteurized milk. The basal diet consisted of dried eggwhite, calcium- and phosphorus-free salt mixture, castor sugar, maize starch and butter fat, with supplements of cod liver oil and vitamin B₁ extract. The quantity of milk supplied daily was calculated to supply about 60 per cent and 70 per cent of the normal requirements of calcium and phosphorus respectively. The experiment was continued for five weeks: the deposition of calcium and phosphorus in the tissues of the animals was determined by two entirely independent methods. In the first, the retention was found from the total intake of these elements in the food and milk and the amounts excreted in the urine and faeces. In the second, the retention was estimated from the amounts present in the bodies of the animals at the end and at the beginning of the experiment; the latter figures were obtained by analyses of a similar number of litter mate controls of the same sex as the experimental animals, killed at the beginning of the experiment. For pooled figures the two methods agreed within 0.2 per cent in the case of calcium and 2.0 per cent in the case of phosphorus; the slight discrepancy in the case of phosphorus was probably caused by a small loss during ashing of the rats. The agreement between the two methods indicates that the metabolism experiment had been carried out satisfactorily.

It was found that the animals retained some 80 per cent of the ingested calcium and phosphorus, irrespective of the type of milk given. Statistical treatment of the results showed that pasteurization had no deleterious effects upon the availability of these elements. The only statistically significant differences were a retention by the does on pasteurized milk of 3 per cent more calcium than their litter mates on raw milk and a greater increase in weight of the bucks on raw milk. In all the rats, about 90 per cent of the calcium excreted was found in the urine and about 90 per cent of the phosphorus in the faeces; the reason for the high excretion of calcium in the urine, which is unusual, was not determined.

There was a similar failure to detect any difference between raw and pasteurized milk when the biological value and digestibility of the proteins and the total nutritive values of the milks

* Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part 1: The Effect of Commercial Pasteurization on the Nutritive Value of Milk, as determined by Laboratory Experiment. (From the National Institute for Research in Dairying (University of Reading) and the Rowett Research Institute, Bucksburn, Aberdeen.) Pp. 87. (Reading: National Institute for Research in Dairying, Shinfield, 1937.) 2s. 6d. net.

were compared in experiments on rats. In the latter experiments, the milk was the only food supplied, but was supplemented by the addition of small amounts of iron, copper and manganese: the manganese was shown to be an essential element for growth. Similar experiments on the value of the milks as sources of the vitamin B complex disclosed, however, that pasteurized milk was a significantly less satisfactory source than raw milk: the difference was, however, observed only in the case of the more rapidly growing bucks. The deficient diet used was supplemented by 8 ml. milk daily, an amount which was known to be sufficient for subnormal growth only. This difference between the milks was not seen when larger amounts were given daily, as in the experiments on their total nutritive value, or when the animals grew more slowly, as in the case of the does. The difference might, however, be disclosed during lactation, when the requirements for vitamin B are much greater.

The vitamin A and carotene contents of the milks were determined spectrophotometrically and by the tintometer, on butters churned from both types of milk over a period of five weeks. No destruction of vitamin A or carotene by pasteurization was found. The vitamin C content was determined chemically, by titration with the indophenol reagent, both before and after reduction of the milks with hydrogen sulphide: both the reduced and the reversibly oxidized forms of

ascorbic acid showed loss on pasteurization, the loss being greater in the case of the latter. The total loss was about 20 per cent. Milk taken directly from the udder without exposure to light contains only the reduced form of ascorbic acid and can be pasteurized without loss of the vitamin by the holder method, in the absence of copper: the reversibly oxidized form of ascorbic acid is formed by the action of light upon the milk and is affected by pasteurization.*

To sum up, pasteurized milk may contain less vitamin B (presumably B₁) and vitamin C than raw milk, but will in other respects have the same nutritive value. Where milk is not the sole diet, such losses will have no significance, provided the diet also contains cereals and fruit. Where milk is the sole diet, a supplement of fruit juice and a yeast extract or other rich source of vitamin B₁ should obviate any possibility of the diet being inadequate in these respects, although, with a proper intake, the lower content of pasteurized milk in vitamin B is unlikely to be detected and it is now usual to supplement the milk with fruit juice (together with vitamins A and D, in the form of cod liver oil or a concentrated preparation of these vitamins). These experiments suggest that there need be no fear of malnutrition from the universal use of pasteurized milk; admittedly the risk of infectious disease will be considerably reduced.

* Kon, S. K., and Watson, M. B., *Biochem. J.*, **30**, 2273 (1936).

Bicentenary of Galvani

TEN years ago all Italy joined in honouring the memory of Volta on the centenary of his death; now arrangements are being made at Bologna to commemorate the bicentenary of the birth of his fellow countryman, Galvani, whose discoveries paved the way for those of Volta and led to the invention of the voltaic pile. Though the Galvani celebrations will not be on the same scale as those of ten years ago, they will help to recall the fundamental work done in Italy on current electricity which has had such fruitful results.

Aloisii Galvani was born in Bologna on September 9, 1737, and was thus about eight years older than Volta. After a youth in which theology and mysticism played a part, he settled down to the study of medicine, and in 1762, after writing a thesis "On the Bones, their Nature, and their Formation", was made a lecturer in the University of Bologna and reader in anatomy to the institute of the city. He was successful both as a teacher

and a surgeon and became known for his researches in comparative anatomy. It was as an anatomist and physiologist, and not as a physicist, that he made the experiments which have immortalized his name.

The work for which Galvani is remembered was done during the years 1780-91. At least as early as 1780, he began observing the effects on muscular contractions caused by the use of the electrical machine, the Leyden jar and Volta's electrophorus. In 1782 he drew up a paper entitled "On the Nervous Force and its Relation to Electricity". His experiments were made on frogs in particular. Assisted by his nephew, Camillo Galvani, in 1786 he began observations on partly dissected frogs which had been suspended by hooks from the iron rails of the balcony of his house. These he first described in a paper "Esperimenti circa l'Elettricità dei Metalli", and in a Latin dissertation of 62 pages dated October 30, 1786, afterwards to form the most important part

of his work of 1791. Galvani was in doubt as to how to explain the effects he observed, and, said J. D. Forbes, who had carefully studied his writings, "in the short space of a few weeks, he had abandoned his earlier notion of the metals being the source of the electricity, and ascribed the effects to the proper electricity of the nerves and muscles". Still pursuing his experiments at intervals, in 1791 he published his most famous, and now very rare, memoir, "De Viribus Electricitatis in Motu Musculari Commentarius", the appearance of which roused great interest in scientific circles.

The first German accounts of Galvani's views were published in 1792 by a young doctor, E. J. Schmuck, and in October of that year Volta wrote his two letters to Cavallo entitled, "Account of some Discoveries made by Mr. Galvani of Bologna, with Experiments and Observations on them". The letters were in French, the first sentence being, "Le sujet des découvertes et des recherches, dont je vais vous entretenir, Monsieur, est l'électricité animale". Volta had sent the letters to be read to the Royal Society as an acknowledgement of his election as a foreign member in 1791. They were read at a meeting of the Society on January 31, 1793, and were duly published in the *Philosophical Transactions*. In 1794, when Volta was awarded the Copley Medal, Sir Joseph Banks in his address said:

"The experiments of Professor Galvani, until commented upon by Professor Volta, had too much astonished, and, perhaps, in some degree, perplexed many of the learned in various parts of Europe. To Professor Volta was reserved the merit of bringing his countryman's experiments to the test of sound reasoning and accurate investigation. He has explained them to Dr. Galvani himself and to the whole of Europe, with

infinite acuteness of judgment and solidity of argument; and through the medium of the *Philosophical Transactions* he has taught us that the various phenomena which presented themselves under the modifications of Dr. Galvani's experiments hitherto tried, are wholly owing to the excessive irritability of the nerves when subjected to the action of portions of the electric fluid, too minute to be discovered, even by the delicate electrometer of our ingenious brother, Mr. Bennet, of Worsworth; and he has detected in the metals, which Dr. Galvani considered as mere agents in conducting his animal electricity, that very existing principle which the Doctor and his followers had overlooked."

Forbes considered the award of the Copley Medal to Volta, rather than to Galvani, a questionable decision, for "the great value of Volta's paper, at the time, was undoubtedly that it directed the attention of English experimenters to Galvani's discoveries, then quite recent and probably imperfectly known". That Galvani was little known and had not travelled, while Volta was personally known in both Paris and London, may have had something to do with the decision.

From 1791 onwards, Galvani did little more to add to his fame. His wife died, his health declined, and when after the French Revolution the Cisalpine Republic was set up, he declined to take the oath of allegiance to the new authorities and was dismissed from his offices. He died on December 4, 1798, apparently at the house of a brother to which he had retired after his dismissal. His writings were republished in one volume in 1841 by the Academy of Sciences of Bologna.

As regards the oft-repeated story of Galvani's observations on frogs being connected with the preparation of a dish for his invalid wife, Forbes dismisses it as an absurd invention.

Obituary Notices

Prof. D. Morgan Lewis

DAVID MORGAN LEWIS, emeritus professor of physics in the University of Wales, died at Aberystwyth on July 28, aged eighty-five years.

Born at Eglwyswrrw, Pembrokeshire, in 1851, he was the eldest son of the Rev. Evan Lewis, minister of the Welsh Independent Church at Brynberian and a prominent figure in his denomination. His early education was received at a local British school and at Cardigan, and later he entered the Presbyterian College, Carmarthen, to train for the ministry. Here he became proficient in mathematics and in 1873 entered Trinity College, Cambridge, where he was

20th Wrangler in 1877. Afterwards he studied physics at the Cavendish Laboratory.

In 1878 Lewis was ordained as minister of the English Congregational Church at Hirwaun, Glam., where he served until 1883. The advent of the new Welsh national colleges decided him to seek a wider field and in the latter year he resigned his pastorate and returned to work at the Cavendish Laboratory. In 1884 he was appointed as assistant to Andrew Gray, professor of physics in the new University College of North Wales at Bangor, with whom he worked in full accord until 1891, when he was appointed to the professorship at Aberystwyth in

succession to D. E. Jones. Here he worked quietly, and gradually built up an efficient department of physics until his retirement in 1919. He was married in 1894 to Miss Annie Powell of Carreg Cennen, Carmar., who predeceased him in 1932.

Prof. Lewis was of a modest and retiring disposition, and greatly disliked publicity. Yet he could be very enthusiastic in those causes which, in his opinion, mattered. While at Hirwain he inaugurated and lectured to classes under the Science and Art Department, and later wrote considerably to the Welsh local Press to stress the importance of scientific and technical education in the new secondary schools which were then being established. He served the University Colleges of Bangor and Aberystwyth and the University of Wales well during their formative years, and the cause of adult education in the Principality found in him a willing helper. During many years, he served as a governor of Aberystwyth County School and was for a period chairman.

After his retirement, Lewis's main interests were in the affairs of his religious denomination, in Welsh hymnology and in archaeology. Until quite recently, his quiet, dignified figure could always be seen at the meetings of the British Association, among whose members he had a host of friends.

T. C. J.

DR. PEMBOY PHILLIPS, director of the Hydrological Service of the Physical Department, Egyptian Ministry of Public Works, died in Cairo on August 4,

at the age of fifty-seven years. Previous to the Great War, he was a lecturer in physics in the University of London and during the War had a commission in the Sound-Ranging Section of the Royal Engineers, with which he saw service in France and Palestine. He joined the Egyptian Government Service in 1919, and was responsible for the collection and discussion of statistics relating to the water supply of the Nile. He did valuable work in the study of the hydrology of the Nile Basin and in the preparation of the large irrigation projects on the Nile.

We regret to announce the following deaths:

Dr. G. P. Clinton, formerly botanist of the Connecticut Agricultural Experiment Station, known for his work in mycology, on August 13, aged seventy-one years.

Prof. F. B. Loomis, professor of geology in Amherst College, Mass., an authority on vertebrate paleontology, on July 24, aged sixty-three years.

Mr. Andrew Mellon, founder of the Mellon Institute of Industrial Research at Pittsburgh, Pa., sometime American Ambassador in Great Britain, on August 26, aged eighty-two years.

Prof. Luigi Pernier, professor of archaeology and the history of ancient art in the University of Florence.

Lord Rothschild, F.R.S., a trustee of the British Museum and founder of the Tring Zoological Museum, on August 27, aged sixty-nine years.

News and Views

Sir Thomas Grainger Stewart (1837-1900)

SIR THOMAS GRAINGER STEWART, the eminent Scotch physician, who died on February 3, 1900, was born at Edinburgh on September 3, 1837. He qualified in 1858, and then visited the medical centres on the Continent, where he came in contact with Virchow, Schönlein and Traube in Berlin, and Oppolzer, Skoda and Hebra in Vienna. On his return to Edinburgh, he was made physician to the university wards in the Royal Infirmary. In 1876 he was appointed professor of physics and proved an exceptionally gifted teacher. He was one of the first in Great Britain to direct attention to the deep reflexes, and under the title of "Paralysis of the Hands and Feet from Diseases of the Nerves", he first described the condition known as multiple neuritis. For many years he held a foremost position as a consultant throughout Scotland and the north of England. His chief publications were "A Practical Treatise on Bright's Diseases of the Kidneys" (1868), "The Teaching of Medicine in Edinburgh" (1877) and "An Introduction to Diseases of the Nervous System" (1884). He was the recipient of many honours. In 1882 he was appointed physician to the Queen in Scotland, in 1887 he was made M.D. *honoris*

causa of the Royal University of Ireland, in 1890 he was elected president of the Royal College of Physicians of Edinburgh and honorary fellow of the College of Physicians of Philadelphia, in 1894 he was knighted, and in 1898 he was elected president of the British Medical Association when the annual meeting was held in Edinburgh.

Samuel Siegfried Karl von Basch (1837-1905)

THIS eminent Austrian physiologist and physician was born on September 9, 1837, at Prague. After studying medicine in his native town and Vienna, he qualified in 1862 in Vienna, where he acted as assistant for several years to Dittel, Jaeger, Turk and Kalisko. In 1865 he went to Mexico, where he was appointed Court physician to the Emperor Maximilian, who was shot on June 19, 1867, and himself narrowly escaped execution. After his return to Vienna he carried out some important experiments on the action of nicotine on the movements of the intestine, and in 1878 was appointed extraordinary professor in experimental pathology. He was the author of numerous publications, but his chief work was "The Physiology and Pathology of the Circulation" (1892), which he dedicated to his former teacher, the celebrated physio-

logist Karl Ludwig. Basch is best known for his invention of a sphygmomanometer, by which he inaugurated the clinical measurement of the blood pressure. He also did valuable work on pulmonary oedema, cardiac dyspnoea and the innervation of the uterus. His death took place on April 25, 1905.

Local Government in Roman Britain

A DOCUMENT of importance in its bearing on the organization of local government in Roman Britain has been brought to light in the course of the fifth season's excavation on the site of the Roman town of Brough, which has just closed. The investigation of this site, which is situated on the north bank of the Humber, commanding the crossing of the river by the Lincoln-York road, is being carried out by the Brough Excavation Committee under the direction of Mr. Philip Corder and the Rev. T. Romans. The present season's work has been directed to laying bare one of the four towers of rectangular form, twenty-five feet wide by ten feet deep, which were added to the front wall of fortification, possibly early in the fourth century. The most important find of the season was an inscribed slab, 2 ft. 3 in. high by, originally, about four feet long (*The Times*, August 27). Mr. Eric Birley reports on the inscription that it commemorates the provision of a stage at his own expense by Marcus Ulpius Ianuarius, *Aedile* of the village of Petuaria, in honour of the Imperial family of Antoninus Pius (A.D. 138-161) and of the spirits of the deified emperors. This inscription confirms the name Petuaria, and is one of the few known instances of the epigraphic confirmation of Romano-British names.

FURTHER, and more important, the inscription affords evidence of a step in the development of the unit of local governments in Britain from the tribal area, here that of the Parisii, to the self-governing canton with its seat of government at the old tribal capital, or a newly erected town. Although such tribal cantons were known from inscriptions at Caerwent and Wroxeter, this is the first mention of a tribal magistrate in Britain. Furthermore, being denominated as the *Aedile* not of the tribal area, as in the previously known inscriptions, but of Petuaria itself, this indicates, in the interpretation of Mr. Birley, a further stage of development in which the central town with its college of four regular magistrates, two *duovirs* and two *Aediles*, was gaining in importance at the expense of the tribal organization. This inscription is also the first epigraphic evidence of the practice in Britain of a magistrate conferring benefactions in return for the honour of election to office.

Arctic Weather Reports

ONLY forty-one years have passed since Nansen made his perilous and unsuccessful attempt to drift with the arctic ice from northern Siberia across the North Pole to the neighbourhood of Greenland, yet since July at least one London morning newspaper has been publishing daily a weather report from the region of the North Pole along with similar reports

from New York and various Continental capitals. Such observations are not at present of great importance to weather forecasters, because the normal travel of weather systems generally tends to be circumpolar, and, moreover, the gap between the Pole and other arctic weather stations—even Spitzbergen—is a very wide one, so wide that it is impracticable to complete a system of isobars to cover the polar regions. But as a landmark in the gradual spreading of a network of observing stations over the whole world, this event is important. Owing to the drift of the ice, a permanent station at the North Pole is impracticable, but the Russian station from which the published observations have been received has apparently not drifted very far from the Pole yet. Its co-ordinates at the end of August were about lat. 87° N., long. 2° E. The reports include an observation of the direction of the wind, and owing to the fact that these are not made exactly at the Pole, the direction can be given in the ordinary manner. At the Pole itself, of course, all winds are from the south, and direction would presumably have to be given in terms of longitude instead of being referred to the points of the compass.

Problems of Conquering Everest

THE problem of reaching the summit of Mount Everest is discussed in a paper in the *Himalayan Journal*, 9, and takes the form of a memorandum prepared by the Eastern Section of the Himalayan Club, with some comments on the conclusions by Mr. E. Shipton. Two main suggestions are made in the light of past experience. The first is that expeditions have been foredoomed to failure because they have attempted to climb the north ridge too quickly. It is contended that men who have stood the strain of reaching the North Col cannot hope to do the remaining 6,300 feet in three days. The writers quote much evidence in favour of their statement, but Mr. Shipton is equally sure that above 23,000 feet a man deteriorates in muscle and energy quickly, and therefore delay at and above that height must be avoided. The second suggestion is that instead of trying in May and June when the effort is a race with the approaching monsoon, it would be better to make the attempt after the monsoon, in October or even in April. Days in October are certainly shorter than in May, but wind velocities so far as is known are slightly lower. Mr. Shipton admits that post-monsoon conditions should be studied, but prefers the pre-monsoon season. Major K. Mason points out that one obvious drawback to October is that it is a month of increasing wind, while May is a month of west winds decreasing owing to advancing monsoon currents.

The British Grid System

IN a paper on the British Grid system by Johnstone Wright, the engineer of the Central Electricity Board, presented to the Engineering Institute of Canada, at Montreal in June last, an interesting account is given of the development of the Grid system in

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The History of Evolutionary Thought as Recorded in Meetings of the British Association*

By Sir Edward B. Poulton, F.R.S.

President of the British Association

SIR WILLIAM THOMSON, in his address at Edinburgh in 1871, said that "the real origin of the British Association" was given in the words of a letter written by David Brewster to John Phillips on February 23, 1831, a few months before the first meeting: "The principal object of the Society would be to make the cultivators of science acquainted with each other, to stimulate one another to new exertions, and to bring the objects of science more before the public eye, and to take measures for advancing its interests and accelerating its progress". That the time was fully ripe for the birth of the Association is made very clear by the words written by John Keble to a friend, referring to the D.C.L. degrees conferred, at the Oxford meeting in 1832, on David Brewster, Robert Brown, John Dalton and Michael Faraday: "The Oxford Doctors have truckled sadly to the spirit of the times in receiving the hodge-podge of philosophers as they did"—an opinion on which Lord Salisbury commented at the Oxford meeting in 1894: "It is amusing at this distance of time, to note the names of the hodge-podge of philosophers whose academical distinctions so sorely vexed Mr. Keble's gentle spirit". It is not only amusing but also pathetic that such words should have been used by a revered member of a University which had done splendid service for science,

as has been so well shown in Dr. R. T. Gunther's volumes¹.

Faced by the serious duty of preparing this address, I felt that the best hope of interesting you would be to choose a subject which has received special attention at our meetings. I have selected the progress of thought on organic evolution as it may be followed in addresses, papers, and discussions, mainly restricting myself to the series of meetings which began with the jubilee at York in 1881, the first of many that I have had the pleasure of attending.

The British Association provides a very favourable field for the discussion of many-sided subjects such as evolution—subjects which attract members from very different, as well as from closely related, sections. Hence a wide range of varied experience is open to one who can look back over more than half a century; and I do not propose to exclude some of the humorous sayings and incidents which, from time to time, have enlivened our meetings and contributed to their success. Some of them certainly deserve to be rescued from oblivion, although to perform this pious duty I must risk the enmity of the Goddess of Folly, who as Erasmus tells us, proclaimed: "I hate a man who remembers what he hears".

The fiftieth anniversary at York was a memorable meeting, with Sir John Lubbock (Lord

* PRESIDENTIAL ADDRESS DELIVERED AT NOTTINGHAM ON SEPTEMBER 1.

Avebury) as president, and the chair of every section except economics, under Grant Duff, taken by a past-president of the Association.

I then enjoyed to the full one of the chief benefits conferred by our Association upon its younger members—the opportunity of meeting older men, up to that time only known to them by the fame of their discoveries. Prof. O. C. Marsh had come over from Yale, his main object being to buy for his University Museum the second and more perfect fossil of the wonderful ancestral bird *Archæopteryx*, with teeth and a long, lizard-like tail—clear evidence of reptilian origin. The earlier example had been bought for the British Museum at a price which was said to have provided the dowry for a professor's daughter, and Marsh soon realized, as he told me, that the second was not for sale on any terms. "We let the other go and I believe they would kill me if this were sold" was the reply given to him by the authority in Munich. He was, however, able to study the fossil, and his description and drawings of the teeth, in the Geological Section, followed the only attack on evolution itself, as distinct from its causes, which I have ever witnessed at any of our meetings. It was the exhibition by H. G. Seeley of his reconstruction of *Archæopteryx* from this fossil, which aroused the fury of the palæontologist, old Dr. Thomas Wright of Cheltenham: "Archæopteryx hasn't got a head, how can it possibly have teeth?" he growled, knowing nothing of the latest find or of the fact that a detached head and scattered teeth had been detected on the slab in which the older specimen was embedded. In spite of Prof. Newton's positive statement and the form of the teeth, drawn by Prof. Marsh at the request of the chairman, Dr. Wright, quite unconvinced, continued muttering "Archæopteryx is a very good bird", its virtue in his opinion entirely uncontaminated by any taint of reptilian affinity.

Prof. Marsh also read a paper in the Zoological Section on his own wonderful discoveries of toothed birds from the rocks of the western United States. Richard Owen, president of the Section, was in the chair and, with the memory of old and embittered controversies in his mind, the author told me that he had felt rather anxious in bringing this communication forward. But in that friendly atmosphere there was no reason for alarm. Owen welcomed the paper warmly and in confirmation told us, in the most charming manner, of the traces of teeth found in an embryo parrot.

FOSSILS AS EVIDENCE OF EVOLUTION

The event which stands out most clearly in my memories of the jubilee meeting is Huxley's evening lecture on "The Rise and Progress of Palæontology"—the science which provides an essential part of the foundation on which geographical, geological and biological evolutionary history has been built. The insuperable difficulty felt by the older naturalists was to believe that the land had been for the most part deposited under the sea, and to account for the presence of fossils, or as they were called, 'formed stones'. The true solution, Huxley explained, was found and published in 1669 by Nicholas Steno, a Danish professor of anatomy at Florence, who carefully studied certain fossils, known as 'glossopetræ', which abounded in the Tuscan rocks and were believed to be fossil fig-leaves. Steno, who was not satisfied with this interpretation, dissected a shark's head and showed that the 'glossopetræ' exactly corresponded in every particular with the teeth—"that in fact they were shark's teeth". The emphasis with which Huxley made this statement comes back to me after the lapse of nearly sixty years. From this, Steno was led to conclude that they were the teeth of shark-like fishes living in the Tuscan Sea and later embedded, with other remains, in the strata which had there accumulated.

I have not noticed the fanciful suggestion of "fossil fig-leaves" in any published version or account of Huxley's lecture that I have seen, but he certainly told us of it and it is an interesting example of the attempts made by the naturalists of the day to explain the fossils embedded in rocks then believed to be of terrestrial origin. I cannot resist the temptation of quoting Plot's* more ingenious and amusing effort to account for the well-known layer of oyster-shells (*Ostrea bellerophon*) found "... at some places here in England, particularly at *Cats-grove* [now *Katesgrove*] near Reading . . . ; which how they should come here without a *Deluge*, seems a difficulty to most men not easily avoided".

Plot was, however, helped "to a salvo" for his own objection by remembering that Reading was "a *Town* of very great *action* during the *Invasions* of the *Danes*, who cutting a deep trench cross between the *Kennet* and *Thames*, and inclosing themselves as it were in an *Island*, held it against King *Ethelred*, and *Alfred* his Brother a considerable time; from whence in all probability, the

Saxons having removed their *Cattle* and other provisions before the *Danes* arrival, 'tis likely that they might be supplied from their *Navy* with *Oysters*, which during the time of the abode of the *Army* on Land, might be a very suitable employment for it: Which conjecture, if allowed, there is nothing more required to make out the possibility of the bed of *Oysters* coming thither without a *Deluge*, but that *Cats-grove* was the place appointed for the *Armies* repast".

The probability of this suggestion may be inferred from the age of the 'Woolwich and Reading' beds in which the oysters are found—estimated by Prof. W. W. Watts and Prof. H. L. Hawkins at about 50–60 million years.

Dr. Plot's explanation of fossils in general, as well as of flowers, was of a very different kind. To account for their existence he appealed to "the wisdom and goodness of the *Supreme Nature*, by the *School-men* called *Naturans*, that governs and directs the *Natura naturata* here below, to beautify the World with these varieties; which I take to be the end of such productions as well as of most *Flowers*, such as *Tulips*, *Anemones*, &c. of which we know as little use as of formed stones".

The modest and withal amusing paragraph which follows I venture to quote in full as an example to be followed in scientific controversy:

"And thus I have given the grounds of my present *opinion*, which has not been taken up out of *humor* or *contradiction*, with intent only to affront other worthy Authors modest conjectures, but rather friendly to *excite them*, or any *others*, to endeavor collections of *shell-fish*, and parts of other *Animals*, that may answer such *formed stones* as are here already, or may hereafter be produced: Which when ever I find done, and the reasons alleged *solidly* answered, I shall be ready with acknowledgment to retract my *opinion*, which I am not so in love with, but for the sake of *Truth* I can cheerfully cast off without the least reluctance".

One chief object which, as I believe, Huxley had before him was to bring forward a calm, clear statement of the evidence on which alone it was possible to achieve that "reconstruction of an extinct animal from a tooth or bone", which had made so deep an impression on the imagination. The reconstruction was in fact a simple inference based on anatomical experience such as that gained by Steno when he dissected the shark and concluded that the 'glossopetræ' were the teeth of shark-like fishes. But this reasoning—that a fossil

tooth or bone on the surface of a rock, cannot by itself enable the geologist to predict that a skeleton of a certain type lies hidden beneath—seeming to diminish the glory of Cuvier's splendid work, was resented by Owen, who had replied with the bitter taunt that a tooth can tell us a great deal—a donkey can kick his master but he cannot eat him. This may have been the encounter referred to by Huxley when he wrote of a friendly meeting with Owen at the Zoological Section of the Association in Leeds (1858): "so that the people who had come in hopes of a row were (as I intended they should be) disappointed". In the same spirit, I think, Huxley was glad to speak of the 'glossopetræ' at the jubilee meeting, where Owen was president of a section, and calmly and simply, to reaffirm conclusions which are unassailable.

Huxley then passed on to Steno's further study of fossils and his proof of their relationship to terrestrial freshwater and marine organisms, and to his application of this evidence to the past condition of Tuscany—all discussed "in a manner worthy of a modern geologist" and later extended by Buffon to all parts of the world then known to be fossiliferous. These conclusions, "which almost constitute the framework of palæontology", only required one addition, made towards the end of the eighteenth century by William Smith, who showed that geological strata contained characteristic fossils so that rocks of the same age could be identified in all parts of the world, while the biologist could follow the changes in the living population of the globe—a record of constant extinction and continual generation of new species. We were then led to three general conclusions: (1) the vast length of time during which life has existed on the earth—"certainly for millions of years"; (2) the continual changes which living forms have undergone during this period; (3) the successive changes in the best-known fossil groups are such as we should expect if each series "had been produced by the gradual modification of the earliest form. . . ." This last conclusion meant evolution which so completely accorded with recent discoveries that "if it had not existed, the palæontologist would have had to invent it".

I can never forget the words spoken to me after the lecture by a dear friend of my youth, the late Viriamu Jones, Principal of University College, Cardiff: "At every sentence I felt myself bowing to Huxley and saying 'you are the greatest man here; no one else could have said that as you have said it'".

AGE OF THE EARTH

As Huxley's lecture continued in a calm spirit an embittered controversy, so his thoughts on the immensity of past geological and biological time lead naturally to another controversy on the age of the earth conducted intermittently at our meetings between 1892 and 1921. It is, I think, a good example of the invaluable help which the British Association brings to discussion when there appears to be a difficulty in reconciling the conclusions reached by the followers of different sciences. Lord Kelvin's estimate of a hundred million years as the period during which the earth had been cool enough to permit the existence of life upon its surface—a period reduced by Prof. Tait to ten million—was a great difficulty to geologists and biologists, who believed that an immensely longer time was required for the history of the fossiliferous rocks and the evolution of animals and plants. Thus, to quote only one instance, Darwin writing to Wallace in 1871 and referring to 'missing links', said, "I should rely much on pre-Silurian time; but then comes Sir William Thomson, like an odious spectre". The geologists resisted more firmly. Thus Sir Archibald Geikie, in his presidential address at Edinburgh in 1892, concluded his discussion of the subject with these words: "The geological record furnishes a mass of evidence which no arguments drawn from other departments of Nature can explain away, and which, it seems to me, cannot be satisfactorily interpreted save with an allowance of time much beyond the narrow limits which recent physical speculation would concede".

At the Leeds meeting in 1890 I had many opportunities of meeting Prof. John Perry, and when we were walking together on the Sunday afternoon, I asked him to tell me something of the Kelvin-Tait conclusions and how far they must be accepted. He had been a demonstrator under Kelvin and spoke of the intense interest with which he had followed his lectures at Glasgow, and he gave me no hope of escape. His change of opinion, throwing a most interesting light upon the influence of the British Association, was the result of the presidential address at Oxford in 1894, when Lord Salisbury chaffed the believers in natural selection, telling them that he did not wonder that they required many hundred million years for so slow a process, but that "if the mathematicians are right, the biologists cannot have what they demand. . . . The jelly-fish would have

been dissipated in steam long before he had had a chance of displaying the advantageous variation which was to make him the ancestor of the human race".

When Perry read this pronouncement, sweeping aside the firm convictions of biologists and geologists, he was led to re-examine the evidence and soon found a flaw. The heat of the earth had been calculated on the assumption of a conductivity uniform through the whole mass, but Perry showed that, with a conductivity becoming higher with increasing depth, the Kelvin-Tait estimate of the time required for cooling to the existing temperature—on which the age of the habitable earth had been based—must be immensely lengthened. Perry told me of this destructive criticism and very kindly helped me to make use of it in the address to Section D at Liverpool in which I replied to Lord Salisbury's amusing attack on the evolutionists.

Lord Lister was our president at Liverpool in 1896, and I cannot resist the temptation to digress for a moment and recall the address in which one of the greatest benefactors of mankind told us, with the utmost simplicity and modesty, the story of his life's work and the success which, in spite of all opposition, had been achieved. To hear him was an enduring inspiration.

The year 1896 was also the jubilee of Lord Kelvin's wonderful half-century of achievement in research and teaching, and I could not help feeling some regret that any criticism of his work should appear at this particular time. But in the kindly spirit of our Association such doubts were quite unnecessary. I well remember how he came one day to our sectional committee-room to bring me some volumes of his works, and how, as I have recorded before, in the following year as we were travelling across Canada after the Toronto meeting and the chance of collecting insects for a few minutes at each station could not be resisted, Lord Kelvin said to his wife, "My dear, I think we must forgive Poulton for thinking that the earth is so very old when he works so hard in one day out of all the endless millions of years in which he believes!"

The one line of evidence which left some anxiety in 1896 was suggested by Helmholtz, who allowed the sun only eighteen million years to have been giving out radiant heat at the present rate—a period Lord Kelvin was willing to extend to 500 million—and this estimated maximum was also accepted by Sir George Darwin, who, in his

address¹ at Cape Town in 1905, spoke of the new evidence obtained by M. and Mme. Curie in their proof that radium gives out heat, and quoting in confirmation the work of R. J. Strutt, W. E. Wilson and G. H. Darwin, finally concluded that "the physical argument is not susceptible of a greater degree of certainty than that of the geologists, and the scale of geological time remains in great measure unknown". The light thrown by radium upon the Helmholtz estimate was also referred to in the presidential address of Ray Lankester at York in 1906, of J. J. Thomson, quoting the work of Strutt, Joly and Rutherford, at Winnipeg in 1909, and became a predominant subject in the joint discussion on the age of the earth, between Sections A, C, D and K, at Edinburgh in 1921². Lord Rayleigh, in opening this discussion, concluded "that radioactive methods of estimation indicate a moderate multiple of 1,000 million years as the possible and probable duration of the earth's crust as suitable for the habitation of living beings. . . ."

Geologists and biologists do not profess to know the age of the earth as the abode of life, but they are sure that, in the words used by Sir William Turner at Bradford in 1900, its birth "must have been in the far-distant past, at a period so remote from the present that the mind fails to grasp the duration of the interval".

ORGANIC EVOLUTION

I fear that too much of our time has been occupied by the attempt to show that the field is clear for the discussion of organic evolution, but until this could be done any such discussion appeared to be wellnigh useless.

It is, I think, a mistake to emphasize too strongly the very natural shock received by many who read the "Origin" or heard of its teaching for the first time and without any preparation; and I believe an even greater mistake to criticize the clergy for the time that elapsed before their acceptance of the new teaching. I shall never forget the reception of Aubrey Moore's paper, "Recent Advances in Natural Science in their Relation to the Christian Faith", by the Church Congress at Reading in 1883³. No speaker could have carried his audience with him more thoroughly: there was not a single protest or indication of dissent—nothing but enthusiastic applause. The Bishop of Oxford, Dr. Mackarness, was in the chair when the paper received this unanimous welcome—

only twenty-three years after the Oxford meeting at which another Bishop of Oxford put his rude and foolish question to Huxley. It is pleasant to know that their celebrated encounter left no bitterness, for Huxley wrote in 1891 to Francis Darwin—"In justice to the Bishop, I am bound to say that he bore no malice, but was always courtesy itself when we occasionally met in after years".

I remember as a youth receiving a gentle parental warning against committing myself too entirely to a belief in evolution—a very different experience from that of our president at Hull in 1922, Sir Charles Sherrington, who in 1873 was persuaded by his mother to take the "Origin" with him on his summer holiday, with the inspiring words—"It sets the door of the Universe ajar!"

I have already recalled Dr. Wright's indignation at York in 1881 as my only experience of opposition to a belief in organic evolution at any of our meetings, and the published proceedings confirm this impression of unanimity. Thus, R. H. Traquair, addressing the biologists at Bradford in 1900, said, "I hardly think that we should now find a single scientific worker who continues to hold on to the old special creation idea"; and Lord Salisbury at Oxford in 1894, referring to Darwin, said, "He has, as a matter of fact, disposed of the doctrine of the immutability of species. It has been mainly associated in recent days with the honoured name of Agassiz, but with him has disappeared the last defender of it who could claim the attention of the world". The mention of this great American naturalist recalls Tyndall's fine address at Belfast in 1874 and his memories of Agassiz's words, "I was not prepared to see this theory received as it has been by the best intellects of our time. Its success is greater than I could have thought possible".

Huxley, who had seconded the vote of thanks to Lord Salisbury, wrote to Hooker a few days later: "It was very queer to sit there and hear the doctrines you and I were damned for advocating thirty-four years ago at Oxford, enunciated as matters of course—disputed by no reasonable man!—in the Sheldonian Theatre by the Chancellor. . . ."

A letter written two days earlier to Boyd Dawkins records Huxley's opinion of another part of the address. "Lord Salisbury gave himself away wonderfully, but he was so good about Darwin himself that I shut my eyes to all the nonsense he talked about Natural Selection".

MOTIVE CAUSES OF ORGANIC EVOLUTION

Leaving now the subject of organic evolution itself, as generally accepted, I wish to speak on the difficult question of its motive causes which for many years have formed the subject of addresses, discussions and papers at our meetings. The great division into two opposed theories of causation became clear in 1887, when Weismann attended the meeting at Manchester, and a discussion on "The Hereditary Transmission of Acquired Characters" was held in Section D. From that time, evolutionists attending our meetings have been either 'Lamarckians', following Erasmus Darwin, Lamarck, Buffon and Herbert Spencer, or 'Darwinians' who followed Darwin and Wallace. Darwin himself, however, included the Lamarckian conception of 'use-inheritance' as a motive cause, although believing it to be far less important than natural selection. The term 'Neo-Darwinian' has therefore been applied to those who, accepting Weismann's teaching, reject 'use-inheritance' altogether.

It must always be remembered that, apart from any theory of causes, the world owes its belief in organic evolution to all the great men whose researches and teaching have founded the two schools, and perhaps chiefly, at any rate, among the English-speaking nations, to Herbert Spencer. I was first led to realize the extent of his trans-Atlantic popularity when I learned from an American story greatly enjoyed in those far-off undergraduate days, that his books were keenly appreciated by a bashful hero, who was so far from sharing the sublime confidence of their author, that he was only led to perform the most fateful action in life by the pressing advice of a very young nephew who assured him, in the presence of the lady, that if he was fond of her, the proper thing to do was to kiss her. Herbert Spencer's infallibility certainly lent itself to such stories as that of his supposed reply to an argument—"That can't be true, for otherwise 'First Principles' would have to be re-written—and the edition is stereotyped"; or how Darwin said that to read Spencer always made him feel like a worm, but that he retained the worm's privilege of wriggling, and at another time "wonderfully clever, and I dare say mostly true". But, allowing for a style which provoked these and other amusing comments, we must never forget that believers in the doctrine of organic evolution owe an immeasurable debt to Herbert Spencer.

James Russell Lowell's amusing lines in the "Biglow Papers"¹⁸ appear to prove that Lamarckism was prevalent in America many years before the "Origin":

"Some flossifers think that a fakkilty's granted
The minnit its proved to be thoroughly wanted,

Ez, fer instance, thet rubber-trees fust begun
bearin'

Wen p'litikkle conahuncoes come into wearin',—
Thet the fears of a monkey, whose holt chanced
to fail,

Drowed the vertibry out to a prehensile tail".

The year of the Manchester meeting, 1887, was the fiftieth anniversary, and we are now celebrating the centenary, of the entry in Darwin's pocket-book:

"In July opened first note-book on Transmutation of Species. Had been greatly struck from about the month of previous March on character of South American fossils, and species on Galapagos Archipelago. These facts (especially latter), origin of all my views".

It is especially interesting to recall that these views, as Prof. Newton told us in his address to Section D, the biological section, did not include natural selection, which only came into Darwin's mind when he read Malthus, "On Population", in October 1838. Newton, who had read the proof-sheets of the great "Life of Darwin", published later in 1887, then spoke of Wallace's independent discovery, made twenty years after Darwin's, a discovery suggested to him also by reflecting on Malthus, and of the friendship between the two great men to whom this fruitful conception had come, referring the cynic who would "point the finger of scorn at the petty quarrels in which naturalists unfortunately at times engage" to this "greatest of all cases, where scientific rivalry not only did not interfere with, but even strengthened, the good-feeling which existed between two of the most original investigators". Here I cannot resist the desire to quote a part of the speech made by Wallace at the most thrilling scientific gathering I have ever attended—the fiftieth anniversary of the Darwin-Wallace essay read before the Linnean Society on July 1, 1858, only twelve days after the arrival of Wallace's letter and manuscript from the Moluccas. Wallace then said, on July 1, 1908:

"The idea came to me, as it had come to Darwin, in a sudden flash of insight: it was thought out in a few hours . . . and sent off to Darwin—all

within one week. I was then (as often since) the 'young man in a hurry': he, the painstaking and patient student, seeking ever the full demonstration of the truth that he had discovered, rather than to achieve immediate personal fame. . . . If the persuasion of his friends had prevailed with him, and he had published his theory, after ten years'—fifteen years'—or even eighteen years' elaboration of it—I should have had no part in it whatever, and he would have been at once recognized, and should be ever recognized, as the sole and undisputed discoverer and patient investigator of the great law of 'Natural Selection', in all its far-reaching consequences"¹¹.

Amusing evidence of the difficulty with which this "great law" was understood is afforded by a verse written by Lord Neaves and dated May 1861:

"A deer with a neck that was longer by half
Than the rest of its family's (try not to laugh),
By stretching and stretching, became a Giraffe,
Which nobody can deny"¹².

Yet Wallace, referring to Lamarck's hypothesis and "that now advanced", had written in his section of the joint essay:-

"Neither did the giraffe acquire its long neck by desiring to reach the foliage of the more lofty shrubs, and constantly stretching its neck for the purpose, but because any varieties which occurred among its antitypes with a longer neck than usual at once secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them".

There were fortunately others who did not launch such ill-aimed criticism. Thus Prof. Newton, reminding the Section that the new teachings had been at once accepted by Canon Tristram¹³ before the appearance of the "Origin of Species" (on November 24, 1859), expressed, with all the enthusiasm of one who was devoted to the same delightful branch of natural history, "the hope that the study of ornithology may be said to have been lifted above its fellows". It was indeed very fortunate that the Darwin-Wallace essay should have been read so soon after its appearance by a naturalist who looked on the species question as did Tristram—a great traveller and observer who studied indefatigably the birds he loved, as living creatures and in as many countries as he could visit.

At the last meeting of the British Association in Nottingham (1893), Canon Tristram was president of Section D and, in his address, gave an account of the observations referred to by Newton at Manchester. The historic interest of this early acceptance of natural selection is such that I have prepared a brief abstract of his chief conclusions:

During a visit of many months to the Algerian Sahara in 1857-58, he "noticed the remarkable variations in different groups, according to elevation from the sea, and the difference of soil and vegetation". On his return he read the Darwin-Wallace essay and wrote, "It is hardly possible, I should think, to illustrate this theory better than by the larks and chats of North Africa". He then explained how the colours arose by selective destruction of birds which harmonized less well than others with the surface of the desert; and similarly with other larks having "differences, not only of colour, but of structure", chiefly "marked in the form of the bill": He took as examples a very long-billed lark (*Galerita arenicola*), resorting exclusively to the deep, loose, sandy tracts, and a very short-billed allied species (*G. isabellina*), haunting the hard and rocky districts. He then pointed out that there is individual variation in the bills of larks and that the shorter-billed birds would be at a disadvantage in obtaining food from sandy areas but at an advantage among the rocks where strength is required. He concluded, "Here are only two causes enumerated which might serve to create, as it were, a new species from an old one. Yet they are perfectly natural causes, and such as I think must have occurred, and are possibly occurring still. We know so very little of the causes which, in the majority of cases, make species rare or common that there may be hundreds of others at work, some even more powerful than these, which go to perpetuate and eliminate certain forms 'according to natural means of selection'".

The temptation to record an amusing incident which happened at one of the meetings of Section D at Manchester cannot be resisted. Work was proceeding smoothly under the genial guidance of Prof. Newton when, suddenly, Dr. Samuel Haughton of Dublin entered and from the back of the room announced in arresting tones that he had an important communication to make about the animals preserved from the Flood. He believed that Mrs. Noah strongly objected to her husband's intention to take the elephants on board, fearing that their weight would cause a dangerous displacement of the Ark's metacentre.

How this domestic difference was composed we had no opportunity of learning, for as the chairman, whose expression combined sympathetic amusement with mild deprecation, was rising and about to protest, Dr. Haughton, anticipating the result, had already turned towards the door, telling us over his shoulder that he was on his way to make a fuller communication on the subject to the Anthropological Section.

ACQUIRED CHARACTERS

After this brief description of an event, which I hope you will agree ought not to be forgotten, we must return to organic evolution and to one of the most important subjects debated at any time before a meeting of the British Association—the question, “Are Acquired Characters Hereditary?”—brought before the world by Prof. August Weismann, who was present at Manchester and spoke in the discussion (unfortunately not reported), introduced by Ray Lankester, in which Dr. Hubrecht, Patrick Geddes, Marcus Hartog and I took part. Weismann’s conclusion that “acquired characters” are not inherited was held by Prof. E. S. Goodrich, in his address to Section D at Edinburgh in 1921, to be “the most important contribution to the science of evolution since the publication of Darwin’s ‘Origin of Species’”, an opinion with which the great majority of biologists will agree, although the terms employed for the two classes, the inherited and the non-inherited, together with the ideas underlying them, were shown by Adam Sedgwick, at Dover in 1899, Archdall Reid, and others, as well as by Goodrich himself, to be incorrect. Nevertheless it will probably be impossible to abandon the word ‘acquired’, employed by Erasmus Darwin (1794), Lamarck (1809), and Prichard (1813) as well as by later authorities. Whenever environmental conditions are followed by characteristic changes, absent when these conditions are absent; or when such changes follow the use or disuse of the parts of an organism, or the education it has received, then we have before us the ‘acquired’ characters maintained by Weismann to be incapable of hereditary transmission. This vital conclusion, accepted, as I believe it is, by nearly all biologists, is not appreciated as it ought to be by the general public. A brief statement of a single piece of evidence may convince some who are doubtful about a conclusion with which human life is very deeply concerned.

My old friend the late A. A. Macdonell, professor of Sanskrit at Oxford, spoke two languages, English and German, as they are spoken by native Englishmen and Germans. I asked him whether he thought it was possible for any mature person to learn a foreign language so perfectly that he would be mistaken for a native. He replied that he was sure it could not be done, and that his own ability to speak the two languages as he did had been only made possible because as a small child he had been continually taken backwards and forwards between the two countries. Yet any human being transported as a baby from his own country to another and brought up there among the natives will learn to speak as they speak. All the past generations, however many, during which his ancestors spoke the language of his birthplace, will count for nothing, will not retard his acquisition of another tongue or modify it in any way.

An interesting and amusing example is provided by the futile striving of an Englishman to pronounce the Welsh double-l, generally attempted by the substitution of ‘th’. Even the advice given by a Welsh clergyman to the English bishop of his diocese is unlikely to bring success: “You must put the tip of your Right Reverend tongue against the roof of your Right Reverend mouth, and hiss like a goose”.

The result of education as an ‘acquired’ character in the Weismannian sense is of such special importance that I think it is well to quote the conclusions stated by Ray Lankester in his address to the seventy-fifth meeting of the Association at York. He then maintained that the “power of building up appropriate cerebral mechanism in response to individual experience, or what may be called ‘educability’, is the quality which characterises the larger cerebrum and is that which has led to its selection, survival and further increase in volume . . . ‘Educability’ can be transmitted; it is a congenital character. But the *results* of education can *not* be transmitted. In each generation they have to be acquired afresh. . . . On the other hand, the nerve-mechanisms of instinct are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are *not* acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations”¹⁴.

Lankester was led by these conclusions to reject altogether the theory of G. H. Lewes, G. Romanes, and others, “that instincts are due to

lapsed intelligence", a theory also disproved by Lloyd Morgan's observations on young birds described by him at the Ipswich meeting in 1895¹². Another very important subject brought forward by Lankester was the evidence, originally published by him in 1894¹³, that Lamarck's first and second laws of heredity "are contradictory the one of the other, and therefore may be dismissed". His statement may be briefly summarized as follows:

The first law assumes that in spite of thousands of generations during which a normal environment has "moulded the individuals of a given species of organism; and determined as each individual developed and grew 'responsive' quantities in its parts (characters); yet, as Lamarck tells us, and as we know, there is in every individual born a potentiality which has *not* been extinguished. Change the normal conditions . . . and (as Lamarck bids us observe), in spite of all the long-continued response to the earlier normal specific conditions, the innate congenital potentiality shows itself. The individual . . . shows *new* responsive quantities in those parts of its structure concerned, new or acquired characters".

"So far, so good. What Lamarck next asks us to accept, as his 'second law', seems not only to lack the support of experimental proof, but to be inconsistent with what had just preceded it. The new character which is *ex hypothesi*, as was the old character . . . which it has replaced—a response to environment . . . is, according to Lamarck, all of a sudden raised to extraordinary powers. The new or freshly acquired character is declared . . . to be capable of transmission by generation; that is to say, it alters the potential character of the species. It is no longer a merely responsive or reactive character, determined quantitatively by quantitative conditions of the environment, but becomes fixed and incorporated in the potential of the race, so as to persist when other quantitative external conditions are substituted for those which originally determined it".

The effect of Lamarck's laws on the hereditary transmission of acquired characters would be this: "a past of indefinite duration is powerless to control the present, while the brief history of the present can readily control the future".

After hearing a very condensed statement of conclusions so essentially bound up with the progress of organic evolution, I feel sure that you will wish to be reminded of Prof. Ewing's words which followed the address at York:

"Now is the winter of our discontent made glorious summer by this Ray of Lankester".

Returning to the unreported discussion on the inheritance of acquired characters at Manchester, I venture to bring forward certain observations opposed to a belief in Lamarckian evolution by means of inherited experience—observations which I then described and have not known to be answered. In the relationship between enemy and prey there is very commonly no opportunity for the latter to learn by experience. The wonderfully elaborate adaptations by which sedentary insects are hidden from enemies have been evolved, not by experience of enemies but by avoidance of enemies. In these examples—and they are numberless—we are driven to accept Weismann's conclusion and with him to invoke "the all-sufficiency of Natural Selection".

When one of the twig-like caterpillars, of which there are so many in Great Britain, is detected by an insectivorous bird, it can do nothing and is devoured at once. Its one defence is the astonishingly perfect resemblance to a twig of the bush or tree on which it lives. It is firmly fixed and its weight also supported by an almost invisible thread so that it cannot escape as many caterpillars do by dropping to the ground and sheltering in the grass or among dead leaves. Its one chance of survival is to gain so perfect a disguise that it will not be seen, and to gain this end the adaptive devices are most elaborate and wonderful: its twig-like shape and colours, with the power of gradually adjusting these so as to resemble the bark of the bush or tree on which the parent moth laid the egg from which it came, even the power to reproduce exactly the appearance of lichen, the rigid stick-like attitude maintained during the hours of daylight. Finally there is the evidence, recently obtained by Robert Carrick¹⁴, that the disguise *does* protect; for examples of one of these caterpillars, resting on a branch of its food-plant fixed over a wren's nest containing young, were unnoticed by the parent bird which used the same branch as a convenient perch; yet seen and at once taken when placed on a white surface below.

One of the best examples of a prophetic instinct is to be found in the larva of an African Tabanid fly (*T. biguttatus*). This maggot lives and feeds in soft mud which, during the dry season when the chrysalis stage has been reached, will be traversed in all directions by wide and deep cracks in which insectivorous animals can search for prey. But the maggot, while the mud is still soft, prepares

for this danger. By tunnelling spirally up and down it makes a line of weakness which will cause a pillar to separate from the mass when the mud hardens and contracts. It then tunnels into the still soft pillar and becomes a chrysalis in the centre of its deeper end. However wide the cracks which appear in the mud, the maggot has arranged beforehand that they will not invade its cylinder. Dr. W. A. Lamborn, who made this most interesting discovery, observed that the summits of the pillars, forming circular disks of about the size of a penny, scattered here and there over the surface, were never thus traversed, but that an empty shell was protruding from the centre of each when the fly had emerged¹. My friend the late Prof. J. M. Baldwin, the distinguished American psychologist, well remembered at many of our meetings, wrote when he heard of this discovery: "it seems *complete*—one of those rare cases of a single experience being sufficient to establish both a fact and a reason for the fact! It is beautiful".

I would ask any believer in Lamarckian evolution, or in Hering's and Samuel Butler's theory of unconscious memory residing in the germ-cells, how it would be possible to explain these prophetic instincts, adapted not to meet but to avoid future experience, except by the operation of natural selection.

The appeal to orthogenesis, or internal developmental force, as the motive cause of evolutionary progress, has often been made—generally by palaeontologists rather than by the observers of living forms. Any such belief in the potency of an internal tendency is, I think, open to the criticism made by Thiselton Dyer in his address to Section D at Bath in 1888: "This appears to me much as if we explained the movement of a train from London to Bath by attributing to it a tendency to locomotion. Mr. Darwin lifted the whole matter out of the field of mere transcendental speculation by the theory of natural selection, a perfectly intelligible mechanism by which the result might be brought about. Science will always prefer a material *modus operandi* to anything so vague as the action of a tendency".

MENDELISM

It is not necessary for me to speak on the rediscovery of Mendel's great work and all that it has meant to our biological sections in the early decades of the present century. The recent developments, following the work of Haldane, R. A. Fisher and others, and the vitally important

relationship between Mendelism and natural selection were brought before us last year in Julian Huxley's illuminating address to Section D. The older belief that only large variations, or mutations as they then began to be called, were subject to Mendelian inheritance, and that small variations were not inherited at all, disappeared when further researches proved that extremely minute differences were "heritable in the normal manner"², and, with this, the foundation of Darwinian evolution became immensely strengthened. It is also right to remember that Bateson, the leader of Mendelian research in Great Britain, always believed in natural selection, regarding it indeed as self-evident and not very interesting. Also that Ray Lankester, as long ago as his 1906 address at York, maintained that however far Mendelism was advanced, it "would not be subversive of Mr. Darwin's generalisations, but probably tend to the more ready application of them to the explanation of many difficult cases of the structure and distribution of organisms".

The relationship between the germinal foundation of Mendelian and Weismannian heredity was considered in a paper by L. Doncaster read before Section D at the South African meeting in 1905. He then maintained that Weismann's "hypothesis that the material bearer of hereditary qualities is the chromatin of the nucleus" of the germ-cells had been confirmed by recent work on their maturation, which "has shown that they contain a mechanism which seems precisely adapted to bring about that segregation of characters which forms the most fundamental part of the Mendelian theory, and it seems hardly possible that the two things are unconnected". MacBride also in his address to the same section at Newcastle in 1906, spoke of the "great epoch-making discovery of experimental embryology, viz. the existence of *specific organ-forming substances*".

These fundamental discoveries bring to mind a conversation with Weismann when he had been finally driven to frame and elaborate this hypothesis, and was so appalled by the number and minuteness of the material bearers of hereditary qualities contained in a single germ-cell that, as he told me, he could not believe that the physicists and chemists were correct in their conclusions about the size of the atom. He admitted that diverse lines of evidence led to the same result, but even so, he believed the future would prove that physicists were mistaken and that the atom was far smaller.

NATURAL SELECTION To-day

It is impossible to say more than a few words about the very interesting and important discussion on "The Present State of the Theory of Natural Selection" held at the Royal Society on May 14 last year. The subject was approached from many points of view by both zoologists and botanists, and their conclusions were very welcome to Darwinians who remembered the earlier opinions expressed when Mendel's great work was rediscovered. I think, however, that Prof. D. M. S. Watson, in the opening address, was inclined to underestimate the value of the existing evidence for a "selective death rate", although everyone will agree that "any new evidence . . . or indeed any suggestion of cases which might be capable of investigation", would be most desirable.

I may briefly mention a few experiments brought before Section D at the Bristol meeting in 1898, beginning with the work of Weldon and Thompson on the common shore crab, showing that the effect of china clay and other impurities in the sea at Plymouth was selective and promoted changes of shape which ensured that the water flowing over the respiratory surface was more efficiently filtered.

Then, on the subject of chance, the heroic help rendered by Mrs. Weldon, who four times recorded the result of 4,096 throws of dice, showing that the faces with more than three points were, on the average, uppermost slightly more often than was to be expected. It comes back to me very clearly because of the interesting explanation—that the points on dice are marked by little holes scooped out of the faces, and that points 6, 5, and 4, respectively opposite 1, 2, and 3 are somewhat lighter, more of the ivory having been removed; also because of Francis Galton's delight and his humorously expressed wonder whether the facts had been realized by those who had an interest other than scientific in the throwing of dice.

Experimental evidence was also submitted by Miss Cora B. Sanders (Mrs. C. B. S. Hodson) and myself, proving that when the rough, angular pupa of the small tortoiseshell butterfly "is suspended from a surface against which it stands out conspicuously, it is in far greater danger than when it is fixed to one upon which it is concealed".

To the observer of living creatures, however, the most convincing evidence is provided by animals themselves. When a wild bird is seen to

capture some conspicuous butterfly or moth and then immediately to reject it, the association between inedibility and a warning colour is more convincingly suggested than when insects are offered to animals in confinement, although such experiments are of great value and often provide the only available evidence. There are, however, instances in which abundant data for statistical investigation are furnished by the wild animals themselves. Thus the long-eared bat has the convenient habit of eating moths—its regular food—while it hangs suspended from a surface to which it returns after each capture; and as the wings are rejected, these may be collected in large numbers, yielding valuable information on the significance of concealing and warning patterns.

In the attempt to determine the motive causes of organic evolution, the work of the naturalist, the student of living nature, is essential. His task is to do what Lyell did for geology by directing attention to the forces now in operation and seeking with their help to interpret the past, and in this work it is especially valuable to study adaptations which have been developed in recent times and can, in certain instances, be proved to undergo changes even now. Thus the interesting observations of H. Lyster Jameson showed that a pale local race of the common mouse had been formed, although incompletely, in 100–125 years, by the selective attacks of owls and hawks on sandhills near Dublin²⁰. I therefore believe that the colours of animals provide one of the most fruitful fields in which to pursue these investigations, and I regret that this work has been recently attacked by an American zoologist who, referring to the recent revival of natural selection, continues—"if the doctrine can emerge minus its sexual selection, its warning colors, its mimicry and its signal colors, the reaction over the end of the century will have been a distinct advantage"²¹. It is of course impossible to discuss, on the present occasion, this confident attempt to depreciate the value of work associated with the names of Bates, Wallace, Trimen and Fritz Müller. I will only point out that their conclusions on warning colours and mimicry have been immensely strengthened and confirmed by the later observations of Guy Marshall, W. A. Lamborn, St. Aubyn Rogers, Hale Carpenter, V. G. L. van Someren and others in Africa; by the experiments conducted by some of these naturalists, and also by H. B. Cott and R. Carriek, and in the United States by Morton Jones.

It is interesting to remember that a paper by two American entomologists²³ was among the first to accept and support by fresh observations the conclusions brought forward by H. W. Bates in his great memoir on the mimetic butterflies of the Amazon valley²², and that one of the authors treated the same subject more completely in a later paper²⁴ much appreciated by Darwin²⁵.

It is also important to remember that the above-mentioned conclusions have been reached by the study of marine animals no less than terrestrial, as was shown by Herdman in his address to Section D at Glasgow in 1901, and by his experiments communicated to the same section at Ipswich in 1895; also that Garstang, with his very long and intimate experience of marine life, adopts the same interpretation of colour and form with the associated attitudes and movements.

If time permitted it would be possible to speak of numerous papers on mimicry and the related subjects which have been brought before our meetings. It is impossible to attempt this now, but many will feel with me that the name of the late Dr. F. A. Dixey should not be forgotten—one who attended so regularly, so often read papers at our meetings, presided over Section D at Bournemouth in 1919, lectured at Leicester in 1907, always giving the results yielded by the study of his favourite insects, and their interpretation by the theory of natural selection; also one who delighted in the social gatherings of his Section.

MAN AND ANIMALS

In my concluding remarks I am anxious to refer to a very interesting and encouraging subject—the feeling for animals and the care for their welfare to-day, as contrasted with the treatment they received a hundred years ago and even in the youth of many among us. Only last autumn, *The Times* of October 12 reported that 1,000 swallows had arrived at Venice “sent there by bird-lovers from Vienna and Munich in order to save them from the effects of the cold weather. Soon after their arrival they were set free and flew south along the Adriatic coast”. A little earlier the writer of the amusing ‘fourth leader’ referred to a meeting of the Society for the Preservation of the Fauna of the Empire at which the care of the opossum was discussed, comparing this with the report of happenings a hundred years earlier when there was a “humorous debate” at the Zoological Society “about puffing cigar-smoke into

the cages of the monkeys”, to their evident discomfort. The writer, yielding too far, we hope, to the depression of the present day, concludes: “The world, it may be, is ‘man-sick’ and yearning to be rid of a bad mistake. But the creature cannot be wholly vile when instead of torturing monkeys it takes thought for the opossum”.

It would not be right to quote from a century-old report without speaking of all that is done and has been done during many years for the care and health of animals by the great London Society, and in doing this, for the education and happiness of our people. But the change of which I have spoken is most deeply impressed on those who remember, as many of us do, the misdirected hours in youth when birds were shot in our gardens and brick traps made to catch them. I feel sure that those who did these things are not essentially different from their children and grandchildren who have grown up in a kinder atmosphere.

I must not occupy more time on a subject which to some may seem inappropriate, but it is bound up with education in its true sense—a leading out—and if, as Ray Lankester said at York, and we are all coming to believe, the hidden powers within *are* inherited while the results of their development are *not*, then there is no easing of the burden with the passage of time, but each generation afresh must bear the heavy responsibility of conducting this development in the best way so that its successor may be able to meet the changing and, at this time, the increasing needs. The relationship between the powers within and their development was suggested in arresting words by the late Prof. Scott Holland: “To say that a man cannot be made good by Act of Parliament is such an obvious truth that people forget what an outrageous lie it is!”

INTERNATIONAL PEACE

Thoughts on the development of these hidden powers by the educating influence of social environment, suggest the greatest of the problems by which we are faced—the end of international war. Michael Foster, in his address at Dover in 1899, after speaking of progress in the material of warfare was led to believe that, “happily, the very greatness of the modern power of destruction is already becoming a bar to its use, and bids fair—may we hope before long!—wholly to put an end to it; in the words of Tacitus, though in another sense, the very preparations for war, through the

character which science gives them, make for peace". In his concluding pages he expressed the hope that the brotherly meeting between the English and French Associations at Dover and Boulogne might be looked upon as a sign that science, by nobler means than the development of armaments, was steadily working towards the same great end. In a time of still greater need and perplexity, may we not, in the same hopeful spirit, look upon the recent visit by which members of the French Association have honoured us, and feel strengthened in the belief that the great end will be reached.

There are, I know, very many people who look upon the Great War with later wars and rumours of wars as the close of Michael Foster's dream. The words in which Sir Arthur Schuster concluded his address at Manchester in 1915, and Sir Edward Thorpe at Edinburgh in 1921, indicate, I hope, that the British Association does not thus despair, and in this belief I bring before you a passage from the far earlier address which Sir Richard Owen delivered to the twenty-eighth meeting at Leeds in 1858—a passage which makes a special appeal at a time when the British and American Associations are confidently hoping to strengthen still further the bonds of sympathy and mutual appreciation by which they have been happily united for so many years.

Referring to the trans-Atlantic telegraph, Sir Richard said:

"We may confidently hope that this and other applications of pure science will tend to abolish wars over the whole earth; so that men may come to look back upon the trial of battle between misunderstanding nations, as a sign of a past state of comparative barbarism; just as we look back

from our present phase of civilization in England upon the old border warfare".

Confident words inspired by the forging of a new link between the two great English-speaking nations. Nearly eighty years have passed since they were spoken, but with all the terrible disappointments there has been great progress, and a time will surely come, and may it come quickly, a time which shall prove that the visions of the young and the dreams of the old were prophetic of a glorious reality.

¹ "Early Science in Oxford", vols. 1-11.

² "The Natural History of Oxfordshire, being an Essay toward the Natural History of England", by Robert Plot, D.D. Printed at the Theater in Oxford. 1677. Dedicated To the most Sacred Majesty of Charles the Second, King of Great Britain, France and Ireland, Defender of the Faith, etc. (pp. 118-123).

³ "Life and Letters", vol. 1, p. 157.

⁴ Report, British Association, Centenary Meeting, 1931, p. 78.

⁵ Report, British Association, 1905, pp. 514-518.

⁶ Report, British Association, 1921, pp. 413-415.

⁷ "Science and the Faith", London, 1899, pp. 232-235.

⁸ "Life and Letters", 1900, vol. 2, p. 379.

⁹ From a letter of August 10, 1894, printed in the *Jesus College (Oxford) Magazine*, for Lent Term, 1938; and reprinted in *Hope Reports*, vol. 16, 1930, No. 3, p. 6. (Privately circulated to many scientific libraries.) Huxley's letter of August 18, 1894, to Lewis Campbell ("Life and Letters", vol. 2, p. 379) refers to the same subject.

¹⁰ The lines are quoted from the first part, published 1846-48.

¹¹ Darwin-Wallace Celebration of the Linnean Society of London, 1908, pp. 6, 7.

¹² "The Origin of Species. A New Song". In "Songs and verses, social and scientific", by an old contributor to *Maga*. Edinburgh, 1868, 2nd Ed.

¹³ *Ibid.*, October, 430-433 (1859).

¹⁴ Report, British Association, 1906, pp. 26-27. The conclusions here quoted had been communicated to Société de Biologie of Paris in 1899 (jubilee volume) and were reprinted in *NATURE*, 61, 624-625, (1900).

¹⁵ Report, British Association, 1895, p. 734.

¹⁶ *NATURE*, 61, 127 (1894); Report, British Association, 1906, pp. 29, 30.

¹⁷ *Trans. Roy. Ent. Soc., Lond.*, 26, 121 (1936).

¹⁸ *Proc. Roy. Soc., B*, 186, 83, pl. v (1930); *Proc. Ent. Soc. Lond.*, 8, 14 (1930).

¹⁹ Report, British Association, 1931, p. 77 and references quoted.

²⁰ *J. Linn. Soc. (Zool.)*, 26, 465, pl. 30 (1898).

²¹ "Evolution", A. Franklin Shull (New York, 1936).

²² Walsh and Riley, *The American Entomologist*, St. Louis, Mo., 1, 190 (1890).

²³ *Trans. Linn. Soc. Lond.*, 23, 495 (1862).

²⁴ Riley, "Third Annual Report on the Noxious . . . Insects of . . . Missouri" p. 143 (1871).

²⁵ Poulton, "Charles Darwin and the Theory of Natural Selection" p. 203 (1896).

Summaries of Addresses of Presidents of Sections*

Noise and the Nation

THE programme in Section A (Mathematical and Physical Science) this year is largely devoted to some of the social and industrial developments of applied physics. The president of the Section, Dr. G. W. C. Kaye, has broken with precedent in giving an address of an experimental character, and in choosing an acoustical subject for the first time in the history of the Section, extending over a hundred years.

Acoustics was long the Cinderella of the physical sciences, but with the coming of the gramophone, radio, broadcasting and the talking pictures, and the popularizing of the telephone, the commercial value of applied acoustics must now run into very large figures. Sound has become a marketable commodity, the cultural and political developments of which, particularly in regard to broadcasting, it is not easy to envisage. The literature is immense and the terminology large and extensive, as may be gathered from the recently published acoustical glossary of the British Standards Institution.

Simultaneously with these developments in applied acoustics, the nation has begun to take notice of the growth of noise—a by-product attributable in great part to an increasingly mechanized civilization. Much research is being carried out to meet the public demand for greater protection against the noise nuisance of to-day, chief interest being probably centred in the noises on the road and the noises experienced in modern buildings, which are admittedly not so quiet as those of a generation ago.

It is only within the last few years that practicable instruments have become available to measure and analyse sounds and noises, though it cannot be said that finality in these directions has been reached. In cases of annoyance caused by noise, experience indicates that while the composition and the psychological aspects are not to be ignored, sheer loudness is often a determining factor. Particular attention has therefore been devoted to the subjective scale of loudness and its unit, the phon, and the associated unit of energy or pressure level, the decibel. An important step was taken this year when both were adopted as international units by some thirteen nations in Paris.

The study of the general question of noise transmission, particularly in buildings, is more complex than might be imagined, and some of the major difficulties are not yet completely resolved. For the purpose, facilities such as are provided by the 'sound-proof' acoustic laboratories at the National Physical Laboratory have proved to be necessary. *Inter alia*, it already appears that special designs of double floors, double walls and double windows, which have been evolved, form material contributions to noise-abatement in buildings. The degree of public interest in the general question is illustrated by the wide variety of noise problems submitted to the National Physical Laboratory during the last few years: for example, the mitigation of the noises in aeroplane cabins and engine-testing factories, trains, ships, tube railways, motor-cars, motor-cycles, motor-buses, motor-horns, pneumatic drills, printing works, transformer sub-stations, cathedrals, assembly halls, business offices, flats, miniature rifle ranges, building operations and so on.

The growing volume of road traffic and the ever-increasing speed and acceleration of individual vehicles are major contributory factors to the problem of road transport noise. A Departmental Committee of the Ministry of Transport was appointed in 1934 and has since published three reports. Loudness measurements, many thousands in number, were conducted for the Committee by the National Physical Laboratory on the overall noise of some hundreds of motor-vehicles, both new and old. The Committee has proposed noise limits, which, while making very moderate demands on most types of vehicle would, by ruling out the flagrant offenders, help to ensure a standard of acoustical decency on the roads of Great Britain. More recently, the Committee has submitted a report on motor-horns.

Organized steps are being taken in Great Britain to further the abatement of the many types of unnecessary noise. There is now a goodly list of 'silent' appliances in everyday life, though it is evident that as regards many commercial machines and processes we shall have to put up with second-class expedients for the present. It is evident, however, that the finding of practicable solutions to the many ramifications of the noise problem would be welcomed by almost every section of the community.

* The presidential address, and addresses by the sectional presidents, are being published as "The Advancement of Science, 1937" (Nottingham: B.A. Reception. London: Burlington House.) 3s. 6d.

Researches in Chemotherapy

CHEMOTHERAPY, which forms the subject of Dr. F. L. Pyman's presidential address before Section B (Chemistry), may be regarded as the treatment of disease by chemical substances, which have been shown by biological methods to be relatively much more toxic to pathogenic organisms than to human or other animal hosts.

Chemotherapy was developed by Paul Ehrlich, and its most outstanding achievement has been the introduction of the arsenic group of spiröchætidicides.

In the field of bactericides, the introduction of phenol as an antiseptic by Lister in 1867 has led to the study of many derivatives of phenol. Recently systematic studies of various homologous series of phenols have resulted in the introduction into medicine of hexyl-resorcinol and amyl-*m*-cresol, the latter having a Rideal-Walker co-efficient of 280.

The chemotherapeutic investigation of amœbiocides was greatly facilitated by the *in vitro* test for amœbicidal efficiency developed by Dobell and Laidlaw. Using this test, Coulthard studied a series of alkyl derivatives of harmol prepared in Messrs. Boots' laboratories and showed that peaks of bactericidal efficiency were reached at butylharmol for *B. typhosus* and at amylharmol for *S. aureus*, whilst peak amœbicidal activity was found in *O*-*n*-nonylharmol. Salts of members of this series were, however, very sparingly soluble in water, and in order to obtain more soluble compounds the corresponding dialkylamino derivatives were prepared and their amœbicidal activities compared with that of emetine. Although the most active member was not as active as emetine, it had several times the activity of *O*-*n*-nonylharmol and it was suspected that the harmol residue might not be the important contributor to the amœbicidal properties of the molecule and that the dialkyl-aminoalkyl group might play an important part. This led through various intermediate stages to the preparation and study of a series of tetra-alkyldiamino paraffins and of these α -tetra-*n*-amyldiaminodecane was found to be the most efficient. For brevity, the compound is referred to as T.A.D.D.

The preceding results had shown that, when tested by the Dobell and Laidlaw technique, T.A.D.D. was the most active amœbiocide so far prepared. It now became necessary to compare the efficiency of this compound with that of emetine under conditions as similar as possible to those found in the intestine of a dysenteric patient. When tests were carried out under these conditions T.A.D.D. was found to be more active than emetine. As originally pointed out by

Ehrlich, the therapeutic value of a substance is a function of its toxicity to both parasite and human host. It became necessary, therefore, to determine the relative toxicities of T.A.D.D. and emetine to mice. The results of such a test showed T.A.D.D. to be from one third to one eleventh as toxic as emetine, depending on the method of administration.

T.A.D.D. had thus a greater *in vitro* amœbicidal activity and was less toxic to mice than emetine. These results appeared to justify the clinical trial of the compound in the treatment of amœbic dysentery.

Such a trial was carried out by Prof. Warrington Yorke, at the request of the Therapeutic Trials Committee of the Medical Research Council. Unfortunately, T.A.D.D. proved to be too irritant for parenteral administration and it was not sufficiently active to be of any real value when given orally.

Whilst this investigation has not yielded a compound of clinical value, it has resulted in the accumulation of valuable data which will be of value in further work on this subject.

The account of such an investigation indicates the enormous amount of chemical and biological team work involved in attempts to evolve new drugs for the treatment of disease.

The Glaciation of the Midlands

IN his address to Section C (Geology), Prof. L. J. Wills discusses the Pleistocene history of the West Midlands with the object of discovering how many glaciations are represented, and of linking these up with the better-known sequences of East Anglia.

It has long been recognized that the boundary between the 'Newer' and 'Older' Drifts crosses the district from Church Stretton through Bridgnorth to Wolverhampton. Prof. Wills devotes attention mainly to the Older Drifts, which have undergone enormous denudation in the vales but have in varying degrees survived on the Midland Plateau and on watershed areas. The evidence of the former great extension of the present outcrops is scattered, but is *en masse* sufficient to allow the assumption that the vales of Severn and Avon were ice-filled during the older glaciations, though it must be realized that they were far shallower then than now.

In the Midlands three principal types of drift can be recognized: *Irish Sea* in the north-west, and belonging to the Newer Drifts; *Western* or *Welsh* on the Midland Plateau (this occasionally contains Irish Sea boulders, and in the Trent

valley is *Pennine*, not Welsh, in origin); *Eastern* to the east of the Warwickshire Coalfield and in the Avon vale as far down as Stratford and possibly as far as Tewkesbury. The Eastern Drift is a continuation of the Great Chalky Boulder Clay of the Eastern Midlands and East Anglia.

Analysis of all the available evidence leads to the conclusion that the Older Drifts of the Midlands are the products of two separate cold periods. In the First Glaciation, ice moving from the north-west brought Welsh and Pennine material. The Welsh lobe travelled down the Severn vale, and its marginal drainage was probably responsible for the siting of the present Lower Severn valley. Some evidence of the First Interglacial has been obtained near Coventry and Rugby, and in Leicestershire. In the Second Glaciation the 'Great Eastern Glacier' of Harmer was the dominant feature, but side by side with it was an important Welsh Ice Sheet covering the northern part of the Severn vale and much of the Midland Plateau. The influence of these two lobes can be seen in the distribution of glacial and river drifts, and in modifications of the drainage. The retreat stages of the two ice sheets can only be traced in very general outline; the indistinctness is a measure of the antiquity of the events.

The Second or Great Interglacial which closed the period of the Older Drifts and led up to that of the Newer, is represented in the Midlands in two ways: first, by vast denudation which allows us to designate the Older Drifts as 'high-level' in contrast to the 'low-level' terraces of the valleys that resulted from the erosion; and secondly, by the Kidderminster Terrace of the Severn and No. 4 Terrace of the Avon, the distribution of which makes it improbable that ice has since invaded the Midlands beyond the limits of the Irish Sea Drifts.

The Third Glaciation is represented in the north-west by the Irish Sea Drifts, and elsewhere by the Main Terrace of the Severn and its correlatives in all the tributaries, and by taele-gravels and melt-water flood-gravels. Only brief reference is made to the outstanding influence of this glaciation on Midland physiography through the establishment of the Iron Bridge diversion of the upper Severn with the resultant rejuvenation of the river due to its increased volume. This and the evidence for a fourth glacial episode can only be touched upon; and no attempt is made to deal with the latest events, the primary object being to establish the existence of two glaciations within the period of the Older Drifts, and the correlation of the second of these with the Great Eastern Glaciation of East Anglia.

Selective Action of Mortality

FOR the reasons that they furnish reliable information concerning the progress of a vast experiment which we are conducting with ourselves as the experimental material, and also that they can be appreciated only by such as can bring to their examination knowledge derived from a comparative study of different forms, wild and domesticated, in the open and under the conditions of controlled experimentation, the attention of the zoologist is directed by Prof. F. A. E. Crew in his presidential address to Section D (Zoology) to the facts and observations relating to the human sex ratio.

It is easily demonstrated that to be born is a far more dangerous adventure for the male than for the female, and that indeed the true recipe for longevity is to be born a girl. It is equally readily shown that numerical equality of the sexes in a population such as ours exists only among those individuals who belong to the ages that are associated with the reproductive prime. Among the 0-15 year olds there are more males than females. Among the 20's and over there are more females than males, and the female numerical preponderance increases with increasing age, so that among the 85's and over there are twice as many women as men. In a democracy such as ours, in which sex is supposed to be disregarded, the political power of women is not at all commensurate with their relative numerical strength.

This swing in the sex ratio from high to very low is known to be the result of a sexually selective mortality which operates to the disadvantage of the male both before and after birth, and since the severity of this mortality is profoundly influenced by a number of environmental agencies, it is possible to use the sex ratio as a measure by which a society may assess the quality of its architecture.

It can be shown that there is nothing unique about the human sex ratio, and that the forces which tend to distort it are identical with those that produce the same results in other forms. When male is contrasted with female, it becomes clear that the greater fragility of the former may be regarded as an indication of his relative lack of importance in respect of propagation. Efficiency and economy would seem to be observed by the removal of the male when he has served his purpose. Through selection the sex ratio can become adjusted to the conditions that exist in a population, and it is possible to construct a thought model of a purely genetic mechanism through the workings of which the size of the primary sex ratio is brought into harmony with the amount of mortality due to the action of sex-linked genetic lethals, to sex-limitation in the expression of

disadvantageous characters, and to the effects of sex dimorphic physiological qualities. The relation between the size of the primary sex ratio and the amount of mortality, both pre-natal and during adolescence, is such as to lead to the establishment of an optimum reproductive sex ratio among those who, in respect of purely biological properties, are newly equipped for ardent reproduction.

Changing Distribution of Population

IN noting that four chief populous regions, in 'Europe', the Far East, India and eastern North America, now contain three fourths of mankind on one eighth of the land area of the world, it is pointed out by Prof. C. B. Fawcett in his presidential address to Section E (Geography), that the peopling of the fourth of these by the great European migration of the last two hundred years is the only shift of population of world magnitude recorded within the historic period. The south temperate lands even now contain barely a fortieth of the world's population; and the other considerable migrations are merely oscillations of the margins of the four great populous regions.

A more important change is the recent growth of great conurbations. In 1801 London, with 950,000 inhabitants, was the only city which approached a million. Now there are about sixty million-cities, a dozen of which exceed five million, and which together include a twelfth of mankind. The number and population of these great conurbations are growing; and if this trend were to continue unchecked for another two or three generations, it would give a world in which a majority of the inhabitants would dwell in two or three hundred such cities.

Within the great populous areas there is also a development of a few small areas of maximum concentration, where great conurbations tend to cluster. Three such areas are noted. The chief is in Western Europe. Part is in England, where it stretches across country from South Lancashire and West Yorkshire to Essex and Sussex and gives this belt of country a mean density of three thousand persons per square mile. It is continued beyond the Strait of Dover to the Rhineland. A second such area, of similar extent but half as populous, lies along the coast of the Middle Atlantic States of the United States of America, where a fifth of the population dwells on a hundredth of the area of the country in an urban zone from Boston to Washington. A third is appearing along the lower Yangtze in China.

There is as yet no comparable development in India.

Somewhat more recent in its development is the widespread retreat of population from 'regions of difficulty', marked by the diminution of population in all the highland areas of Britain and Europe and in the semi-arid parts of Australia and North America. Both changes are ascribed mainly to improvements in agricultural science and in transport, which make the cultivation of such marginal lands both less necessary and less attractive. This change is aided by the check to the natural growth of population in all the lands of Western civilization; for the rapid increase in numbers which has been a dominant fact of human life during the past two hundred years, during which mankind has increased from about 500 millions to some 2,000 millions, is now coming to an end. But there is as yet no indication that this check to growth is affecting the trends of movements discussed, which result from the development of applied science.

Economic Research and Industrial Policy

THE rationalization and planning movements, unofficial and official, that have in recent years swept over the industrial world involve a number of practical policies that must be separately discussed if their efficiency is to be scientifically assessed. In his presidential address to Section F (Economic Science and Statistics), Prof. P. Sargant Florence reviews recent realistic research into the policies of the siting, size and scope of industries.

A policy of siting or location has been urged upon the Government in connexion with the redevelopment of the depressed areas. Economic research has had to devise methods of measuring the degree of localization of all industries in the various regions of England and Wales and is now nearer a position to specify what industries can be developed where employment is still stagnant. In general, the extreme localization of industries at the source of fuel or of the existing supplies of skilled labour seems to have reached a limit, and the proximity to the home market to have become relatively more important.

A policy of larger-sized plants, firms or areas of control is usually implied by rationalization and planning. Recent statistical research into prevailing sizes, the trend in sizes, and comparative profits and costs in Britain, Germany and the United States does not confirm the theory that limits to size have been reached owing to organization becoming unmanageable. Size, however,

varies characteristically with different industries, and depends largely on their degree of mechanization and localization. A particularly pressing problem is the large number and the small size of middlemen and shops in the distributive trades. The lack of any official census of distribution for Britain makes calculations difficult, but it seems probable that there is one retailer for about every ten families, and, even for single commodities like tobacco or confectionery, an outlet for every twenty to thirty-five families! This appears excessive, since the smaller the sales turnover of each retailer the more profit he must charge per unit of sales to obtain a given income for himself. This raises prices and leads, in a vicious circle, to yet lower turnover.

Policies involving the scope of industry are those 'integrating' various processes, products or services under the control of one organization, or specializing upon and standardizing certain varieties. Standardization, as against integration, allows of mass production and of possibilities of increasing returns. There are difficulties in measuring and comparing the scope of plants or firms, but several recent experiments in connexion with plans of rationalization have shown the great increase in efficiency that specialization and narrowing of scope may achieve within one plant.

Policies of site, size and scope are interrelated. Large size is more manageable if of narrow scope, but difficult if sites must be scattered among the consuming population owing to the intransportability or the servicing requirements of the product. Further research along realistic and statistical lines is urgently needed if public policy or the policy of private firms is to achieve greater efficiency and save wastes of materials, mechanical power and man-power.

Research in Engineering

IN his presidential address to Section G (Engineering) Sir Alexander Gibb deals with the importance of research in the history of engineering. Recognition of this fact has been of very slow growth.

Organized research was nearly unknown until the end of the nineteenth century. Early progress was due almost entirely to individuals and learned societies, such as the Royal Society, working often in an atmosphere of public ridicule. Though the British led the way in Government recognition about the middle of the nineteenth century, it was largely due to the German example after the Franco-German War that the true value of research to the nation and industry was realized.

The Reichsanstalt and other testing laboratories had a direct effect on British policy which showed itself in the setting up of the National Physical Laboratory in 1900, leading later to the Department of Scientific and Industrial Research, which is now the focus, linking together all research going on in Great Britain.

The year 1900 is a boundary mark in the history of research in Great Britain. The National Physical Laboratory (1899) and the Engineering Standards Association (1901) were born then. The first, with the Department of Scientific and Industrial Research, of which it became a part in 1918, has grown into a body employing a staff of more than 1900 scientific workers; while the Engineering Standards Association has become an immense organization of no fewer than 870 committees with 4850 members.

Engineering, which started as an art, is now an applied science; and we look on scientific and industrial research as an essential factor in our national existence. In one generation our attitude has completely changed, from individualistic effort to co-operation and co-ordination. To-day national research departments, industrial research laboratories belonging to great firms or industries, research associations, scientific institutions and universities and technical colleges are the chief agencies which carry out the work, often in close co-operation one with another.

In the United States, the Dominions, and on the Continent progress and development have been equally revolutionary; and more so in some of the totalitarian States, where all research is centralized under State control. In Great Britain, though co-ordination and co-operation have done much to link together the various elements, we still lack a general national plan. Some form of affiliation to a central controlling body is inevitable if we are to avoid overlapping and duplication with their attendant waste of energy, time and money. This, incidentally, is especially necessary where the publication of the results is concerned. At present these are scattered in far too many different periodicals. A central clearing-house for engineering information is an urgent need.

One note of warning is sounded by Sir Alexander. The effects of research may sometimes be too sudden and revolutionary. Obsolescence may be too rapid, and vested interests may be tempted to buy up and suppress new inventions in order to save the loss their exploitation may involve to already operating plant. It would, however, be a short-sighted policy to restrict our enthusiasm for these reasons. He is satisfied that at the moment in the engineering world there are two outstanding questions, the co-ordination of effort and the promotion of intensive research.

Assam Origins in Relation to Oceania

DR. J. H. HUTTON in his presidential address to Section H (Anthropology) deals with certain aspects of the culture of the Assam hills which suggest a close association in origin with those of Oceania, and which may therefore throw some light on the general problem of the succession of cultures in the Indonesian archipelago.

The link between the cultures of the Naga Hills and of Melanesia has been brought into prominence by recent work of Prof. Henry Balfour, while the work of Dr. A. C. Haddon and others in Borneo and New Guinea affords instances enough to show a line of related cultures connecting Assam with the islands of the Pacific. To determine, however, the nature of that relation, it is advisable to concentrate on particular areas, and for this purpose the Fiji Islands, the Marquesas and Madagascar are chosen as being three widely separated points with inhabitants of varied race and culture in the Oceanic area.

In the case of the Fiji Islands, parallels with Assam are indicated in practices connected with war, head-hunting and human sacrifice, with the cult of the dead, and with beliefs in regard to the soul, and in items of material culture, in particular in regard to the Fijian national game of *veitanga*, and in some psychological aspects. In the Marquesas Islands a similar series of parallel customs is found, particularly in the practices associated with head-hunting; for example, in the separate disposal of the mandible and in the use of stone. In Madagascar a rather different parallel complex is found, though here again there is much similarity in the use of stone and in the treatment of the dead.

An important feature of Naga culture is the use by certain tribes of slit wooden gongs or xylophones. The cult associated with these gongs is in many ways closely parallel to canoe cults of Melanesia, and it is suggested that the Naga "canoe-gong" is a dug-out canoe by origin which has survived, as a musical instrument and a fertility fetish, a change of environment which inhibited its use as a canoe. The intimate association of the canoe-gong with head-hunting is particularly noticeable, as the ceremonial is very similar to that associated with the canoe in Melanesia, the main difference being that in the latter case the association is natural, since the canoe is the means of obtaining the victim, whereas in the Naga Hills there seems no direct reason for associating the "canoe-gong" so closely with the taking of heads. Further, the canoe can be, and is, used as a gong for certain purposes in the Pacific, where it is sounded by means of the

handles of the crew's paddles. A somewhat similar practice is found in Manipur, and it is suggested that the dumbbell-like implement used for pounding on the sides of a canoe-gong is a degenerate form of a paddle formerly used for propelling it as well.

The general conclusion is that not only has the culture of Assam been influenced by a stream of migration from Indonesia north-westwards, but also that in both areas, as in Oceania, a series of corresponding and related cultural strata are to be found in an amalgamated form, even if the actual site of amalgamation was elsewhere. It is suggested that such a site is to be sought for in or near the Indian archipelago.

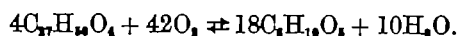
Heat Production, Nutrition and Growth in Man

IT is almost a truism to say that the amount of money spent on medical research has greatly increased of recent years; but, as Dr. E. P. Poulton shows in his presidential address to Section I (Physiology), the application of research to medical practice has lagged behind, especially where newer and expensive apparatus is concerned, largely because of the straitened circumstances of the voluntary hospitals. A pious benefactor could accomplish much with a comparatively small sum of money if he helped the voluntary teaching hospitals in this respect, as when once the medical student—the future doctor—has become accustomed to a new method or new apparatus its spread through the country cannot be so long delayed.

Direct calorimetry means the determination of the heat in a calorimeter. Indirect calorimetry means its calculation from the oxygen absorbed and the carbon dioxide given out. At present indirect calorimetry is based on the theory that the respiratory quotient (volume of carbon dioxide given out divided by volume of oxygen absorbed) indicates the proportion of fat and carbohydrates being burnt in the organism. A comparison of the figures for heat, oxygen and carbon dioxide obtained by Benedict and Carpenter and Du Bois and his colleagues, shows that there is a fundamental error in the present method of indirect calorimetry.

The theory which best explains the facts is that carbohydrate and fat are always burnt in a fixed proportion in the organism, and that when the respiratory quotient rises there is simultaneous conversion of carbohydrate into fat,

and with a fall of respiratory quotient vice versa, as indicated by the following equation, which is based on Cathcart and Cuthbertson's analyses for human fat, and from which it follows that every litre of oxygen used in the conversion is equivalent to 3.93 calories :



A quantitative proof of this conversion (1) during basal metabolism tests, (2) after food and (3) during exercise on a carbohydrate diet is obtained from the fact that, after allowing for the heat, oxygen and carbon dioxide required for the combustion of carbohydrate and fat in a fixed proportion, the equivalence of the remaining oxygen and heat is very close to this figure.

Since these conversions are ephemeral under basal conditions, the basal metabolism should be measured by the carbon dioxide alone, and this means a new definition of basal metabolism ; an experimental method is described. It is argued that the proper standards of metabolism in adults depend on the weight and age of the individual, and that the height should not be brought in as a separate factor, as in Du Bois's height-weight formula. In babies, however, height is more important than weight, because some individuals are heavy, probably from the retention of fluid due to hypothyroidism. There are three nutritional periods in childhood : the first, up to a length of 29 inches (1 year), when the baby puts on fat and the carbon dioxide increases rapidly ; the second, from 29 inches to 41½ inches (5-6 years), when the excess of fat is lost and the metabolism only increases slightly with the weight ; and the third, from 41½ inches upwards, when the weight and carbon dioxide increases steadily. It is shown that the relation weight to age is not a satisfactory standard of growth ; but only height and age, the 'cumulative growth curve'. Although growth is greater now than it was fifty-six years ago, and children of better-class families are taller than those from poor families, the average general nutrition of the child in these groups, represented by the relation of the logarithm of the height to the logarithm of the weight, remains constant, and it is suggested that the calorie intake is sufficient ; but that certain growth factors are deficient among the poorer classes.

Tests for Colour Defects

DR. MARY COLLINS in her presidential address to Section J (Psychology) discusses some of the tests used in the diagnosis of colour defect. A brief reference is made to total colour-blindness and blue-yellow blindness, but they have

neither the same theoretical nor practical importance of the third form of the defect, namely, red-green blindness. The incidence of this latter type in the male population is quoted in recent literature at figures ranging generally from 5 per cent to 12 per cent, as contrasted with the figures usually given of 3-4 per cent, her own results giving 7.5 per cent. It does not necessarily follow that the incidence of the defect is increasing, but the indications are that the detection of the defect is now more accurate owing to the improvement of test material.

It is gradually being realized that many degrees of red-green colour-blindness exist. In its extreme form there is complete blindness to red and green, but in a milder form blindness to these two colours is only partial. Red and green can be discriminated if conditions are favourable, but when unfavourable conditions exist, as in mist or fog, these colours are confused. The anomalous trichromate forms one type of the partial colour-blind. The suggestion is made that provided the colour perception so far as red and green are concerned of a sufficient number of individuals could be examined, a continuous series ranging from normal, that is, perfect perception of these colours, to extreme red-green colour-blindness might be found. The intermediate forms, which although not totally blind to red and green show great deviations from the normal, are very important.

Tests for colour defect fall into two categories ; in one type of test, transmitted light is used, in the other reflected light. While the former is regarded as the more fundamental, the latter can be of great service for quick diagnosis of colour anomaly. As a spectrometric examination is not always possible, either some form of lantern test or pigment test is substituted. Both are essential in posts where lack of accurate colour discrimination involves danger to the community. The former, using coloured lights, brings conditions nearer to practical conditions. In other posts, however, a pigment test is all that is essential. To this end, a combination of the Ishihara test, the first three tables of the Stilling test and Schaaff's mosaic plates is recommended.

A detailed examination of a number of pigment tests has been made. The responses of a group of colour-blinds have been compared with the responses of a control group of individuals with normal colour vision. In this way an evaluation of the tests has been made possible. Some of the tests, too, have been submitted to filter analysis.

Inconsistencies have appeared. It may be that the discrepancies revealed are due to numerous deviations from the normal in colour vision, and that we are not dealing with linear variations in

degree, but with multidimensional variations. A wide new field for investigation is thus disclosed, the working of which may yield valuable results for the whole theory of colour vision.

Education and the Modern Study of Plants

THE subject of Prof. E. J. Salisbury's presidential address to Section K (Botany) is the modern study of plants in relation to education. There are several misconceptions with respect both to the contacts and to the contents of botanical science. Despite the vastly enlarged content of botanical knowledge since it was regarded as a harmless and elegant occupation for the female sex, the general conception of botany has remained much what it was then. The high value of botany as an educational subject and indeed its absolute necessity in any system of real cultural development is an aspect that botanists have failed to present and emphasize. This is partly the outcome of the growing obtrusion of the more technological aspects in this as in other subjects; a trend which is making itself felt further and further back in the student's training, at the expense of general education and culture. Here, as elsewhere, too much attention is paid to the acquisition of mere information, too little to the principles which are involved.

Our educational methods are too often divided in their allegiance between the provision of a liberal culture that will make for the greatest happiness of the individual in terms of mental contentment and an abiding resource in later life, and the technical equipment of the student for the earning of his daily bread. This emphasis on erudition has been perhaps encouraged by the universities through the fact that a sufficiently broad basis of scientific knowledge is not insisted upon before specialization begins, and that in the appointment to academic posts too little attention is given to capacity as teachers.

The merits of botany from the cultural point of view are many. It provides perhaps the best medium for training in accurate observation, it is the foundation of a vast extent of human activity and the basis of a large and essential part of every human environment. Its very extent, however, as indicated by enumeration of its diverse branches of taxonomy, morphology, anatomy, cytology, mycology, palaeobotany and plant geography, on the descriptive side, and the experimental aspects of ecology, physiology, bacteriology and genetics,

indicate the breadth of the botanical field, whilst the applied aspects of agriculture, horticulture, pomology, sylviculture and plant pathology show the great contribution that botany can make to the well-being of the human race as well as to the enrichment of the mind. This diversity tends towards detachment of interests and specialization which should be accompanied by greater co-ordination. The accumulation of data in these varied directions of inquiry will only fulfil its purpose if the many threads are continually woven into a single fabric of knowledge.

Herein lies the particular cultural value of the synthetic approach which we term ecology. The study of the plant in relation to its environment not only brings together almost every aspect of plant study but also has a direct bearing upon many practical problems such as land utilization, the conservation of water supplies, or the selection and care of national parks.

The Informative Content of Education

MR. H. G. WELLS, in his presidential address to Section L (Education), directs attention to an aspect of educational science that has received perhaps a disproportionately small amount of attention in educational literature, the question of information. He leaves the physical and mental training of our modern populations aside, he contributes nothing to the discussion of language teaching, mathematics, the cultivation of literary appreciation, music, drawing and aesthetic training generally, and he concentrates upon the question of what a modern human being should know in order to play the part of a citizen, happily and adequately. What sort of *fact system* should be and can be established in a normal human mind under the conditions existing in a contemporary civilized community?

Few people realize the restrictions set to the accumulation of knowledge by the exigencies of the time-table and the school-leaving age. When due allowance has been made for the other elements in educational work it is questionable whether we can allot more than six hours a week to imparting real knowledge (real, that is, as distinguished from methods of expression, etc.), or, assuming ten 40-week years, rather less than two thousand four hundred hours altogether in the school period of life. A vast amount of miscellaneous knowledge is, of course, picked up by talking, reading, observation and so forth outside the formal school scheme and we learn facts in vast variety to our

dying days, but this is uncorrelated stuff, and it is within the limits of these two thousand four hundred precious hours that a sound framework of general knowledge must be established, if ever it is to be established in the growing mind.

At present we waste a considerable amount of this meagre allowance in imparting useless and unedifying information or information of secondary importance. We need a much more stringent economy in this respect and a more rigorous examination of what is included. The desire for knowledge, unless it is perverted and discouraged, is a natural impulse in the developing human being, and the informative side of educational work should be based on the natural curiosity of the child and should stimulate, develop and gratify it. The curiosity of the child turns mainly upon inanimate things and what can be done with them, upon animals and (secondarily) plants and upon personal and then social reactions. Upon the systematic exploitation of these primitive divisions of curiosity our teaching of the facts of physics, biology and historical and social sciences must rest. By a careful selection of topics it is possible in the period up to the dawn of adolescence to impart clear conceptions of material science; making for mechanical understanding and competence, and a vision of the history of life upon the earth and of human history and human conditions, hygienic, physiological, geographical and political, sufficient for adequate citizenship without any killing of the spirit of inquiry.

A much more realistic and serviceable knowledge than is generally attained, of economic life and of the legal conventions of property and of the process of finance which dominate our everyday lives, is possible before the school-leaving age, but it is possible only through the stringent elimination of any irrelevant matter and of any matter which distorts the general picture. The major fault of the knowledge system we build up to-day in the general mind is its lack of proportion. The historical intelligence, the political mind of the contemporary European citizen is a sort of hunchback mind, in which the hole-and-corner facts of the national history and the petty details of the Jewish tribal records loom, preposterously exaggerated. The necessity of a drastic modernization of the historical outlook has been shirked too long—with disastrous results to the world. History, the backbone of our fact system, needs to be straightened and that hunch removed.

Under modern conditions schooling is only foundation work. There is now no end to education throughout life. The primary fact system passes insensibly into a vast variety of technical learning and adult culture and so upward at its highest levels to the knowledge evoked by original inquiry

and creative work. The proportion of those who contribute by observation and criticism to the common stock of knowledge and to its sifting and organization is likely to increase very considerably in the future. Mass observation as it is being developed by Harrison and his group may have many important effects upon the public mentality.

State Intervention in Agriculture

IN his presidential address to Section M (Agriculture), Mr. J. M. Caie first shows the position occupied by agriculture in the State, by giving statistics of areas, holdings and populations, the output of food from our farms, and the contribution they make to the food consumption of the people. Corresponding figures for Denmark and Norway are given for purposes of comparison. Specially notable facts are that the number of persons per acre of cultivated land in Great Britain, 1.5, is relatively high, while the proportion of the population engaged in British agriculture, about 6 per cent, is very low, as compared with 29 and 30 per cent in the other two countries; that the products of animal husbandry represent about 72 per cent of the output of our land; that the value of the output per acre of land is about £8 in Great Britain and Norway, and £11 in Denmark, while the annual output per person in British agriculture is £200 and in Danish £150; that in respect of most products, except liquid milk, oats and potatoes, we require to import very considerable quantities; and that agriculture buys from other industries goods valued, roughly, at twenty to thirty million pounds a year.

State intervention may be divided into three categories: (1) compulsion, enforced by penalties; (2) provision of means for voluntary action, with powers to compel minorities; (3) assistance—financial, advisory, protective, etc. Present measures of control are such as relate to annual statistical returns, contagious diseases of animals, destructive insects and pests, live-stock breeding, agricultural wages, etc. Under the second category comes the recent marketing legislation, while under the third category particular mention may be made of State grants for agricultural education and research. In 1912 these amounted to £100,639 per annum, whereas in 1936 the corresponding figure was £765,339. During that period the only significant increases in the average yield per acre of our principal crops were about 4–5 bushels of oats and half a ton of potatoes. But many progressive farmers could show increases in excess of

the general average, and the effects of improved methods are also to be found in reduced costs of production.

Statistics suggest that British agriculture at present falls short of producing as much home-grown food as is possible and desirable for the nutrition of the people and of affording employment on the land to as many persons as is reasonably practicable. As the output per unit of agricultural labour is steadily rising, increased production may not necessarily cause increased employment, but on the other hand it will probably be long ere the large-scale mechanized farm is normal in Great Britain. Two million acres have gone out of arable cultivation since the Great War, and increased production is at present a question of making up leeway in land and people rather than of settling men on new holdings.

The amount of assistance afforded by the State to agriculture indicates a possibility that, sooner or later, greater control may be exercised over the farmer's methods and the quantity and quality of his products. Such measures might raise questions as to insurance against loss, limitation of profits, control of rent, wages, etc. If it were the permanent policy of the State to support agriculture, it might be desirable to survey the whole industry, its place in the social and economic structure of the country, its present and potential capacity to meet the food requirements of the people, and its relation to international trade.

Lastly, one must consider whether in State aid, with its attendant shadow of control, lies the only hope for British agriculture. Some, at any rate, would wish to believe that our farmers, given a fair share of the home markets, could maintain their position by their own initiative, energy and resource, and with the help that education and research, both scientific and economic, can give. Otherwise there is at least a risk that our farming may become a hanger-on of the State, dependent on its bounty and subject to its commands.

Natural History Outlook

THE natural history outlook has changed so much during the present century that a new orientation is required if natural history societies are to keep their place as an integral part of the organization of science in Great Britain. In his presidential address to the Conference of Delegates of Corresponding Societies, Prof. James Ritchie directs attention to the changes which specialization has wrought in the opportunity of original

amateur investigation, and suggests ways in which the societies might turn modern trends to good account.

Local societies perform useful work in spreading knowledge of scientific method and progress by their lecture programmes and discussions, but a higher aim is the gaining of new knowledge by regional investigations. The stable work which until now has kept the societies alive as contributors to science has been the building up of local lists. That outlet for the energy and enthusiasm of the local naturalist has become restricted owing partly to the exhaustion of opportunity for discovering rarities, and partly to the increasing subtlety of identification demanded by the modern systematist, so that the amateur has been frozen out of a province which for ages was particularly his own.

Two notable developments in the natural history outlook of the present century suggest ways in which the natural history societies may still retain their usefulness and contribute their quota to the advancement of knowledge.

In the first place, there is a marked tendency, due to the complexity of scientific problems, to forsake the individualistic form of research and to replace isolation by the collaboration of many workers organized as a team, whose joint labours converge upon some definite problem. In the second place, the emphasis of research has moved from morphological studies, which have passed far beyond the scope of the amateur, to the investigation of the animal as a living thing. A combination of these two tendencies offers a new outlook and a new field for the societies, the combination of organized co-operation or team-work directed towards the solution of biological problems. Much has already been learned by such methods, for example, about bird migration by organized co-operation in the ringing of birds in Great Britain and other countries, about the arrival and movements of birds and many other seasonal occurrences by the organized reports sent to the Royal Meteorological Society and published annually as a Phenological Report, about the migration of insects by the records sent to a committee of the South-eastern Union of Scientific Societies. Members of the societies, as individuals, already do good work in all these investigations, but more observers are required, and the societies could organize them, and could add enormously to the scope and scientific value of the inquiries of such organizations as the Bureau of Animal Population at Oxford or the Institute of Ornithology.

Should some societies lack in numbers of naturalists able to engage in such joint enterprises in biological problems, there are many other opportunities open to the individual naturalist for

the study of biological questions of real importance. Very little is known about the influence of weather and food supplies in Nature upon the development of mammals, birds, insects or, indeed, any other creature, and such studies, or the investigation of plant and animal populations in a circumscribed area, or of the changes wrought upon plant and animal groups by the interference of man, offer themselves as subjects for direct and not too difficult attack.

. A third line of inquiry suitable for the amateur naturalist lies in simple experimental zoology, exemplified by such as Darwin's tests for the intelligence of earthworms, or Lord Avebury's

experiments with bees and colours, or in more modern method Miss Ilse's experiments upon the colour preferences of butterflies.

Such investigations as have been suggested may not result in great discoveries—great discoveries lie in the lap of the gods—but for the observer they mean a training in accuracy, persistent or continuous observation, careful recording, and in the end that rigid consideration which leads from facts to general truths. To the societies, the natural history outlook will bring new vigour, and with it that satisfaction and honest pride which go with the enlarging, even in modest degree, of the bounds of knowledge.

Britain. He points out that the basic unit in British local administration is the parish, the zone of influence of a single place of worship in the Middle Ages. Rural districts, urban districts and boroughs have been built up by the aggregation of parishes, and national parliamentary representation is still organized on that fundamental unit. As a consequence, in spite of many reforms, there are still more than two thousand separate authorities responsible for local community organization. Early legislation favoured supply by a local council. This favoured the setting up of a large number of small generating stations. The work of Ferranti showed the possibilities of alternating current transmission; but the small areas resulting from the early legislation, the wide distribution of coal and its abundant supply did not give the incentive to A.C. supply that there was in other countries. In 1925, a Government committee was set up under the chairmanship of Lord Weir. The committee came to the conclusion that there was a wide difference between generation and distribution and that retail distribution was a local matter which might suitably be decentralized. The findings of this committee were the basis of the Electricity Act of 1926. A Central Electricity Board was formed to construct and operate a large number of high-tension transmission lines called a Grid. The board divided the network into nine schemes covering the whole of Great Britain except northern Scotland. Not only did the construction of the Grid have a beneficial effect upon national employment at a time of acute depression, but also the experience in high-voltage construction which it entailed has placed British manufacturers once more in the forefront of technical progress.

University's Care of Body and Mind

ROOSEVELT POLYTECHNIC INSTITUTE, founded in 1834 at Troy, New York, claims to be the oldest institution of higher learning in any English-speaking country that has devoted itself continuously to instruction and research in science and engineering. In a recent bulletin, it directs attention to the very thorough provision it has made not merely for the technical efficiency of its graduates but also for ensuring the physical fitness and bodily vigour of its undergraduates and for developing in them a broad and balanced mental outlook. Applicants for admission are examined physically; and if corrective exercises seem advisable they are prescribed by the Department of Physical Education. Every undergraduate is required to take during the first year a comprehensive course in physical education, including personal hygiene, recreational games, gymnastics, swimming and athletics. Medical advice and hospital care in case of need have been made available for all students. A member of the staff of a neighbouring hospital is in attendance daily for an hour and a half in the gymnasium for consultation. In the first year every undergraduate has to qualify in English, drawing, history, graphics, mathematics, physics and chemistry, and has to prepare a thesis during the summer vacation. The English course covers the material and methods of composition as

illustrated by the successive steps in the preparation of a comprehensive article on a subject of immediate interest, the preparation and delivery of incidental speeches and a survey of contemporary ideas and current usages. Except in the case of students of architecture, all undergraduates also take a brief course introductory to professional study, designed to acquaint them with the materials and methods of study in different fields, to introduce them to the members of the faculty whom they will eventually meet in their work, and to indicate the nature of the openings which will be available to them upon graduation.

Natural History and Science in South Australia

THE presidential address before the Royal Society of South Australia, delivered by Dr. C. T. Madigan last year, is devoted to the history of the hundred years of science in South Australia as appropriate to this centenary year (*Trans. Proc. Roy. Soc. S. Australia*, 60, Dec. 1936). He points out that the Royal Society is really older than the State itself, for though it has an unbroken existence only since 1853, its origin can be traced back to the South Australian Literary and Scientific Association initiated among the founders of the Colony in London in 1834. The active functioning of the Royal Society dates from the inspiring presidency of Prof. Ralph Tate; in the twenty-five years of his association with the Society between 1876 and 1901, it became the established medium for publication of original scientific contributions. The nature of this published work is summarized by Prof. Harvey Johnston for general zoology, by Sir Douglas Mawson on geology, by Prof. J. G. Wood and Mr. J. M. Black on botany, by Dr. James Davidson on entomology, and Dr. T. D. Campbell on anthropology. Naturally these descriptive and natural history subjects, so important in a young colony, bulk most largely in this first century, and Prof. R. W. Chapman's report, whilst reminding us that many of Sir William Bragg's first publications in physics appeared in the *Transactions* of the Society, makes it most abundantly clear why this state of affairs prevailed. Before the Society or its predecessor, the Adelaide Philosophical Society, could spend its energies upon the publication of natural history, it had to pass through a phase in which it was the public forum for the advocacy of any and every cause associated with general education. In those days, even so late as 1868, a speaker urging the establishment of free schools, could quote a South Australian parent in this strain, "I have ten children who can't read or write. I can't read or write myself, why should they?"

Zoology of Iceland

THE study of the zoology of Iceland has lagged behind the investigation of its geology and geography, but a new work in five volumes on the "Zoology of Iceland" should form a worthy contribution to the knowledge of a fauna of unusual interest from several points of view (Openhagen and Reykjavik: Levin and Nunksgaard). The work will be carried out by specialists, and each part will appear as it is

completed, so that publication will be discontinuous and will probably cover a period of about ten years. To subscribers parts will be sold at Kr. 1.00 per sheet, and the whole work is estimated to contain about 100-150 sheets. The two parts first to be published have been received—R. Spärck on "The Benthonic Animal Communities of the Coastal Waters", and E. Weesenberg-Lund on "Gephyrea". Both authors find that the fauna with which they deal consists mainly of an arctic and an arctic-boreal admixture, in which the latter predominates, and with which rare forms, such as the gephyrean *Sipunculus norvegicus*, represent a southern fauna which may have survived from a warmer period. In summing up the conclusions of his investigation, Spärck points out that the absence of a boreal shallow-water fauna seems to indicate that in post-glacial time no land connexion can have existed between Iceland, the Faroes and the continent of Europe. But the fauna itself is by no means a sparse one, since in quantity it compares favourably with the fauna of the North Sea, which is generally considered to be very productive and is richer than the corresponding faunas of East Greenland and northern Russia. This relative wealth of bottom fauna may be a dominant factor in determining the presence of a fish population, which in turn has determined the importance of the fisheries in Iceland waters.

Plants and the Dwelling-House

Most people readily admit the value of out blooms and growing plants for decoration of the home, but not all plants can make good growth in the somewhat trying conditions of the average dwelling-house. A recent publication of the Field Museum of Natural History, Chicago, is entitled "House Plants" (No. 20, 1937, 35 cents). It has been written by Mr. R. van Tress, and maintains the well-known practical outlook of this Museum's publications. Such well-tryed subjects as the *Aspidistra* (here called, most appropriately, the 'cast iron plant'), the small conifer *Araucaria excelsa*, various geraniums, and the india-rubber plant (*Ficus elastica*) are known to all. The leaflet also shows that hybrid species of *Hippeastrum*, *Hydrangea*, *Poinsettia*, *Begonia*, *Azalea*, *Primula sinensis*, heliotrope, the African violet (*Saintpaulia ionantha*), the shrimp plant (*Beloperone guttata*) and many others, including the common English ivy, are suitable for domestic conditions. They give greater and more varied beauty than the better-known species. Many illustrations enrich the leaflet, and there would seem to be no reason why the plants mentioned therein should not succeed in Great Britain as well as in the United States.

Supraconductivity

THE issue of the *Journal of the Washington Academy of Sciences* of June 15 contains the address of the retiring president of the Academy, Dr. F. B. Silsbee, of the Bureau of Standards, delivered in January. It extends to twenty pages, and deals with the additions which have been made during the last two or three years to our knowledge of the electrical

properties of metals at very low temperatures. References are given to previous summaries up to 1935 and to nearly thirty memoirs on the subject which have been published since, most of them in 1936. The original description of a supraconductor as one in which the resistivity is zero is beginning to be replaced by the newer one that the magnetic induction is zero and that any current which flows in it is confined to an excessively thin layer at its surface. The abruptness of the change of conductivity as the temperature is lowered has been investigated, and in the case of tantalum has been expressed by means of the error function. The paradox of how a magnetic field which cannot penetrate a supraconductor can still affect its conductivity is still unsolved, and the reasons for the decrease of heat conductivity and increase of specific heat in the supraconducting state have still to be determined.

Philadelphia Academy of Natural Sciences

THIS year the Academy celebrates its one hundred and twenty-fifth anniversary, and the opportunity has been taken of relating to friends and members in a special report the work accomplished during the past year. The title chosen for the report is "Discovery" (which unfortunately duplicates the name of a well-known British scientific periodical). The year was marked by the announcement of an ambitious programme which included the strengthening of the scientific work of the Academy, the inauguration of an Education Department which would correlate the work of the Academy with the public and private school system in Philadelphia, the erection of modern educational exhibits, and the re-establishment of the Department of Geology and Palaeontology. For the support of the educational programme over a five-year demonstration period a sum of \$74,915 dollars was required, and the response to the end of 1936 reached the fine total of \$241,135 dollars. Already important steps have been taken towards the accomplishment of the programme, and we note with satisfaction that the first step was to restore the reductions which had been made during the period of stress in the salaries of the staff. We join with the Academy in lamenting the death on January 22 of its president, Mr. Effingham B. Morris, who since his election to the presidency in 1928 has been the leader and stimulus in all phases of the Academy's work for science and for the community.

Peace Movements

THE "Peace Year Book, 1937" (London: National Peace Council. 2s.) contains a good deal of useful information on international affairs and should prove a reliable book of reference on the peace movement throughout the world. It includes directories of peace organizations in Great Britain, of national organizations, Anglo-foreign societies and local peace organizations as well as peace and kindred organizations abroad. The appendixes include the text of the Covenant of the League of Nations, a bibliography of books and pamphlets, notes on the reform of the League, the Mandates System, an analysis of the

armaments situation and an extensive summary by Dr. Hilda Clarke of the report of the Royal Commission on the Private Manufacture of and Trading in Arms. The first part of the book contains articles on international affairs, the situation in Spain receiving special attention, and the work of the League of Nations in 1936 is reviewed by Maurice Fanshawe. Of special interest to scientific workers is an able article in the second part of the book by J. D. Bernal on "Science and Peace", in which some account is given of the work of the Science Commission of the World Peace Congress. The general resolution on the attitude of scientific workers to war is given in full, together with the report of the Science Sub-Commission, and Mr. Bernal indicates some of the responsibilities of men of science in this matter.

Training in Domestic Science

In the *Electrical Age* of July 1, a quarterly journal published by the Electrical Association for Women, an interesting description is given by Anne R. Macarthur of the Glasgow and West of Scotland College of Domestic Science, one of the most important women's training colleges in Great Britain. There are now three hundred students taking the three years (sometimes four years) 'teaching diploma' courses. In addition to the usual household subjects are cooking for sailors and yachtmen, hygiene, etc. The college was built in 1911, the rooms being light, airy and spacious, but it was no sooner finished than it was taken over as a War hospital. During the past session, 1,697 students have attended the college for diploma courses as teachers of domestic science and as dieticians. They have the advantage of working with every type of equipment which they are likely to meet on completion of their course. Electricity figures prominently in the 24 kitchens, 5 laundries, 14 sewing rooms and in the residences and model flats of the College. The College residences are lofty houses overlooking Kelvingrove Park and all have bedrooms for one, two or more occupants, pleasantly furnished sitting-rooms and modern bathrooms. A common room with a parquet floor and softly coloured furnishings extends the full width of the building. On the roof, a bijou isolation hospital, with a small electrically equipped kitchenette offers comfort and most hygienic conditions to invalids.

Natural History in the Schools

THE annual reports of two school societies, the Marlborough College Natural History Society and the Rugby School Natural History Society, suggest that the schools are taking their due place in the training of the naturalists of the future. Both Societies have had a busy year. Marlborough has dropped from the report the local hand-lists, which must have given to young collectors many a useful pointer towards identification of species, and it has discovered that the members prefer an informal ramble to the massed expedition of a formal field day, which is all to the good from the point of view of training observation. Rugby includes long lists

of the seaweeds and marine fauna of Port Erin, which do not seem to be particularly appropriate, although the introduction on the zoning of marine forms illustrates a useful type of observation. Both reports contain records of the local fauna made by members, and both Societies have a useful credit balance on the year's accounts, notwithstanding that Rugby spent more than £400, mostly in erecting a new vivarium and in altering and redecorating the rooms of various sections.

Agricultural Research in Great Britain

THE annual reports on the work carried out at the various agricultural research institutes in the United Kingdom during 1934-35 have now been published (H.M. Stationery Office. 5s. net). The volume also includes reports of certain other agricultural investigations carried out under the auspices of the Agricultural Research Council, and an account of the research activities of the agricultural advisory officers. In view of the scope of the work described, it has of necessity been published in summarized form, but those desirous of further information will find references to the original papers in the appropriate section, and the names and addresses of the directors of the institutes to whom inquiries may be sent.

Grants for Metallurgical Research

THE Iron and Steel Institute offers annually a limited number of grants from the research fund founded by the late Mr. Andrew Carnegie in aid of metallurgical research work. The object of the scheme is to enable students who have passed through a college curriculum, or have been trained in industrial establishments, to conduct researches on problems of practical and scientific importance relating to the metallurgy of iron and steel and allied subjects. The value of the grant will depend on the nature of the proposed research work, but the maximum amount granted in any one year will, as a rule, not exceed £100. Applications for grants must be made before September 30. Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

Third Prehistoric Congress of the Far East

THE third Prehistoric Congress of the Far East will take place at Singapore on January 24-29, 1938. Membership of the Congress is confined to delegates nominated by their respective Governments or by scientific societies and institutions. Other anthropologists and prehistorians, however, will be allowed to attend the sessions of the Congress as visitors. They will enjoy all the privileges of members of the Congress, with the exception of the right to vote. The official languages which will be recognized are English, French and German. There is no subscription. Applications for invitation should be addressed to the Director, Raffles Museum, Singapore, Straits Settlements.

Metal-Ammonia Ions

IN connexion with the letters from F. J. Garrick and from Dr. J. S. Anderson, N. L. Spoor and Prof. H. V. A. Briscoe published in *NATURE* of March 20, 1937 (p. 507), Prof. A. A. Grünberg, Kovenaky persulok 22, log. 12, Leningrad, has been good enough to give references to several papers by himself and his collaborators which are for the most part inaccessible to English readers. In these, during the last seven years, it has been shown experimentally that the ammines of platinum and rhodium may undergo acid-dissociation by a mechanism similar to that inferred from the exchange experiments on cobalt ammines. Prof. Briscoe and his collaborators state that they are glad to learn that their entirely independent experiments afford, both qualitatively and quantitatively, so satisfactory a confirmation of the findings and predictions Prof. Grünberg has already published. Of the more recent references he gives, one (A. A. Grünberg and D. T. Rjabtschikoff, *Acta Physico-Chimica*, 3, No. 5, 555; 1935), which is in German, and may be seen in a few British libraries, should certainly be consulted by chemists interested in this subject.

Medical Research in India

THE first annual report, for 1935-36, of the Indian Institute for Medical Research has been issued by the Governing Body. The Institute in Calcutta commenced work on January 1, 1935, with a 'diagnostic' section, for helping medical practitioners, and four research departments, and a brief survey of research work carried out is given. This includes the preparation of a potent anti-choleera serum, trials of which are now being carried out, a vaccine for the treatment of oriental sore (leishmaniasis), nutritional researches, with the discovery that some common Indian fruits contain a high content of vitamin C, and the mechanism of antigen-antibody combination.

Announcements

THE second International Congress of Cosmobiology will be held at La Malou on September 19-21. Further information can be obtained from Dr. M. Faure, La Malou, Hérault, France.

THE second International Scientific Congress of Alimentation will be held in Paris in the second fortnight of October and will consist of the following six sections; physiology of feeding, rules for normal feeding, feeding in the colonies, the teaching and social importance of food hygiene, and the protection and supervision of articles of food. Further information can be obtained from M. Alquier, 16 rue de l'Estrapade, Paris 5e.

THE one hundred and fiftieth anniversary of the birth of the celebrated Czech physiologist and histologist Johannes Evangelista von Purkinje will be celebrated by a series of ceremonies and addresses at Prague, Brno and Bratislava on September 24-28. Further information can be obtained from the secretary, Dr. Jarmila Psotnicková, 32 Katerinka, Praha II.

THE Serbian Royal Academy of Sciences, which is composed of four academies—those of social science,

natural science, philosophical science and fine arts—recently celebrated the fiftieth anniversary of its foundation in the presence of the Regent, Prince Paul of Yugoslavia, Dr. Radenko Stankovitch, formerly professor of the Faculty of Medicine at Belgrade, the Patriarch of the Orthodox Church, and a number of other well-known scientific workers and high officials of the Balkan countries.

THE library of the Radcliffe Observatory, Oxford, is about to be transferred to its new quarters in South Africa, and publications intended for it should now be addressed to "The Radcliffe Observatory, Pretoria, South Africa", instead of to Oxford.

A LECTURE COURSE on industrial law has been arranged by the Industrial Welfare Society at its headquarters, 14 Hobart Place, S.W.1, beginning on October 4 at 6.30 p.m., for ten weeks, and will be conducted by Mr. H. Samuel, barrister-at-law. Further information can be obtained from the secretary of the Society.

AN exhibition of Egyptian antiquities newly found at Arment by the Sir Robert Mond Expedition has recently been arranged at the Archaeological Institute, St. John's Lodge, Regent's Park, London, N.W.1, by the Egypt Exploration Society. The exhibition will remain open until September 25. Admission and catalogue are free.

WE have received a communication from the Secretary of St. Joseph's House, Diocesan Home for Boys (a home for orphan and destitute boys), 126 Baker Avenue, Salisbury, Southern Rhodesia, stating that it is proposed to encourage the boys in the study of science, including microscopy. The Secretary would be grateful for gifts of small microscopes which any reader may be prepared to present to the Home.

THE Sir William White Post Graduate scholarship in naval architecture (1937) of the Institution of Naval Architects has been awarded to Mr. Allan M. Baxter, of the Royal Technical College, Glasgow.

THE following scholarships for 1937 have been awarded by the Institution of Electrical Engineers: Duddell Scholarship to R. S. Peacock, King's School, Ely; Swan Memorial Scholarship to Dr. B. C. Robinson, Armstrong College, Newcastle-on-Tyne; William Beedie Eason Scholarship to R. P. Kinsey of Evershed and Vignoles Ltd.; Silvanus Thompson Scholarship to J. R. Catlin, of Igranio Co. Ltd.; David Hughes Scholarship to L. Lieberman, Queen Mary College, London; Salomons Scholarship to S. G. Bittles, College of Technology, Belfast; War Thanksgiving Education and Research Fund (No. 1), Grant of £50 to J. E. Parton, University of Birmingham; Paul Scholarship to T. H. Fulford, Acton Technical College, London.

ERRATUM.—Dr. Gwyn Williams informs us that the MS. of his letter "Kinetics of Catalysed Polymerization of Styrene" (*NATURE*, Aug. 28, p. 363) contained an error. The polymers produced have molecular weights of the order 3,000, not 5,000 as printed (p. 364, col. 1, line 10).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 428.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Light thought to have been seen in the Neighbourhood of Alternate Current Magnets

THE late Prof. S. P. Thompson showed that visual effects (excitation of the optic nerve) were produced when the head was placed in an alternating magnetic field.¹ He said, further:

"Nearly four years ago Prof. Birkeland of Christiania told me that his workmen at the nitrate factory at Notodden declared that they could see lights over the choking coils used to limit the currents supplied to the electric furnaces. This may have been in reality a subjective phenomenon similar to that now recorded."

No doubt the view expressed by Prof. Thompson is the most probable. It seemed worth while, however, as a 'fool experiment', to see whether objective lights could be detected by prolonged photographic exposure.

Dr. W. H. Hatfield, to whom I casually mentioned the idea, was so kind as to interest himself in it, and he had a suitable alternate current magnet constructed at the Atlas and Norfolk Works, Sheffield. The iron was, of course, laminated, the gap between the poles being about 0.7 mm. wide and about 8 mm. deep. The mean flux density through the cycle was 4800 lines per sq. cm.

The top of the magnet was flat, so that a photographic plate could be brought right up to the gap, the lines of force being parallel to it. An Ilford hypersensitive panchromatic plate was used, with a thin sheet of 'Cellophane' between it and the magnet.

If the effect existed, there should have been a dark line on the plate, corresponding to the gap. Exposures up to thirty days were given, but no positive result was obtained. Some test experiments indicated that a luminosity fairly distributed through the visual spectrum and just bright enough to be seen by a well rested eye should have impressed the plate easily in twelve hours. The actual exposure was some sixty times greater. It appears most improbable, therefore, that any objective lights can exist. Perhaps most readers of NATURE would have been content to assume that in the first instance.

RAYLEIGH.

Terling Place, Chelmsford.

August 17.

¹ *Proc. Roy. Soc., B.*, **28**, 396 (1910).

Cosmic Rays and Magnetic Storms

S. E. FORBUSH¹ has noted a systematic decrease of cosmic ray ionization at Cheltenham, U.S.A., and Huanacayo, Peru, simultaneous with a decrease of the earth's horizontal magnetic force (H.F.), during magnetic storms of April 1937. V. F. Hess and A. Demmelmair² have confirmed the existence and world-wide character of the cosmic ray decrease by

observations on the Hafelekarr near Innsbruck. They agree with Forbush in concluding that the study of these cosmic ray changes during magnetic storms will give valuable information on the spectrum of the cosmic radiation.

It promises also to settle an important unsolved question which bears closely on the mode of origin of magnetic storms themselves. The most intense disturbance of the earth's surface field during a magnetic storm usually occurs in polar regions; but this is not the part of the disturbance with which the greatest change in the energy of the magnetic field round the earth is associated. The energy change depends mainly on the general decrease of H.F. that occurs in all latitudes during and after the main phase of a magnetic storm³. The polar magnetic disturbance appears to be due to electric currents in the earth's atmosphere, but it is not known where the general decrease of H.F. is produced, except that the main cause is above the earth⁴. It may be in the highest layers of the ionosphere or right outside the atmosphere.

Ferraro and I have tentatively suggested⁵ that it may be due to a ring current encircling the earth at a radial distance of a few earth-radii, a , and composed of positive and negative charges in oppositely directed orbital motions. Störmer⁶ had earlier suggested a ring current of much larger radius, composed of charges of one sign only. I have criticized this hypothesis on various grounds^{7,8}, one being that it would imply an appreciable modification of the earth's field, during a storm, throughout an immense volume of surrounding space, in a manner likely to alter considerably the normal paths of cosmic rays. The present observations give a quantitative relation between the change in cosmic ray intensities and the magnitude δH of the decrease in H.F. at the equator during a storm; they should, with the aid of such calculations of cosmic ray paths as have been made by Störmer and by Lemaitre and Vallarta, lead to an estimate of the distance of the currents which reduce the H.F.

Below these currents the H.F. is reduced, above them it is increased, and there the main component of the earth's field corresponds to a doublet of magnetic moment $M + \delta M$ exceeding the earth's normal moment M . It is presumably this increase δM , in this outer space, which accounts for the decrease of cosmic ray intensities.

Theoretical discussion of the cosmic ray change might conveniently be based on the following simple model of the earth's field during a magnetic storm. It is not intended to represent all the important actual features of the field, even if the currents concerned are located in the high ionosphere, and still less if they are ring-currents outside; but it should give the order of magnitude of the radius a' at which the currents are located.

Take one third of the equatorial decrease of H.F. to be due to induced internal currents (having an equivalent magnetic moment $-\frac{1}{3}a^2\delta H$), and two thirds to be due to external currents. Take these to be distributed over a concentric spherical shell of radius a' , the current intensity being proportional to the cosine of the latitude; the field within the shell will be uniform, $-\frac{2}{3}\delta H$, and outside it will be that of the doublet of moment $+\frac{2}{3}a'^2\delta H$. Thus, for $r > a'$, the equivalent doublet of the total field will be $M + \delta M$, where $\delta M = \frac{1}{3}(2a'^2 - a^2)\delta H$. In this region the existing theory is applicable, with merely this change in M . For $a < r < a'$, the field will be that of a doublet $M - \frac{1}{3}a^2\delta H$ and a uniform field $-\frac{2}{3}\delta H$; in this region special calculations are needed. The important point is to determine whether a'/a is but little greater than unity, which would indicate that the currents are in the high ionosphere, or of magnitude 2, 3 or more, which would favour the ring-current hypothesis of the main phase of a magnetic storm.

S. CHAPMAN.

Imperial College of Science,
South Kensington,
London, S.W.7.
Aug. 23.

¹ *Phys. Rev.*, **51**, 1108 (1937).

² *NATURE*, **140**, 316 (1937).

³ *Terr. Mag.*, **37**, 269 (1932).

⁴ *Terr. Mag.*, **40**, 349 (1935).

⁵ *Terr. Mag.*, **36**, 77-97, 171-186 (1931); **37**, 147-156, 421-429 (1932); **38**, 79-96 (1933).

⁶ *Arch. Sci. Phys.*, **32**, 277 (1911).

The Cluster Theory of Imperfect Gases

DEVIATIONS from ideality of real gases are generally attributed to the effects of the volume of the molecules and to the attractive forces between them. The volume effect has been described fairly simply and accurately, but explanations put forward as to the way in which the attractive forces act are open to criticism. One of the older common explanations¹ is that the unbalanced attraction inwards on the molecules near the boundary wall results in their being slowed down before they hit the wall, thus giving a lower contribution to the pressure than they would in the absence of attractive forces. As stated, this appears to be a violation of the Principle of Equipartition of Energy. Another way of expressing what is probably the same thing, is often preferred². In this, the deficiency in pressure is attributed to a lower concentration in the boundary layer arising out of a relatively higher potential energy in this layer, due to the attraction inwards. These explanations ignore the fact that adsorption measurements show that all known walls exert a strong attractive force on all gaseous molecules and that the concentration in the boundary layer is invariably higher than that in the body of the gas.

Extensive mathematical treatments of the properties of imperfect gases have been made by Keesom³, Core⁴, and others⁵. These are based on the well-known statistical law that the probability of finding molecules in an element of volume dv is proportional to $e^{-X/RT}dv$, where X is the potential energy of the molecule. The treatment leads to the expected result that molecules are more likely to be found in an element of volume within the range of molecular attraction than in a volume outside this range.

It also gives values for the 'second virial coefficient' of gases, a coefficient to which $(b - \frac{a}{RT})$ of van der Waals' equation is in approximation.

Attempts at obtaining a kinetic picture of the above result lead to an interesting conclusion. Consider any molecule in a gas moving with a definite velocity. As it enters a region of lower potential energy such as occurs in the neighbourhood of another molecule its kinetic energy increases. During the whole of the period while it is in this region, except for the small fraction of time of actual collision, the molecule moves *faster* than before the collision. If this were the complete picture, molecules would spend *less* time in an element of volume within the range of molecular attraction. It might be argued that a consideration of all types of collisions would give a mean different from this. Calculations of a number of typical cases have, however, failed to reveal any exceptions. As an extreme example, overtaking and overtaken molecules spend a longer time than usual inside the range, but they would spend a still longer time inside the same volume if there were no attractive forces.

It is obvious from the above argument that molecules *normally avoid* elements of volume in the neighbourhood of attracting molecules, a fact that should give rise to a correction term of the same sign as the 'b' term of van der Waals' equation. The observed sign is, of course, the opposite. This can only be explained by assuming that a molecule, while in a range of low potential energy, sometimes loses part of its kinetic energy by collision with a third body, forming a stable 'cluster' with the other molecule. These clusters have a comparatively long life and more than compensate for the effect described above, giving a net result of the right sign. For complex molecules third body collisions are unnecessary, as the energy may be temporarily transferred to another degree of freedom of the system.

This phenomenon of stabilization is a general one entering into all kinds of equilibria involving fields of force. In the simple case of any molecule moving downwards in an isothermal box in a gravitational field, its velocity will increase and, in the absence of collisions, it will normally spend *less* time in the region of low potential energy. The Boltzmann distribution arises from the fact that a few molecules lose so much energy on collision with the walls that they are unable to rise to the top against the field, and spend therefore a much longer time at the bottom.

The existence of clusters has been postulated by many writers to explain their observations on various properties of real gases. Van der Waals⁶ himself believed them to exist near the critical point; he used the term *Scheinassoziation*. In the derivation of van der Waals' equation of state by Herzfeld and Smallwood⁷, the formation of clusters is realized. Volmer⁸ discusses the likelihood of molecular aggregates acting as condensation nuclei in pure super-saturated vapours. The possibilities in the Cluster Theory to explain the behaviour of gases have not, however, been generally realized and the theory is not to be found in elementary textbooks.

Tri- and tetra-molecular clusters are formed in a similar manner, particularly at higher pressures. At normal pressures, di-molecular clusters predominate, a fact which, with the Mass Law, leads at once to an equation of state of the type of van der Waals.

It is proposed to discuss elsewhere the ways in which the Cluster Theory permits simple treatments of other physical properties of gases, such as specific heat, viscosity, light scattering, the Joule-Thomson effect, and the pressure-broadening of spectral lines.

C. F. GOODRICH.

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June 15.

¹ See, for example, O. Maass "Physical Chemistry" by Taylor, vol. 1, p. 98 (1924); W. O. MaO. Lewis "Kinetic Theory", p. 72 (1923), and Washburn "Principles of Physical Chemistry", p. 88 (1921).

² Fowler, "Statistical Mechanics" p. 291 (1936).

³ Keesom, W. H., *Phys. Rev.*, **22**, 129 and 643 (1921); **23**, 225 (1922).

⁴ Cora, A. V., *Phil. Mag.*, **45**, 255 (1923).

⁵ A brief treatment is given by Hershfeld and Smallwood, "Physical Chemistry" by H. S. Taylor, p. 225 (1931).

⁶ Van der Waals, Nobelprædike (Lepzig, 1911).

⁷ Volmer, *Z. Elektrochem.*, **35**, 555 (1929).

A Method of obtaining Polarized Neutron Beams

RECENT progress in cooling methods have made it possible to obtain temperatures where kT becomes comparable with the energy separation, due to space quantization of nuclear spins in high magnetic fields.¹ The nuclei will, under such conditions, occupy the lower levels of space quantization more abundantly than the higher ones, provided that temperature equilibrium between the lattice of the cooled substance and its nuclei is obtainable.² This effect is equivalent to a polarization of the nuclei, and might be useful for obtaining highly polarized neutron beams without great loss of intensity.

Should the nuclei in question have a resonance level for absorption of slow neutrons (thus absorption by an S -level) it would be expected that the capture cross-section would be very dependant on the relative orientation of the neutron spin and the spin of the capturing nucleus. In the special case of an unexcited nucleus having the spin $1/2$ and the compound nucleus—formed by slow neutron capture—the spin 0, the cross-section should be zero for neutrons the spin of which is parallel to the nuclear spin, whilst it should be normal for neutrons of opposite spin orientation. A substance the nuclei of which are polarized will thus polarize a beam of slow neutrons by selective absorption of one component of spin orientation. The degree of polarization will only depend on the ratio of occupation of the two levels of space quantization.

In the rare case of a group of thermal neutrons principally due to one nuclear resonance level, this method will furnish polarized beams of thermal neutrons, as the method proposed by F. Bloch.³ In most cases, however, only neutrons belonging to one particular resonance level—thus neutrons having energies of several volts—will be polarized. Precision experiments with such neutrons will permit of measurements of their velocity.

Added in proof: Halpern and Johnson⁴ point out that some paramagnetic salts could give higher magnetic scattering cross-sections for slow neutrons than iron, the atomic factor being bigger. At ordinary temperatures scattering of slow neutrons by paramagnetic salts will not furnish polarized neutron

beams. It might, however, be useful to employ for the polarization method proposed by F. Bloch³ paramagnetic salts magnetized at very low temperatures instead of magnetized iron.

HANS V. HALBAN, JUN.

Institute of Theoretical Physics,
Copenhagen.
August 14.

¹ Kurtz, N. and Simon, F., *Proc. Roy. Soc., A*, **140**, 152 (1935); de Haas, W. J. and Wierma, H. O., *Rapport 7me Congr. Int. Froid*, **267** (1936).

² Hettler, W. and Teller, H., *Proc. Roy. Soc., A*, **184**, 629 (1936); Gorter, O. J., *Physics*, **3**, 995 (1936).

³ Bloch, F., *Phys. Rev.*, **50**, 259 (1936).

⁴ Halpern, O., and Johnson, M. H., *Phys. Rev.*, **53**, 52 (1937).

Circular Ultra-sonic Grating in Liquids

A. Žáček and V. Petrůlka have recorded observations of radial and torsional vibrations of annular quartz plates cut perpendicular to the optical axis and have found that, with radial oscillations, standing ultra-sonic waves, which can be rendered visible by means of precipitated lycopodium, are formed in the hole in the middle of the crystal plate.



FIG. 1.

A closer investigation of the acoustic field showed that one was dealing with a complicated phenomenon, and that the ultra-sonic waves might be caused not only by radial vibrations but also by other types of vibrations, thus forming interesting figures of lycopodium. This fact was the reason for producing ultra-sonic waves in both gases and liquids, and observing them closely. These experiments have shown that the ultra-sonic waves formed in xylol, or better in a mixture of xylol and carbon tetrachloride, can be observed not only in the hole but also around the crystal plate. In the case of radial vibrations, only concentric circles are produced. If we make use of other types of vibrations, not only concentric circles, but also diametrical lines may appear (Fig. 1). This phenomenon is in all probability connected with the electrical axis of the quartz crystal. The circular grating formed in the liquids by the standing waves will be further utilized in diffraction experiments.

J. ČERNÝSKÁ.

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Prague.
July 28.

Vitamin E Deficiency in the Suckling Rat

It has been reported previously^{1,2} that partial deficiency of vitamin E in the doe rat leads to the production of abnormal young. This abnormality is associated with both anterior pituitary deficiency and thyroid deficiency. It is most marked when the litter is about eighteen days old and usually results in death three or four days later.

Since at birth the young, though small, appear otherwise normal, it seemed possible that the abnormality develops after birth and might be prevented if the young were fed by a normal doe. An E-deficient rat had a litter of three—two males and one female. Five days after birth, the two males were exchanged for four males from the normal breeding stock which were born on the same day. The stock mother then had her own females and the four normal males. All the young suckled by the E-deficient doe were abnormal at 16 days, and all were dead two days later. The thyroid glands were examined histologically and all showed the hypoplasia typical of this condition. All the young suckled by the normal rat grew well and showed no sign of abnormality. The experiment was repeated, with the same result, when the females from the two litters were exchanged on the fifth day, and again when the young were transferred on the day of birth.

This experiment shows that the young of vitamin E-deficient rats are born normal, but that thyroid and anterior pituitary deficiency develop as a result of the lack of some essential constituent of the mother's milk. This missing factor is almost undoubtedly vitamin E since lack of this vitamin results in similar changes in these glands in the adult rat, although the accompanying symptoms of stunted growth, uncalcified skull, clenched feet and weakness are not observed because the animal has already attained maturity.

M. M. O. BARRIE.

Physiological Laboratories,
The British Drug House, Ltd.,
Graham Street, London, N.1.
Aug. 10.

¹ Barrie, M. M. O., *NATURE*, **130**, 236 (1937).

² Barrie, M. M. O., *Lancet*, **ii**, 251 (1937).

Vitamin P

We have reported previously that certain flavanones (vitamin P) greatly influenced symptoms of experimental scurvy. This latter condition was interpreted as a mixed C and P avitaminosis. At our request, our experiments have been repeated by several laboratories. The results were partly corroborative and partly negative. The reason of this discrepancy is now cleared up. Vitamin P requires for its activity the presence of traces of ascorbic acid. A scurvy diet frequently contains such traces which in themselves have no influence on the development of scurvy, but enable vitamin P to act. In the entire absence of ascorbic acid, vitamin P is inactive. Quantitative data will be published elsewhere. Previous conclusions are upheld. The object of this note is to prevent superfluous discussion.

A. BENSAËTH.

A. SZENT-GYÖRGYI.

Szeged.
August 12.

Choline Esterase Activity of Superior Cervical Ganglia

By a direct chemical micro method the maximum choline esterase activity of the superior cervical ganglion of the cat has been measured and found to be, on the average, equivalent to the splitting of 0.10 γ of acetylcholine chloride per sec. per mgm. of fresh tissue. The full experimental details will be given in another publication.

This figure may be applied to the data of Brown and Feldberg¹, who found that the greatest output of acetylcholine from the ganglion perfused with egerinized Locke's solution occurs in the first 5 minutes of preganglionic stimulation at 17 per sec. In this time 0.1 γ was liberated from a ganglion weighing 12.9 mgm. Hence the time required for the splitting of the acetylcholine liberated by one nerve impulse would be

$$\frac{0.1 \gamma}{12.9 \text{ mgm} \times (0.10 \times 10^{-3} \gamma/\text{mgm} \cdot \sigma) \times (300 \times 17) \text{ stimulations}} \\ = 0.015 \frac{\sigma}{\text{stimulation}};$$

provided that the enzyme and substrate are localized sufficiently so as to obtain a complete combination of the two, that is, theoretical maximum velocity of hydrolysis. Actually, the velocity falls when the concentration becomes less than a certain value; hence 0.015 σ represents a limiting least time which might be merely approached in actuality. Compared to the refractory period of the ganglion, which Brown² has found to be of the order of 2 σ , it is apparent that the enzyme need operate only with an average rate of about 0.75 per cent of its theoretical maximum velocity in order to destroy the acetylcholine liberated by a nerve impulse within the refractory period. After the first 5 minutes, the quantity of acetylcholine liberated per impulse falls until finally only about a fifth of the initial amount is set free¹; under these conditions the enzyme could hydrolyse the acetylcholine within the refractory period at about 0.15 per cent of its maximum velocity.

From the foregoing it would appear that the enzyme present is sufficient to destroy the acetylcholine liberated by a nerve impulse within the refractory period. However, it must be borne in mind that for the conditions of minimum velocity of hydrolysis, as in the case of an even distribution of enzyme and substrate throughout the tissue, the reaction velocity would be very far indeed from the maximum one, because of the low substrate concentration and affinity for the enzyme. In this case the time (t_s) for splitting 99 per cent of the substrate is given by:

$$t_s = \frac{1}{V_{\max}} \int_{S_1}^{S_2} \frac{K_s + S}{S} dS,$$

where $V_{\max}$ represents maximum velocity of hydrolysis, K_s the Michaelis constant for the affinity between enzyme and substrate, S the substrate concentration at any moment, S_2 the original substrate concentration, and S_1 1 per cent of S_2 . It follows that:

$$t_s = \frac{1}{V_{\max}} (K_s \ln \frac{S_2}{S_1} + S_2 - S_1) = \frac{4.6K_s + 0.99S_2}{V_{\max}}.$$

Since the value of K_s , which I am now investigating, is unknown for the enzyme from the source in question, it is sufficient for a rough calculation to assume it to be of the same order of magnitude as the K_s already found in the case of human serum³, namely, 0.001, from which t_s becomes about 8 sec.

In order that this time be reduced to 2 σ , it would be necessary for the enzyme and substrate to be concentrated within a small portion of the total ganglionic volume, such as at the nerve endings. Already evidence for a localization of this type has accumulated^{4,5}.

The calculation given above is merely an approximation, and serves only to show the enormous gap between the time for splitting under minimum and maximum conditions, and the necessity for localization of enzyme and substrate within the ganglion cell if the theory of chemical mediation is to hold.

DAVID GLICK.

Carlsberg Laboratory,
Copenhagen.
Aug. 7.

¹ Brown, G. L., and Feldberg, W., *J. Physiol.*, **58**, 205 (1934).

² Brown, G. L., *J. Physiol.*, **81**, 238 (1934).

³ Glick, D., *Biochem. J.*, **31**, 521 (1937). *Compt. rend. Lab. Carlsberg*, **21**, No. 15 (1937).

⁴ von Brücke, F. Th., *J. Physiol.*, **59**, 429 (1937).

⁵ Dale, H. H., "The Harvey Lectures" (Williams and Wilkins Co., Baltimore, 1936-37).

Choline Esterase in the Central Nervous System

THE theory of transmission of nervous impulses to the voluntary muscles postulates the presence of a high concentration of choline esterase in nerve endings or their neighbourhood¹. We have previously demonstrated the accumulation of choline esterase at the end plates of muscle². We have now compared the rate of hydrolysis of acetylcholine in the grey and white matter of the spinal cord of the dog and found the concentration 10-20 times higher in the grey matter. 100 mgm. grey matter hydrolyses 7-9 mgm. acetylcholine in one hour, while 100 mgm. white matter split only 0.4-0.9 mgm.

In the central nervous system, as in muscle, choline esterase is found in high concentration in the tissue that contains nerve endings. This suggests that in the grey matter the enzyme may have a similar functional significance as at the end plates of muscle, that is, the rapid removal of acetylcholine, and that this substance may act as transmitter of nervous impulses in the central nervous system.

In the nervous system of crustaceans (lobster) there is also a higher concentration of choline esterase in the ganglion cells than in the nerve fibre.

D. NACHMANSOHN.

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July 28.

¹ Brown, G. L., Dale, H. H., and Feldberg, W., *J. Physiol.*, **57**, 304 (1936).

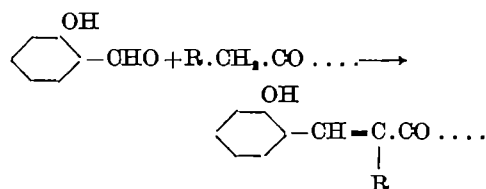
² Marnay, A., and Nachmansohn, D., *C.R. Soc. Biol.*, **126**, 942 (1937).

Specificity of the Salicylic Aldehyde Reaction of Csonka-Straub

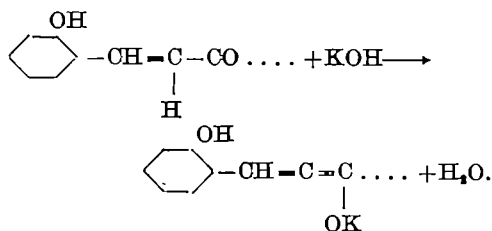
SOME time ago Straub (in Szent-Györgyi's laboratory) described a colorimetric method for the determination of pyruvic acid, similar to the method previously proposed by Csonka for the determination of acetone. In the presence of salicylic aldehyde and concentrated potassium hydroxide, both substances develop a yellow colour, suitable for colorimetry. Having met with the necessity of determining pyruvic acid in the presence of several other ketones, I have made a study of the specificity range of this reaction and obtained the following results.

A positive salicylic aldehyde reaction is obtained with all compounds containing a CH_2CO group linked directly to a hydrogen or carbon atom; for example, acetaldehyde, acetone, ethyl acetoacetate, methylhexylketone, diaetyl, acetophenone, pyruvic acid, levulinic acid. The reaction is negative: (1) with carbonyl compounds that do not contain the above-mentioned group—formaldehyde, propionic aldehyde and higher homologues, ketobutyric acid and all higher ketosacids, fructose, dihydroxyacetone, acetonedicarboxylic acid; (2) with compounds containing a CH_2CO group linked to oxygen or nitrogen, that is O- and N-acetyl compounds, the CO group of which is not a genuine carbonyl group; for example, acetic acid, acetyl glycine, acetylcholine, acetylsalicylic acid, triacetin.

The mechanism responsible for this very definite range of reaction specificity is obviously the following. In the first stage of the reaction salicylic aldehyde is condensed with the carbonyl compound to an oxybenzylidene derivative (Perkins' reaction):



If a menthyl group be attached to the carbonyl group of the original compound, that is, in the case $\text{R} = \text{H}$, enolization will ensue in a strongly alkaline medium, leading to the formation of an enolate, the intense yellow colour of which is due to the system of cumulated double bonds:



With R other than a hydrogen atom enolization and the formation of the cumulated double bond system is ruled out and no colour will appear, even though benzylidene condensation had taken place. With O- and N-acetyl compounds neither the condensation nor the enolization is obtained under the conditions of the colour test.

The salicylic aldehyde reaction is a sensitive test for the qualitative (and in many instances for the quantitative) determination of any methyl-carbonyl-derivative in the absence of other substances belonging to the same group. The reaction is very important as a valuable means for distinguishing these compounds from the homologous or substituted carbonyl derivatives. The specificity range outlined above should be especially kept in mind when making use of the reaction for quantitative studies on the metabolism of pyruvic acid, which may give rise to substances such as acetaldehyde, acetoin, acetoacetic and acetylpyruvic acids and acetone, all falling within the specificity range of the Csonka-Straub reaction.

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A Cage Colony of *Anopheles gambiae* Giles

MATHIS¹ has reported the successful rearing of *A. gambiae* under laboratory conditions. He fed the adults on a guinea pig and found that mating occurred in quite small cages. For some years now I have made attempts to establish a laboratory colony of this species without any success. Great difficulty has always been experienced in getting caged adults to feed. The following animals have been tried: shaved guinea pigs, rabbits, goats and human beings. When feeding did take place, no fertilized eggs were recovered. Recently a further attempt has been made, and this has proved successful.

Adult *gambiae* reared from eggs, obtained from gravid females captured in the field, were placed in an indoor cage lined with asbestos measuring 6 ft. x 5 ft. x 5 ft. The temperature in the cage was kept constant at 25° C. by means of a radiator connected to a thermostat. Large bird-baths and ferns were placed inside, yet the humidity of the air in the cage, as measured by a sling hygrometer, never rose above 40 per cent.

For a month the insects were given the opportunity of feeding on a human being every evening, and they very seldom took advantage of this. At the end of this period, however, nearly full-grown larvae were seen in one of the bird baths and very robust adults resulted.

After this date a small pig was introduced and the mosquitoes fed very readily. Eight days after introduction of the pig, first-stage larvae were seen in the breeding dishes; these represented the second

generation in captivity. Since that date hundreds of larvae have appeared and third generation adults are now ready to deposit eggs. The colony is regarded as being firmly established.

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August 6.

¹Mathis, C., *C. R. Soc. Biol.*, **131**, 21-22 (1936).

The Position of Genetics

THE attacks of Lysenko on Vavilov and other Russian geneticists reported in *NATURE* of August 21 are not wholly dissimilar to Dr. H. Dingle's attack on Prof. E. A. Milne in a recent issue of this journal. Vavilov was accused of being anti-Darwinian, Milne of going back to Aristotle, in neither case perhaps with full justification. If these attacks have led to a curtailment of Vavilov's work, the situation of genetics in the Soviet Union is indeed serious. If not, hard words break no bones, and the outlook for genetics in Moscow is at any rate no worse than in London, where I understand that the only department of genetics in the University is shortly to come to an end.

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Points from Foregoing Letters

LORD RAYLEIGH has made photographic tests to see whether, as had been supposed by certain observers, there were lights in the field of an alternate current magnet. The result was negative.

Prof. S. Chapman indicates that the decrease of cosmic ray intensity noted by Forbush in America (United States and Peru) and by Hess and Demmelmair in Austria, during the magnetic storms of April 1937, should throw light on the mechanism of magnetic storms; in particular, it should show whether the world-wide decrease of horizontal magnetic intensity during a magnetic storm is due to currents in the high ionosphere or to a ring-current right outside the earth's atmosphere.

The 'cluster' theory, which postulates that the molecules of imperfect gases occur in groups (mainly pairs under ordinary conditions), permits, according to C. F. Goodeve, a simple treatment of many properties of imperfect gases.

The possibility of obtaining polarized beams of neutrons by selective absorption on passing through a substance cooled to very low temperatures, the nuclei of which have a resonance level for absorption of slow neutrons, is pointed out by Dr. Hans v. Halban, jun. Paramagnetic salts magnetized at low temperatures might be employed for this purpose.

Standing ultra-sonic waves produced in xylol, or in a mixture of xylol and carbon tetrachloride, by an annular quartz plate can be observed within the ring and also outside the crystal plate. Miss J. Čerňavská submits a photograph obtained with radial vibrations, showing that a concentric circular grating has been formed in the liquid; this can be used in diffraction experiments.

Further experiments by Miss M. M. O. Barrie show that the young of vitamin E deficient rats are born normal but that they develop symptoms connected with thyroid and anterior pituitary insufficiency. However, if suckled by a normal rat, the young develop normally, showing that there is a lack of some essential constituent (probably vitamin E) in the mother's milk.

By a micro-chemical method D. Glick has calculated the rate at which choline esterase enzyme, acting on the super cervical ganglion of the cat, can split acetylcholine, a compound liberated during nerve activity. The time required is well within the refractory period of the nerve impulse, provided the known amount of enzyme and substrate are concentrated at the nerve endings. D. Nachmansohn has found an increased concentration of choline esterase at the nerve and plates of muscles and now reports that the grey matter of the spinal cord of the dog contains 10-20 times more choline esterase than the white matter. He suggests that the grey matter may act as transmitter of nervous impulses in the central nervous system.

The salicylic aldehyde reaction which gives a yellow colour with acetone and pyruvic acid (Caonka-Straub) is found by Prof. A. E. Braunstein to be a sensitive reaction for any methyl-carbonyl (CH_3CO) derivative, in the absence of other substances of the same group. The author directs attention to the fact that, in studying the metabolism of pyruvic acid, one should be on the look-out for substances such as acetaldehyde, acetoin, acetoacetic and acetopyruvic acids and acetone, which also give the Caonka-Straub reaction.

Research Items

Clan Reciprocity among the Bororo

IN an account of the social organization of the Bororo Indians of South America, M. Cl. Levi-Strauss refers to certain reciprocal obligations between clans, which he considers worthy of intensive study. He himself was able only to obtain a few discursive notes on the customs this reciprocity entails (*J. Soc. Américanistes de Paris*, N.S., 28, 2). For example, when the young men are about to be initiated, the chief of the village entrusts their instruction to the phratry opposite to their own. On the death of a member of the tribe, it is customary for a collective hunt to be arranged. The organization of the hunt is entrusted by the nearest relative of the deceased to a member of the opposite phratry. The funeral emblems are handed to him, and he acts as organizer and leader. The preparation for the funerary dances is the duty of special clans; but the clan for whom the dance is prepared must take part as partners. This duality is well expressed in certain dances, in which the dancers stand in two lines and exchange places in the course of the dance. Each line or side belongs exclusively to one phratry. After the dance, the dancers are bathed by the members of the opposite phratry. An even closer tie binding the clans is formed by the interchange of food. At a stated time a member of one of the clans will carry a bowl of food from his own house to the man's house, where it is received with a ritual cry of welcome. Six or eight men of another clan are then fetched to the man's house, and partake of the food with their shell spoons. This exchange of food takes place reciprocally between all the clans, though with the exception of this ceremony and the giving of food to dancers after the dance, all meals are taken in the family dwelling. The privileges of the clans include the exclusive possession of names, songs, dances, and emblems and of certain techniques and materials. These rights are strictly respected.

The Human Sex Chromosomes

FROM a study of spermatogenesis in three individuals, Dr. P. C. Koller (*Proc. Roy. Soc. Edin.*, 57, 194) has deduced some interesting conclusions. The length of the X-chromosome in man is found to be 4-5 μ and that of the Y 1.5 μ . These chromosomes frequently lie off the metaphase plate in mitosis, and in anaphase the Y frequently lags. In the leptoxgotene stages of meiosis the X and Y are precociously condensed. They are divided into pairing and non-pairing regions. The non-pairing portion of the X is about two thirds of its length, while that of the Y, if present, is very small. The spindle attachment of the X is subterminal and is believed to lie in the pairing segment, so that crossing-over may occur on either side of it. The region between the centromere and the non-pairing (differential) segment is a quarter to a half that of the whole pairing region in which crossing-over will take place. Genes in this part of the X will show incomplete sex linkage, the linkage being lowest in loci farthest from the non-pairing segment. Both symmetrical and asymmetrical sex bivalents were found, and the X and Y sometimes fail to pair. In one individual

chromatid bridges and fragments were observed. He was probably heterozygous for an inversion. Such inversions may yet prove to be of significance in the racial differentiation of man.

Barbels of Japanese Fish

THE structure and function of the barbels of two Japanese fish have been investigated by Mitus Sato (*Sci. Rep., Tôhoku Imp. Univ.*, Feb. 1937, 3 papers). One, the goatfish, *Upeneoides benesasi*, has two long barbels on the chin, and the other, a sea catfish, *Plotosus anguillaris*, has four pairs of barbels, two pairs above and two below the mouth. The barbels in both fish have a central supporting cartilaginous rod and in the epidermis covering them lie a number of characteristic taste organs which are supplied by branches of the fifth and seventh cranial nerves. In the catfish such organs are also to be found in the lips. These organs are more important than either sight or smell in the selection of food. In the goatfish the removal of the barbels causes a loss of the power to distinguish food. This does not occur in the catfish, since some of the organs are left in and around the lips.

Chromosomes of Coffee Plants

A STUDY of the chromosomes of *Coffea* has been made by Dr. C. A. Krug (*J. Genetics*, 34, No. 3), who confirms that $2n = 22$ in *Coffea arabica* and has found the same number in seven other species. Most of the cultivated varieties of *C. arabica*, however, are tetraploids; while the var. *bullata* of Cramer, which has broader and much thicker leaves, is an auto-octoploid ($2n = 88$) or in certain plants hexaploid. The octoploid condition also arises somatically on a branch of a tetraploid, and can revert somatically to the tetraploid. Hexaploids are much less frequent, so it is concluded that the octoploids probably arise through chromosome doubling after fertilization. Their fruits are abnormal, giving a very low percentage of germination. All the offspring were $4n$ except one $6n$ and one $8n$. The $4n$ plants may have arisen parthenogenetically. The pollen meiosis in the octoploids is irregular, only about 62 per cent of the tetrads having four microspores. From $4n \times 8n$ seven plants were obtained, all having $2n = 44$. These must have arisen from parthenogenesis or by the fertilization of $2n$ eggs by $2n$ pollen. The hexaploids also show high gametic sterility and low seed production. Four seedlings were produced, three of which had 66 chromosomes and one 44. In reciprocal crosses between *C. arabica* ($2n = 44$) and *C. canephora* ($2n = 22$) a triploid hybrid plant produced misshapen seeds with little or no perisperm but with normal embryo. *C. canephora* has several chromosomes longer than the rest, and these are recognizable in the hybrid.

Petrofabric Study of Moine Schists

AT the meeting of the Geological Society on May 5, F. C. Cole presented an important paper dealing, for the first time, with the application of petrofabric analysis to the problems of the metamorphic rocks

of the Highlands. In all, 85 analyses of quartz and mica fabrics of Moine schists have been made. Specimens collected over a wide area have given in every instance a well-marked girdle-diagram, indicating that the schists are typical *B*-tectonites. In these, the direction normal to a girdle, known as the *b*-axis or tectonic axis, has the same significance as a visible fold-axis. The *b*-axes of the Moine pitch uniformly into the south-east quadrant, suggesting that the present regional metamorphic condition of the Moine is the result of movements along approximately south-west and north-east lines. The effect of the post-Cambrian overthrusting on the fabric of the schists is also examined. Relics of the earlier fabric are traceable in partially mylonized rocks, but the thrust movements have had little or no constructive effect, being in the main cataclastic, and the continuity of the structure is lost. The evidence indicates that the general metamorphism of the Moine schists was effected by movements, earlier than the overthrusting phase of the Caledonian orogeny, acting in a direction almost at right angles to the direction of overthrusting, but parallel to pre-Torridonian directions of movement in Lewisian areas.

Drilling of a Deep Pressure Test in India

EXPERIENCE has shown that problems pertaining to the drilling of a well under pressure to great depth are many and formidable. The main difficulties to be overcome are shallow zones of low-pressure sands, which cause loss of fluid and circulation, deeper high-pressure water and gas sands, 'heaving shale' formations and hard formations, which retard drilling and are conducive to crooked holes. Mr. G. F. Wilson, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, described measures which have been adopted to overcome these particular difficulties when drilling a deep well in India. The casing was set below the low-pressure zone; heavy mud was used as well as pressure drilling; by continuous maintenance of pressure and the use of treated muds, heaving shale formations were penetrated and the effect of hard formations counteracted so far as possible by provision of a hydraulic table. The history of this test well showed that pressure drilling is quite practicable for prolonged periods, providing the best obtainable equipment is used. Where, however, rock pressures are known and can be dealt with by mud, it is better not to employ pressure drilling, but to keep it as a standby, since the increased cost of fuel and equipment for drilling under pressure is in most cases greater than that of mud-loading materials.

Crystalline Structure of Pentaerythritol

THE elucidation of the structure of sugars by X-ray analysis has been hampered by lack of knowledge of various interatomic distances. F. J. Llewellyn, B. G. Cox and T. H. Goodwin (*J. Chem. Soc.*, 883; 1937) have made an analysis of the relatively simple compound pentaerythritol, $C(OH)_4$, which shows that the model consists of a central carbon atom surrounded by four CH_2 groups at the corners of an almost exact tetrahedron; each hydroxyl group is attached to its CH_2 by a bond making nearly a tetrahedral angle with the $C-CH_2$ link, and is so directed that the four OH groups lie at the corners of a square. The bond lengths and angles were

calculated from the measured atomic co-ordinates and cell dimensions, the distances being $C-C=1.50$ Å. and $C-O=1.46$ Å., the first being slightly less than that found in diamond and usually assumed for aliphatic compounds, and the second almost exactly equal to the calculated sum of the half-bond lengths of carbon and oxygen. The structure of the lattice as a whole is of a very pronounced layer type, the molecules being linked together by hydroxyl bonds in sheets in the (002) planes, and the separation of more than $3\frac{1}{2}$ Å. accounting for the perfect cleavage parallel to {001}. The evidence supports the view that the relatively short distance between hydroxyl groups represents a hydroxyl bond in which a hydrogen atom binds two oxygen atoms closely together while remaining attached essentially to one of them. The arrangement is very similar to that found in resorcinol. All other inter-molecular distances are much greater and correspond with relatively weak van der Waals' forces.

Determination of Lactoflavin in Milk

A RAPID method for the determination of lactoflavin (vitamin G) in milk by a fluorimetric method is described by C. H. Whitnah, B. L. Kuerth and M. M. Kramer (*J. Amer. Chem. Soc.*, 59, 1153; 1937). To 10 ml. of milk, 16 ml. of 10 per cent trichloroacetic acid is added, the mixture is allowed to stand for $\frac{1}{2}$ -1 hour and centrifuged for 5 minutes at 2,000 r.c.f. Ten ml. of the resulting serum is neutralized with methyl orange as indicator and diluted until the sample can be matched in the light of an Eberhard Fluoray lamp with standard flavin solutions (Labco PX grade) containing 0.12-0.06 gamma of flavin per ml. The consistency of the method was confirmed, and comparisons with the biological assay by the Bourquin-Sherman method were satisfactory. Attempts are being made to apply the method to colostrum, which is higher in lactoflavin content than normal milk.

Classification of Stellar Spectra

THE spectral classification of stars of types A to K has recently been discussed by W. W. Morgan (*Astrophys. J.*, 85, 380), who points out the desirability of a two-dimensional system of classification depending on effective temperature and luminosity. The system should be in empirical units based on the actual observed criteria in the spectra, so that no errors are introduced by assumptions involved in reducing these to values of the corresponding physical parameters. The Henry Draper notation provides a suitable method of classification in the temperature direction which is practically constant for all values of the surface gravity in the stars considered; but the criteria on which it is based should be as far as possible independent of a star's luminosity. Classification in the luminosity direction should similarly be based on lines which are unaffected by temperature over the range in which they are employed. The author suggests, as simple criteria which fulfil these conditions, some single line intensities, intensity ratios and differences. They enable the H.D. type to be determined with high accuracy, and (for types A7 to K9) give an additional numerical classification directly related to luminosity. The criteria for types A0 to A6 are not sufficiently accurate to give more than a 'group' classification (for luminosity) into super-giants, main sequence stars and white dwarfs.

The Bone-Bearing Beds of Bethlehem: Their Fauna and Industry

By Elinor W. Gardner and Dorothea M. A. Bate

IN a note in 1934 (*NATURE*, Aug. 11, 1934, p. 219) one of us (D. M. A. B.) directed attention to an interesting discovery of elephant remains in a deposit at Bethlehem. This was the result of a cursory examination on the spot undertaken for the Department of Antiquities.

Shortly afterwards, the late Sir Henry Wellecome became interested in the site, and a concession was obtained by Mr. J. L. Starkey from the Department of Antiquities, Palestine, for the Wellecome Archaeological Research Expedition to the Near East. In the spring of 1935 the Geological Section of the above Expedition began its first season's work with E. W. Gardner as geologist and D. M. A. Bate as palaeontologist. It was continued in 1936 under the same auspices, and resumed in 1937, thanks to the enthusiastic support of the trustees of the late Sir Henry Wellecome and of Sir Robert Mond.

GEOLOGY

The bones were first found by the owner of a garden digging for water on the highest point of Bethlehem, 790 m. above sea-level. On all sides the ground falls away, on the east towards the Dead Sea Rift, on the west towards the Mediterranean.

The position of the deposit isolated on the highest part of the Judean arch at once, therefore, aroused interest, for the solution of the problem of its origin would certainly throw interesting light on the past physiography of the region and its relation with the Rift Valley and Transjordan.

In the original pit, elephant bones were seen *in situ* at 15 m. below the surface. On opening up the area they were found some 6 m. down in a coarse gravel with a stiff clay matrix, which makes their extraction a slow and difficult business. The gravel consists mainly of chert of all sizes, some blocks being half a metre or more big. Limestone is a minor constituent, but is locally abundant. A few iron nodules are also found. The materials are very little sorted, and are mostly derived from local Cretaceous rocks, with the exception of the iron nodules, which are more characteristic of the Eocene.

As the excavation was enlarged it seemed in the first season as though there were two gravels separated by a bed of pure clay, all dipping east, but later work showed that in depth the two gravels coalesce. They are both bone-bearing, in contrast to the pure clay, which has never yet yielded any remains.

Those in the western gravel are badly preserved, perhaps because they occur nearer the surface and are less protected by deposit of lime or nari towards the top. An interesting specimen found there was a

jaw of an elephant, and perhaps part of the skeleton. The mass of bone, 3 m. long, dipped, with the beds, steeply to the north-east; while some of the deposits in the north-east corner—the original area—dip as steeply ($\pm 40^\circ$) to the south.

In 1935 no junction of the gravels and clays with country rock was found, and therefore in 1936 the area was enlarged in the hopes of finding one.

On the east and south a white chalky rock, nari with humps of limestone, had already been sporadically uncovered, and on cutting back the south side it increased rapidly both vertically and laterally. In places it arches over the gravel, sometimes with a



Fig. 1.

very clean junction. It is veined with red clay, which in places develops into pipes narrowing upward, and mostly dipping eastward. In depth blocks of limestone, some with fossils, become more and more abundant and of increasing size. The surface of these is weathered sub-aerially, and often shows characteristic carving and fretting.

The gravel in the west lies on this deposit, which may be called a cemented scree or breccia, at a steep angle, and sometimes penetrates into it as pipes. The approach of the scree is heralded by increasing numbers of limestone boulders in the gravel and by the reddening of the clay. In the east and south-east, on the other hand, the junction is sharp and vertical, or nearly so, the gravel and clay fall away under the pick in big masses, leaving a clean face of white rock. In the same area vertical or steep clay faces are exposed in the same way, and these, if not on the junction, are always very near it.

On the south the steep scree face has been followed down for 11 m., at which depth it flattens out into a small platform before plunging down again. From the northern edge of this platform a hard triangular mass of breccia rises two metres above the floor. The space between it and the southern wall was filled

with grey bone-bearing gravelly clay, which ended quite abruptly against the breccia block. A somewhat similar but smaller mass has been found in the north-west corner. The irregularity of the surface of the scree deposit, together with the nature of the junction with the bone-bearing beds, seems to indicate that it was formed before them and that they were laid down on and against it.

In the south-east corner yet another curious deposit was found. This consisted of a pipe—3 m. broad—in the sand, and scree, filled with blocks of chert of all sizes, some more than a metre in all dimensions. In contrast to the chert in the gravel, which is more or less worn, these blocks of whatever size are sharply angular.

The pipe slopes in the north-east and ends some 6 m. down after narrowing slightly, and finally disappears in the narrow cracks of the cemented scree. On the south side of the pipe near the base the scree contained some remarkable polished cherts. They were found in pockets of red clay in the scree and were mixed with quite unworn and angular fragments. The polish is so high that it is more like a glaze. In some cases the cherts are intensively worn, in others and more frequently, they are less so and show numerous flake scars.

It is still too soon to discuss the origin of all these materials, but there can be little doubt that the gravel and clay bone-bearing series is a water-laid deposit, and that the bed against which it rests is a sub-aerial one.

The gravels are rapidly contracting in area as they go down and this, in conjunction with the inward dip, points to the filling of a roughly funnel-shaped hole, or alternatively to the collapse of the original floor on which they were laid. Whatever may be the ultimate decision, the impossibility of any such deposit forming in its present position indicates wide physiographic changes, which in their turn point to a great age. More exact dating must be left to the paleontologist.

ARCHAEOLOGY

It is possible, however, that some help in the dating problem may be obtained from implements. Throughout the work a close watch has been kept for human worked flints, but until this year nothing definite was found. Now, however, a number of possible tools have been obtained, in the bone-bearing gravel, and these, if accepted, will be invaluable not only in dating, but also in helping to trace the deposits elsewhere.

Miss Caton-Thompson, who saw them *in situ*, and has kindly consented to work them out, contributes the following note:

"The cherts in the deposit have a wide variation in size, ranging from huge blocks to small chips and pebbles. Both tabular and nodular varieties are present. The former is mainly represented by a pale greenish chalcodonic chert with a rough or corrugated cortex; the latter by a dark grey-to-black 'chalk flint'. A peculiar local variety, favoured on certain sites by Acheulean man for hand axes, is also included; it has the appearance of an angular pudding-stone, and is known as brecciated chert.

"The play of mechanical forces on the flints is strikingly evident. Striations, shattering, bruising, crushing, rolling and thermal action are all visible. Taken as a whole, however, rolling is very slight compared with normal gravel constituents, and a

considerable proportion of the material is relatively fresh.

"The danger of claiming humanly-fashioned tools from such an assemblage and so vast a selection is obvious. Nevertheless, we think that a certain number of pieces are difficult to explain in other terms. They will provoke healthy controversy as acute as that which has beset the 'artefacts' from the Red Crag of Foxhall, or the sub-Crag detritus bed flints at Bramford. Many of the Bethlehem 'artefacts' resemble the latter, in so far as both, when of tabular flint, conform closely in shape and edge trimming to the classic type of Harrisonian eolith. This is the first time they have been found in a sealed deposit in Palestine or the Near East, though Mr. Starkey has long known them from the bed of Wadi Ghuzzah. Flakes, though rarer, are also present, and display 'striking platform' and/or bulb.

"Balancing the probabilities, we think the type of flaking and edge trimming exhibited on these admittedly selected specimens is less easily reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man in remote pre-Chellean times." E.W.G.

PALEONTOLOGY

The first discovery of fossil elephant remains in Palestine was announced in NATURE of August 11, 1934, p. 219. Subsequent finds have been made in the Wady Mughara caves and in the bed of the River Jordan not far from its exit from Lake Huleh, but both these are of later date than the deposit at Bethlehem which yielded the first remains. In fact, with the possible exception of a single specimen which I hope to describe shortly, the Bethlehem deposit has yielded a mammalian fauna of earlier geological age than any so far known from Palestine. As yet it has been possible to make only a preliminary examination of the animal remains obtained during the three seasons' work; this has revealed the presence of the following vertebrates:

<i>Felis</i> sp. (size of <i>Panthera leo</i>)	<i>Rhinoceros</i> cf. <i>strucosus</i>
<i>Hippopotamus</i> sp.	<i>Stegodon</i> sp.
<i>Bos</i> sp.	<i>Elephas</i> sp.
Antelope	<i>Testudo</i> sp. (of gigantic size)
Giraffoid	<i>Testudo</i> sp. (of very small size)
<i>Hipparion</i> sp.	

Besides the above species there is known to be a small carnivore, but its remains are extremely fragile and have not yet been extracted from the matrix. With, perhaps, the exception of the large *Felis*, the *Bos* and the tiny tortoise, all these species are new to Palestine, and without doubt represent extinct forms.

Among the mammals the name *Bos* is used in a broad sense, since the species is known only from portions of horn cores. Likewise the antelope and the Giraffoid are only represented by a small number of skeletal remains. The discovery of *Hipparion* is of special interest, both chronologically and geographically. Species are known from many Tertiary deposits in Asia, including India, and are generally considered to be typical of the Pliocene. Last year (1936) Father Teilhard de Chardin and Prof. de Terra recorded *Hipparion* remains from the Basal Pleistocene of India, although they themselves did not wish to claim this dating as proved conclusively. The find at Bethlehem seems to suggest that further corroboration may be forthcoming from India. In

East Africa, on the other hand, *Hipparion* remains are well known from Pleistocene deposits, and have been recorded from Oldoway, Beds I-IV, from Kaiso and from Lake Rudolf.

The Bethlehem *Rhinoceros* has been compared with *R. etruscus*, since some of the upper cheek teeth appear to be similar; the height of the crowns is, if anything, slightly less in the Palestine specimens. In this connexion it is of interest to remember that the late Dr. W. D. Matthew compared the Indian *Dicerorhinus platyrhinus* with *R. etruscus*.

The discovery of the *Stegodon* remains is of outstanding moment. This is essentially an Asiatic genus, though Dr. A. T. Hopwood allows me to mention that its occurrence in African deposits is now known and will shortly be published. India during the Pliocene appears to have been the great centre for the adaptive radiation of the *Stegodon* group. Here the genus lingered on into the Middle Pleistocene; in Java it is known from an even later horizon. As might be expected, the *Elephas* from Bethlehem is represented by a primitive form with low-crowned cheek-teeth.

The gigantic tortoise is known from a considerable number of plates from the bony carapace and plastron. Most of these were collected early this year and have not yet been examined critically. It will be remembered that remains of a gigantic tortoise were discovered by Dr. Leakey in East Africa in 1935.

Many of the animal remains have been subjected to pressure, and this corroborates the geological evidence that movements must have taken place after their inclusion in the deposit. Frequently it has seemed evident that complete carcasses have been embedded in the deposit, notably in the case of the elephant quoted above by Miss Gardner. Likewise it may be mentioned that so far the animal remains have given no indication of a difference of fauna from different parts of the excavation.

Unfortunately, owing to local conditions, specimens are generally very fragile, and always difficult to extract. It is hoped, however, that further work next spring may result in the acquisition of still larger collections, which will enable us to extend our knowledge of this new fauna.

In conclusion, it is suggested for the Bethlehem fauna that its origin is Asiatic, and that its age is not later than Early Pleistocene, using this term paleontologically as indicating the time of arrival of true *Bos*, *Elephas*, and *Equus*. The fauna also indicate a warm climate, with a more liberal supply of permanent water than is found in the country at the present day. Further, it is claimed for this fauna that it will provide a faunistic link for this period between Asia and East Africa, enabling a better understanding to be reached regarding the migrations and centres of dispersal of various mammalian groups.

D. M. A. B.

The Lake District as a National Park

THE question of the afforestation projects which are being carried out by the Forestry Commissioners has been the subject of considerable controversy and alarm among residents of the Lake District and those who have an admiration for this beautiful piece of England.

The Friends of the Lake District have recently published a pamphlet entitled "Make the Lake District a National Park" (Ambleside: Friends of the Lake District. Sec., 2 Midland Bank Chambers, 1937), which is, in effect, an appeal to all lovers of the Lake District based on a new method of treating and preserving this unique region without involving any of the upset to local agricultural methods which is one of the strong objections offered to the Forestry Commission's activities. The pamphlet opens with the sentence, "Regions of great natural beauty have a lasting value for the refreshment and inspiration of man." The object of the proposal to create the area a national park is to preserve for the future the outward aspect of the district as at present seen "with the grand and the beautiful in splendid harmony". The formation of a national park does not necessarily entail the nationalization of ownership. "The policy has no quarrel with the essentials of the present system of land holding, or with the enjoyment of private property as such. It can be achieved inside the traditional framework."

One of the great objections to the afforestation proposals of the Forestry Commission has been the disturbance involved to local methods of agriculture, and especially to the famous strain of Herdwick sheep. The fells of the Lake District are rough grazing, occupied by Herdwick sheep; and, since

there is no conflict of interest between sheep and the pedestrian, the local agricultural system and free access, it is said, are good partners.

The valley bottoms are not arable, but grass land with a generous lay-out of footpaths on the 'inside land'; the meadows do not run far up into the dale-heads, nor do the 'intakes' run far up on to the hill-sides. The whole configuration and covering of the land is, given moderately free access, ideal for the formation of a national park. The tourist industry, second in importance only to the sheep, will greatly benefit and thus assist the local hardy inhabitants to enjoy a greater prosperity.

The Lake District extends over parts of the three counties of Lancashire, Westmorland and Cumberland. There are seven planning authorities in the Lake District and half a dozen highway authorities, while the Forestry Commission possesses full powers overriding most of these. In order to secure uniformity, the proposal made by the Friends of the Lake District is that a National Park Commission should be appointed by the Government with statutory powers for protective purposes to override other bodies; that the Commission should receive a grant from the taxpayers' money and that it would be responsible to Parliament only. In return for the outlay the public, by arrangement with the land-owners and commoners, would acquire a right to utilize all paths, etc., which have for long been frequented by the courteous permission of such proprietors and commoners. Any other national parks created in the country would be placed under the general control of the National Park Commissioners.

Science News a Century Ago

The Insulating Power of Fluids

IN 1837, Faraday was making researches connected with the induction, and the conduction of electricity by various types of insulators. As is generally known, his observations were entered in his diary in numbered paragraphs, the entries for September 6, 1837, running from No. 3875 to No. 3891. The first few of these were as follows:

"3875. Tried insulating power of some fluids by dipping a glass rod in them and then touching a gold leaf electrometer with the wet part, the finger being also applied to the wet part about the third of an inch from the electrometer. Thus a film of the liquid of about half an inch long formed the communication.

"3876 Oil of turpentine—good and filtered; insulated well.

"3877 Oil of turpentine—old and with water at the bottom of the bottle; discharged the electrometer at once.

"3878 Naphtha (French)—insulated well.

"3879 Oil gas liquid—Do.

"3880 Caoutchoucine—discharged moderately.

"3881 Cocoa nut oil (the expressed solid part)—discharged at once.

"Hence Oil of turpentine, Naphtha and Oil gas liquid appear as if they would do for transinductive media."

Discovery of the *Victoria regia*

AT a meeting of the Botanical Society held on September 7, 1837, the secretary read a communication from Robert H. Schomburgk dated New Amsterdam, Berbice, May 11, 1837, on a new genus allied to the water-lily, which by permission of Her Majesty he had named *Victoria regia*. The discovery of the plant by Schomburgk, in the River Berbice, in British Guiana, was made in January. When on the river he saw something which raised his curiosity, "All calamities were forgotten; I felt as a botanist and felt myself rewarded. A gigantic leaf, from five to six feet in diameter, salver-shaped, with a broad rim of light green above, and a vivid crimson below, resting upon the water: quite in character with the wonderful leaf was the luxuriant flower consisting of many hundred petals. The smooth water was covered with them, I rowed from one to another, and observed always something to admire. . . . We met them afterwards frequently, and the higher we advanced the more gigantic they became".

British Association at Liverpool

ON Saturday, September 9, 1837, the General Committee of the British Association met in the library of the Liverpool Athenæum, the Marquis of Northampton being in the chair. In the course of the meeting it was announced that the Government, at the request of the council, had consented to repeal the duty on the importation of philosophical instruments, and also to extend the Ordnance Survey to Scotland. It was also stated that the council had directed its attention to the establishment of a law of universal copyright, and had entered into communication with M. Guizot, Minister of Public Instruction in France, and Mr. Sergeant Talfourd.

It was submitted and agreed to that admission to the General Committee, then open to the presidents

and vice-presidents and office-bearers of chartered philosophical societies and contributors to the *Transactions*, should be extended to the officers of the Literary and Philosophical Society of Newcastle, the Natural History Society of Newcastle, the Wernerian Society of Edinburgh, the Royal Geological Society of Cornwall, the Geological Society of Dublin and the Statistical Societies of London and Manchester.

Babbage's "Bridgewater Treatise"

IN May 1837, Babbage published "The Ninth Bridgewater Treatise. A Fragment". It was adversely criticised in the *Mechanics' Magazine* of September 9, 1837, in which it was said that "almost every chapter is composed of mere scraps of composition, without any attempt to unite them into one whole; some chapters have no end; many more have no beginning and one at least might be fairly said to have neither beginning, middle nor end. . . . It is perhaps hardly necessary to do more", said the reviewer, "than state the plain fact that the main object of this Ninth Bridgewater Treatise is professedly to raise our conception of the power and wisdom of the Creator, by comparing the mechanism of the Universe with that of Mr. Babbage's calculating engine!"

Indulgent Examiners

THE *Lancet* of September 9, 1837, contains the following story from a correspondent, entitled "A New Method of Passing Apothecaries Hall": "Candidates who are rejected are most strongly recommended to commence crying immediately after the sentence of the Examiners is pronounced; this mode of appeal to the worthies of the Hall being likely to prove effectual for candidates in that predicament. A case in point occurred last week. A great boy on the wrong side of thirty left the room crying aloud. The sentimental event touched the feelings of the examiners and the scientific youth was called back after a few minutes into the presence of the Board, whence he returned to the 'finking' room with his diploma, where he commenced kicking up his heels and laughing most uproariously, and finally placing his dexter thumb to the point of his nose, in an expressive manner, quitted the Hall, perplexed much to know whether the operation of sneering or laughing was most suited to the occasion".

Preservation of Bodies for Dissection

THE issue of the *London Medical Gazette* for September 9, 1837, contains the following description of the method of preserving bodies for dissection invented by M. Gannal, to whom the Academy of Sciences in Paris awarded a prize of 8,000 francs: "The process simply consists in injecting an aqueous solution of an aluminous salt by one of the carotids; some pints are sufficient; after it the body may be preserved exposed to the air for a long time without putrefaction, and sometimes at last dries and is mummified. He uses acetate of alum prepared from the acetate of lead and sulphate of alum and potash; and five or six pints of a strength that will mark 18° on Beaumé's aerometer, are sufficient to preserve a body for five or six months. He has also used simple sulphate of alum for procuring the acetate. With one kilogramme of common sulphate of alum in lumps, 250 grains of acetate of lead and two pints of water, a mixture may be obtained sufficient to preserve a body four months; or common sulphate of alum alone will make one keep for two months".

University Events

CAMBRIDGE.—At King's College, K. P. Harrison and O. L. Zangwill have been awarded Harold Fry studentships, and D. S. Evans has been awarded a Martin Thackeray studentship. At Clare College, Denman Baynes research studentships have been awarded to J. V. Dunworth and T. E. Easterfield for natural sciences and mathematics respectively. At Emmanuel College the external research studentship offered to graduates of other universities intending to commence residence as research students in October next has been awarded to A. G. Ward (Queen's University, Ontario) for research in physics.

DURHAM.—The title of emeritus professor has been conferred on Prof. W. M. Thornton from the date of his retirement at the end of the session 1936-37. Prof. Thornton has been professor of electrical engineering since 1906.

Dr. Emrys Williams has been appointed lecturer in electrical engineering in succession to Dr. J. A. Wilcken, who has resigned, upon his appointment as assistant editor of *Science Abstracts* issued by the Institution of Electrical Engineers.

Societies and Academies

Paris

Academy of Sciences, June 28 (C.R., 204, 1909-1992).

ALFRED LACROIX: A new basaltic type, comparable, from the chemico-mineralogical point of view, with the feldspathic meteorites.

MME. HILDA GEBRINGER: Chance variables arbitrarily connected. Case of convergence according to the law of GAUSS.

FUMIMOTO MAEDA: Nuclei of the Fourier type.

LEON BESCHKINE: The general solution of rectangular plates (plane problems).

JEAN ROUBAUD-VALETTE: A generalization of the operation of Dirac.

GEORGES DARRIBUS: A new form without singularities of the electrodynamic of Born.

ALEXANDRE DUTOUR and FERNAND PRUNIER: The observation of the Sagnac phenomenon by an immobile observer.

JEAN LECOMTE, HENRI VOLKINGER and ARAKEL TOHAKIRIAN: The infra-red and Raman spectra of the chlorobromomethanes.

PIERRE MESNAGE: The molecular emission spectra of some metallic salts.

H. BIZETTE and M. SCHUBERT: Anomalies of the magnetic rotatory dispersion of sulphuric acid solutions of tellurium.

MAURICE COTTE: The calculation of the influence of the space charge in electronic optics.

JACQUES SOLOMON: The origin of the quadrupole moments of the atomic nuclei.

MAURICE DODÉ: The dissociation of native zinc carbonate, a reaction in which a mixed condensed phase intervenes.

RENÉ DELAFLAIE: The vapour pressure of gaseous saturated hydrocarbons at low temperatures in the presence of silica gel. Pressures are given for methane, ethane, propane, normal and isobutane at temperatures ranging from -26°C . to -171°C . Some quantitative separations of these hydrocarbons can be carried out by this method.

JEAN COURNOT and Mlle. LOUISE HALM: Studies on the corrosion of magnesium and some ultra-light alloys protected by deposits on the surface.

MME. LÉONIE WALTER-LÉVY: Magnesium basic chlorocarbonate.

M. LEMARCHANDS and P. PIERRON: The action of bromine on yellow mercuric oxide.

MAXENCE MEYER: The thermal decomposition of the α -diethoxydiacids.

JULIEN DURAND: The major irregularities of the crystalline country of Rouergue and of Albigeois.

RENÉ ABBARD and EDGAR AUBERT DE LA RUE: The existence of the upper Neogene with *Cycloclypous* at the islands of Epi and Malekula (New Hebrides).

EUGÈNE RAGUIN and HENRI VINCENT: An exceptional (hypothermal) type of lead-bearing deposit in the Montagne-Noire.

Mlle. JANE MANUEL: The sexuality of the principal species of the genera *Saccharomyces*, *Hansenula* and *Pichia*.

LOUIS BOUKOURÉ: The constitution of the genital glands in the russet frog after extensive destruction of the germinal line by the action of ultra-violet rays on the egg.

GEORGES CARRIÈRE, PIERRE JEAN GINESTE and EMILE LAINE: The action of the thyroid body on the thymus.

STÉPHAN JELLINEK: Cells with regular geometric deformations without traces of heat action. The action of ultra-short waves (6 metres, 500 watts) on the larvae of *Salamandra maculosa*.

Moscow

Academy of Sciences, C.R., 15, No. 3, 1937.

N. ACHYSEER and M. KRININ: The best approximation of periodic functions derived by summation of trigonometric series.

H. HILMY: The theory of quasi-minimal ensembles.

R. O. KUZMIN: The distribution of values of some arithmetical functions.

B. FESSENKOFF: (1) Eclipses of the moon and the distribution of atmospheric ozone. (2) The infinite universe and the luminosity of the night sky.

N. A. ŠIŠAKOV: An investigation of structures of silica glass, pozzolans and clays by means of electron diffraction (see also NATURE, May 29, p. 927).

S. ŠUBIN and A. SMIRNOV: The scattering of light by the electrostatic field of a point charge from the point of view of the non-linear quantum electrodynamics.

L. I. BELAJEV: Pseudo-extraction and some specific properties of films obtainable thereby.

M. I. DEMENTJEVA, A. V. FROST and E. K. SEREBRIAKOVA: Equilibrium hydrogenation of *n*-butylene to butadiene, $n\text{-C}_4\text{H}_8 \rightleftharpoons \text{C}_4\text{H}_6 + \text{H}_2$.

A. S. SEREBROVSKIJ: Analysis of the allobalance of a chromosome by two markers. Utilization of several quantitative characters simultaneously.

M. F. TERNOVSKIJ: Amphidiploid shoots of the F_1 hybrid *Nicotiana tabacum* L. $\times$ *N. sylvestris* Sp. et Comes.

V. P. OSTRAKOVA-VARŠAYER: *Galleria melonella* L. as a new material in genetical investigations.

O. J. SOBOLEVSKAJA and V. S. BUTKVIČ: Formation of citric acid in the makhorka leaf (*Nicotiana rustica* L.).

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
(NOTTINGHAM MEETING).

Sunday, September 5

At 8.15 p.m.—Prof. H. Hartridge, F.R.S.: "Illusions of Colour" (Public Lecture at Nottingham).

Monday, September 6

At 10 a.m.—Prof. D. Brunt, Dr. K. C. Lange, Prof. V. Vaisala: "The Upper Atmosphere" (Symposium: Section A).

Dr. Irving Langmuir, Dr. H. Eyring, Prof. H. S. Taylor, F.R.S., Prof. E. K. Rideal, F.R.S., Dr. J. F. Danielli, and Dr. H. J. Phelps: "Surface Action in Biology" (Joint Symposium: Sections A, B and I).

Prof. A. Plant, Prof. B. F. Shields, H. T. Weeks, H. G. Selfridge, jun.: "Retail Distribution" (Discussion: Section F).

Dr. W. B. Turrill, W. J. C. Lawrence, Prof. J. R. Matthews, Dr. T. J. Jenkin and Dr. J. W. Gregor: "Genetics and Taxonomy" (Discussion: Section K).

At 11.30 a.m.—Prof. H. Levi, J. Sargent and J. Wickham Murray: "Technical in Relation to General Education" (Discussion: Section L).

At 2 p.m.—Prof. P. M. Roxby, Dr. L. Dudley Stamp and Prof. C. B. Fawcett: "Culture Regions" (Joint Discussion: Sections E and H).

At 7.30 p.m.—T. M. Herbert: "The Transport of Food" (Public Lecture at Newark-on-Trent).

At 8 p.m.—Sir Gilbert Walker, F.R.S.: "The Mechanics of Sport" (Public Lecture at Derby).

Dr. J. E. R. Constable: "Science in Everyday Life" (Public Lecture at Long Eaton).

At 8.30 p.m.—Prof. J. Gray, F.R.S.: "The Mentality of Fishes" (Evening Discourse).

Tuesday, September 7

At 10 a.m.—Dr. R. E. Stradling, Dr. F. M. Lea, Dr. J. S. Dunn, F. H. Clews, H. H. Macey and Dr. G. R. Rigby, Dr. D. G. R. Bonnell: "Chemistry of Building Materials" (Symposium: Section B).

Prof. Winifred Cullis, Dr. H. Maceo, Prof. R. C. Garry, Dr. L. P. Lookhart: "Physiology as a Subject of General Education" (Section I: Discussion).

Sir John Russell, F.R.S., Dr. Winifred Brenchley, W. Davies, G. E. Blackman, and Mr. Martin Jones: "Pasture Problems" (Joint Discussion: Sections K and M).

At 8 p.m.—Dr. L. Dudley Stamp, Prof. H. L. Hawkins, F.R.S., Dr. J. S. Huxley, Prof. E. J. Salisbury, F.R.S., Sir Daniel Hall, K.C.B., F.R.S., Prof. J. H. Jones: "Planning the Land of Britain" (Joint Discussion: Sections C, D, E, F, K and M).

INSTITUTE OF METALS, September 6-9.—Annual Autumn Meeting to be held at Sheffield.

September 6, at 8.—Dr. D. R. Pye, F.R.S.: "Metalurgy and the Aero Engine" (Autumn Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT ENGINEER in the Research Department, Woolwich, S.E.18.—The Chief Superintendent (September 10).

LECTURER IN MINING ENGINEERING in the Denbighshire Technical Institute, Wrexham.—The Secretary and Director of Education, Education Offices, Ruthin (September 11).

CRIMINAL-ROBBER LECTURER IN PSYCHO-PATHOLOGY in the University of Aberdeen.—The Secretary (September 15).

JUNIOR LECTURER IN PHYSICS in the Military College of Science, Woolwich, S.E.18.—The Commandant (September 17).

DEMONSTRATOR IN CHEMICAL PATHOLOGY in the University of Leeds.—The Registrar (September 18).

STATE CHEMIST FOR IRELAND.—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (September 24).

ASSISTANT IN BIOCHEMISTRY in the University of Oxford.—The Whitty Professor of Biochemistry (September 29).

JUNIOR ASSISTANT in the Science Museum Library.—The Director, Science Museum, South Kensington, S.W.7 (October 4).

LECTURER IN PHYSICS AND MATHEMATICS in the College of Technology and Art, Rotherham.—The Director of Education, Education Office, Rotherham.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1936. Pp. v+235. (London: H.M. Stationery Office.) 3s. 6d. net. [118]

National Institute of Poultry Husbandry. Bulletin No. 13: Table Duck Production. By A. J. Macdonald and Joan W. T. Kay. Pp. 12. (Newport, Shropshire: Harper Adams Agricultural College.) [118]

National Advisory Council and the Grants Committee for Physical Training and Recreation. National Fitness, the First Steps. Pp. 24. (London: H.M. Stationery Office.) 2d. net. [118]

National Institute for Research in Dairying, 1912-1937. Twenty-fifth Anniversary Review. By the Staff of the Institute. Pp. 59+xxi. (Shinfield: National Institute for Research in Dairying.) [128]

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1764 (3500): On the Application to Tubular Frameworks of the Method of "Systematic Relaxation of Constraints". By Macdonald W. Woods and B. J. Warlow-Davies. Pp. 22. 3s. net. No. 1765 (3487): On Reynolds Numbers of Transition. By A. Fago. Pp. 12. 2s. net. No. 1767 (2706): Abstract of a Film Illustrating the Theory of Flight. By Dr. H. G. H. Townsend. Pp. 8+8 plates. 2s. net. No. 1769 (2718): Induced Drag due to Washout. By O. N. H. Lock. Pp. 5. 1s. net. No. 1773 (2628): Note on the Design of Corners in Duct Systems. By Dr. G. N. Patterson. Pp. 16+1 plate. 2s. 6d. net. (London: H.M. Stationery Office.) [168]

Graduate Employment: a Report of the 1937 Congress of the National Union of Students of England and Wales and the Preparatory Investigation for the Congress. Pp. 64. (London: National Union of Students.) Free. [168]

Department of Scientific and Industrial Research. Report of the Building Research Board, with a Report of the Director of Building Research for the Year 1936. Pp. vi+210+25 plates. (London: H.M. Stationery Office.) 4s. net. [168]

Ruskin and Brantwood: an Account of the Exhibition Rooms. By J. Howard Whitehouse. Pp. 44+8 plates. (Cambridge: Ruskin Society.) 2s. net. [168]

Other Countries

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102. Mededeelingen en Verhandelingen, 40: Het Klimaat van Nederland (The Climate of the Netherlands). P: Zonneshijns en Bewolking (Sunshine and Cloudiness). By Dr. C. Braak. Pp. 52. (* Gravenhage: Rijksoverheid.) 0.50 fl. [138]

Sudan Government. Agricultural Research Service. Report of the Government Chemist for the Year 1936. (Chemical Section, Publication No. 79.) Pp. 17. (Khartoum: Agricultural Research Service.) [138]

Latvijas Valsts Meteoroloģiskais Birojs (State Meteorological Bureau of Latvia). No. 3. Pēdējā divu 30 gadu periodu (1871-1900 un 1901-1930) vidējā gaisa temperatūru salīdzinājums (Mean Air Temperature Differences between last two 30 Year Periods). By J. Barot. Pp. 14. No. 4: Gaisa temperatūra Latvijā (Air Temperature in Latvia). Dala (Part) 1: Gaisa vidējā temperatūra (Mean Air Temperature). By J. Barot. Pp. 82. III: Meteoroloģisko novērojumu Gada grāmata (Meteorological Observations Year Book) 1936. Pp. 48. (Rīga: Latvijas Valsts Meteoroloģiskais Birojs.) [158]

Commonwealth of Australia. Council for Scientific and Industrial Research. Pamphlet No. 60: Observations on some Wool Samples from North-Eastern Asia. By H. Munn. Pp. 28+8 plates. (Melbourne: Government Printer.) [168]

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert, Mission G. F. De Witte (1933-1935). Fascicule 1: Introduction. Par G. F. De Witte. Pp. 39+22 plates. Les Parcs Nationaux et la Protection de la Nature. Pp. 88. Aspects de végétation des Parcs Nationaux du Congo Belge. Série 1: Parc National Albert. Vol. 1, Fascicules 1-2: Aperçu général de la végétation. Par W. Robyns. Pp. 43+12 plates. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [168]

City of Durban. Jubilee of the Durban Museum, 1887-1937. Pp. 30. (Durban: Durban Museum.) [168]

Archivos da Fundacao Getulio e Guinle, 1936-1937. Pp. 11+22+13 plates. (Rio de Janeiro: Rodrigues e Cia.) [178]

Catalogues, etc.

Dunns Seed Wheats, 1937. Pp. 22. (Salisbury: Dunns Farm Seeds, Ltd.)

Book Spectroscopes and Spectrometers. Pp. 16. (London: R. and J. Beck, Ltd.)

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Vol. 140

Research and Industry

IN his presidential address on September 2 to Section G (Engineering) of the British Association meeting at Nottingham, Sir Alexander Gibb took for his subject "Research and Engineering". He pointed out that engineering began as an art; at a later stage it developed into a somewhat scientific but purely empirical practice; and that it is now at the final stage of applied science. The same transformations may be noted in many other industries, though it must be admitted that there is still a great number of industries yet in the second stage of development, and some even in the first. Nevertheless, there is an increasing attention paid in industry generally—and not only in engineering—to the vital necessity of continuous research as being, to quote the words of Sir Alexander, "the only means of continuous progress in an increasingly competitive world".

Sir Alexander Gibb gave a necessarily brief historical survey of the rise and development of research, which is a plant of very recent growth. Apparently he regards the beginnings of the national recognition of the value of research as dating back to less than a century ago, when the Royal Commission was appointed to find uses for a surplus of £213,000, made by the Great Exhibition of 1851. The money was used to purchase land in Kensington Gore, on which were built museums and schools of art, and also to provide science scholarships. Government grants from 1850 onwards to the Royal Society and private donations or bequests went to aid research in mathematics, physics, astronomy, biology, chemistry and general purposes.

In Great Britain, throughout this early period, original research continued to be mainly the work

of individual scientific workers and was carried on chiefly at their own expense. Industry lagged far behind in its recognition of the value of scientific research, and it may be said, indeed, that it is only within very recent times that industry generally has accepted the view that scientific and industrial research is an essential factor in our industrial and national existence. It is also true to add that it needed the lessons of the Great War to open fully the eyes of the Government to the paramount need of systematic scientific research in our industrial organization.

Perhaps nothing in the development of the research movement is more significant than the way in which the distinction between pure and applied science, which was originally as sharp as the distinction between 'Gentlemen' and 'Players' at Lord's, has gradually lost its sharpness and become vague and indefinite. It is not so very long ago that, in many quarters, research into the internal structure of the atom was regarded as a noble and elevating pursuit of pure science, and research on soap as a rather ignoble, if not degrading, investigation—as though an atom were inherently dignified and became disreputable only when it was associated with other atoms to form the molecules of a homely, if necessary, commodity. Indeed, the artificial division between pure and applied science has dissolved perhaps most rapidly in the very laboratories which may seem, at first sight, to have been designed to buttress and perpetuate it. In industrial research laboratories, both at home and abroad, there is abundant testimony to the importance of 'pure science' research—what it is now the fashion to call 'fundamental research'.

The same recognition is a remarkable feature of the experience of those industrial research associations which have been formed under the aegis of the Department of Scientific and Industrial Research. Almost with one voice they are crying out that the time and energies and the expenditure involved—necessarily and rightly involved—in solving *ad hoc* problems of great and immediate importance to the respective industries, leave them with too little time and energy and funds to be devoted to that fundamental research which they recognize as equally vital to the progress of industry. The solution, let it be said at once, demands not the curtailment of one, to make possible the enlargement of the other, but adequate funds to enable both *ad hoc* and fundamental research to be pursued on a sufficient scale.

We may note here that Sir Alexander Gibb says: "There is what one may call true fundamental research—splitting the atom, or extreme low temperature investigation." Perhaps it is convenient to call such research fundamental. It is a little difficult, however, to see how "splitting the atom" is more "fundamental" than splitting the molecule in ordinary industrial cracking processes; or to understand why "extreme low temperature investigation", more than high temperature researches in, say, polymerization or hydrogenation, is "true fundamental research". However, the point is one of small importance. In all cases of so-called industrial research, the ultimate need is nothing less than the full available knowledge of all the factors involved, and these factors include as well those that may conveniently be regarded as 'pure' or 'fundamental' as those of immediate industrial importance. The real aim of industrial research, whether in engineering or in any other industry, should be to elucidate the scientific principles involved, to gain the scientific knowledge needed and to apply the knowledge, in so far as it can be applied, to industrial practice. To achieve these aims it may be necessary to undertake what is called pure or fundamental research, on one hand, and applied research, on the other. But, at bottom, these constitute essentially one research purpose.

Another feature noticed by Sir Alexander in his address is the degree to which, in later years particularly, co-ordination and co-operation in research have become recognized as essential. Sir Alexander quotes the remarks of Mr. Thomas Midgley on the occasion of the award to the latter this year of the Perkin Medal of the Society of

Chemical Industry: "In any earlier age, when science and industry were simply individualistic processes, it is conceivable that some person, by his efforts alone, could have advanced applied chemistry to have justified your Committee to bestow upon him the Perkin Medal. To-day this is no longer so; to advance applied chemistry, even a little, requires the organized efforts of many individuals." This is, of course, true also of industry and manufacture in general. The work undertaken by the various research boards of the Department of Scientific and Industrial Research, and the wide field of scientific and industrial research covered by the activities of the industrial Research Associations, all testify to the vital need to-day of co-ordination and co-operation in research. Scientific research is becoming less and less an individual effort and more and more a matter of team work.

Towards the conclusion of his address, Sir Alexander Gibb directed attention to the fact that, the greater the success of research, the more immediate and drastic is the effect on existing plant and equipment. He says: "Millions are necessarily sunk in fixed assets, which may in a year or two be made obsolete by the development of new methods", and he declares that many valuable inventions have been bought up by vested interests and suppressed, in order to save the greater loss that their exploitation would involve to already operating plant. This particular allegation has been made so often that it is difficult to believe there is not a good deal of truth in it. The lack of data of specific instances of inventions being purchased only to be promptly strangled is, however, a great handicap to any assessment of what the nation has lost and may lose by such a practice. Not many years ago, large commercial combinations were regarded with deep suspicion, as being nothing but price rings. But the findings of a Government inquiry into the extension of trade organizations and combinations did a great deal to allay public mistrust. The question arises whether a similar Government inquiry should be made into this alleged practice of smothering valuable inventions at, or soon after, their birth. It might turn out that the practice neither goes so deep nor is so widespread as popular impression allows. On the other hand, if such an inquiry should reveal a grave public mischief, appropriate measures could be taken. From every point of view, however, it is desirable that precise information should be available on this subject.

Cultural Basis of the History of Science

Famous American Men of Science

By J. G. Crowther. Pp. 414 + 12 plates. (London: Secker and Warburg, Ltd., 1937.) 15s. net.

SINCE the publication of Prof. Hesse's challenging discussion on the social background of Newtonian mechanics at the International Congress of 1931, there have been welcome indications of a new attitude which may do much to rescue the history of science from the disfavour or indifference of the majority of scientific workers. Prof. Wolf's book has made the famous woodcuts of Agricola's treatises on sixteenth century mining technology accessible to a wide circle of readers. The issue of Hooke's diaries and the reprint of the "Heads of Enquiries" have shed a new light on the early days of the Royal Society. Mr. Dickinson's admirable biography of Matthew Boulton has disclosed a mine of information about the scientific renaissance which accompanied the Industrial Revolution. Not least important of recent literature with this new orientation was J. G. Crowther's "British Scientists of the Nineteenth Century".

One of Mr. Crowther's reviewers compared the latter to Mr. Strachey's "Eminent Victorians". The comparison was a just one in so far as the faintly ironical flavour of the author's style placed it among the class of books which may be read painlessly. From another point of view it was less apt. Mr. Crowther is not a writer of footnotes or a biographer in the gentlemanly tradition. He has a vigorous and a unified point of view about the topics he handles. As Mr. James Branch Cabell used the romantic medium to satirize romanticism, Mr. Crowther uses the art of biography to put the individual in his place. That is not to say that he underrates the exceptional capabilities of the personalities he selects or discounts the magnitude of individual differences. What distinguishes Mr. Crowther's treatment from that of Prof. Lenard and a host of imitators who have raised the conventional cult of the scientific worthy to the status of a historical creed, is that he is pre-eminently interested in what circumstances of his situation enable a man of exceptional gifts to be trained in a particular way, how the conditions of his time canalize his curiosity into some specific and profitable channel and how his social circumstances provide him with instruments for solving the problems he tackles.

Great men do not come trailing clouds of glory from the abode where the eternal are. The human zygote—albeit well favoured with genes—does not

attain the stature of international eminence in a social vacuum.

"From the perspective of the history of science," says Mr. Crowther, "the question of personal priority is of no importance. The significant feature of Henry's great paper of July, 1832, is that the phenomenon of electro-magnetic induction was discovered, or about to be discovered, independently at about the same time in Albany, U.S.A., and in London, England. These events show that the progress of science depends far less than is generally believed on the efforts of individual geniuses. . . . As Henry and Faraday made the discovery almost simultaneously, it could not have been of such a unique nature that it could occur only to one investigator of supreme genius."

Mr. Crowther might have made a more topical hit by substituting genes for God when he writes:

"The traditional explanation of why the laws of gravitation were discovered in the seventeenth century is that Newton happened to be born then. As Pope wrote:

'God said: let Newton be, and all was light.'

According to this view, the light of gravitation would have been seen 'in 1665 B.C. instead of A.D. 1665, if God had chosen to let Newton be twenty-three years of age on the former date."

Mr. Crowther's new book, no less noteworthy than its predecessor, follows the same plan and traverses a less familiar terrain. Its four hundred pages are devoted exclusively to four studies: Benjamin Franklin, Joseph Henry, J. Willard Gibbs and Thomas Edison. It deals, therefore, with a longer period of modern science than its predecessor, and the individual portraits are more detailed. Though it appeared first in its American edition, we may anticipate a wider audience in Britain than in the United States. It abounds in incidents of social history less familiar to men of science in Great Britain than to educated Americans. The selection of personalities, though closely involved in the dominant themes of British science, do not include any representatives of the biological sciences, such as genetics, to which the American contribution has been specially noteworthy. It would be interesting to read what Mr. Crowther would have made of the initial impetus which American biology received from the expansion of agricultural technology during the latter half of the nineteenth century. To regret that he

has not done so is a tribute to, rather than a criticism of, the book as a whole. The range of Mr. Crowther's knowledge and the discrimination with which he writes encourages us to ask for more.

The social background of science is so complex that two writers might well handle the same period with great detail and very little overlapping. Some of the main issues which confront the historian of science may be summed up in the triadic formula familiar to readers of crime fiction. The tempo of scientific progress receives new *motive* power from new problems which arise in the technique of navigation, mining, agriculture and other forms of production. New technical amenities, such as the manufacture of cheap and abundant glass of high transparency or the production of cheap amplifiers, provide the *means* for tackling problems which have defeated renewed efforts in the past. New social machinery for the recruitment of a new fund of social personnel—schools and academies, organized professions and scholarships—make *opportunities* for enlisting talent in the solution of new problems. One of the advantages of the biographical treatment which Mr. Crowther follows is that it does not commit him to concentrate on any one aspect of the social background of science to the exclusion of others. At one moment he dwells on the special climatic conditions which favoured Franklin's work on atmospheric electricity. At another he examines the influence of railroad extension on American contributions to electrical communications. Throughout the book he sustains a keen appreciation of the interplay of commercial and professional preoccupations in providing the means of livelihood for scientific workers.

The interest of Franklin for the student of scientific history extends far beyond the fact that he brought the first electrical invention into economic use. The Philadelphia Academy is a halfway house between the Invisible College and organizations such as the Edinburgh Society or the Lunar Society of Birmingham. Franklin, whose interest in electricity was inspired by the work of Hawksbee, Gray and Watson, had close personal contacts with Priestley, Boulton and other notables of the Edinburgh and Birmingham circles. Mr. Crowther insists that his political career and his scientific interests were different facets in the same social pattern. The further advancement of science was then contingent on the rising social influence of the entrepreneur, and drastic political changes were essential to establish it. There is much in the history of the time to show that this view was shared by many scientific men. Both the Lunar Society, among whom Priestley was elected a member of the National

Convention and a delegate for the Department of Orne, and the Manchester Literary and Philosophical Society, when the elder Henry was one of its leading figures, sent official representatives to the Club of the Jacobins.

In the essay on Joseph Henry, first director of the Smithsonian Institution, Mr. Crowther's narrative puts the first beginnings of wireless communication in a new setting, and provides a useful corrective to reiterated emphasis on the cardinal incentive which Maxwell's theory is supposed to have supplied. Starting with Henry's experiments and Varley's lightning protector, the history of radio might well be rewritten from the record of workshop discoveries in connexion with microphone construction with much less reference to the parallel mathematical development of wave-theory.

Like Lytton Strachey, Mr. Crowther has the knack of selecting a situation which is ironical in its own right and needs no comment to embellish it. Such is the story of James Smithson, whose will provided for starting what Taft called "the incubator of American science". Such also are many of the well-authenticated incidents from Edison's history. The following is a sample:

"He made his first invention at Stratford when he was sixteen years old. Night operators were required to send hourly signals to show they were awake. He devised a clock which made the time signals automatically. This enabled him to sleep while on duty and preserve his energy for his own interests during the daytime."

When Edison started putting up telegraph lines between private business offices to exploit his alphabetical dial instrument, he himself says that they slung wires over the house-tops "without asking anyone's permission. Apparently they went to houses and stores which had already had wires supported by the roofs, and told the occupants they were the telegraph men and wanted to see the wires. They were always given permission to go up to them, and while there fastened up their own. This, apparently, is how it was possible for Edison, without any capital, to put up his own small centralised telegraph system in the center of a city. He did not pay rent for the wires slung over the property of others".

The importance of the new school to which Mr. Crowther belongs is that it gives the history of science a new cultural status. The future of scientific progress is not assured by its own momentum. In the past there have been Dark Ages. The recent exodus of scientific men from Germany shows that the prestige of science is more precarious than many would like to believe. In some small measure no doubt the choice between

progress and decay can be influenced by scientific workers as citizens equipped with understanding of agencies which decide the stability of a social culture. Only as an integral part of the story of man's social relationships can the history of science give them this understanding. As such Mr.

Crowther's book has a wide appeal and claims a large audience. Among men of science it should arouse a new sense of social responsibility. Among those who have received a humanistic education it should stimulate a new interest in science.

L. T. H.

Science and the Modern Highway

Principles of Road Engineering

By Prof. H. John Collins and O. A. Hart. (The Roadmakers' Library, Vol. 6.) Pp. xvi + 628 + 21 plates. (London: Edward Arnold and Co., 1936.) 50s. net.

ALL branches of applied science have made rapid progress during the last quarter of a century, and not least that of the science of road building. During this time, we have seen the transformation of our roads from the dusty and pot-holed surfaces of the horse-driven carriage and early motor age to the smooth and clean highways of to-day, and with it the very face of England has also changed in a way that at one time would have been deemed impossible. Physics, chemistry and geology have all been pressed into the service of the highway branch of civil engineering, so that it has been transformed from empiricism to something approaching an exact science.

Great Britain has so far lacked a treatise which deals clearly yet briefly with the principles of highway engineering; the book produced by Prof. Collins and Mr. Hart, linking as it does the more specialized works which form the "Roadmakers' Library" in such an admirable manner, is therefore peculiarly welcome. Its merits are well considered with respect to the series of which it forms a part, since this is intended in course of time to cover the whole field of roadmaking and at the same time to make some reference to present policy in Great Britain regarding the development of our highway system. Thus the taking over of the thousands of miles of trunk roads by the Government—only a proposal when this book was published—is now an accomplished fact, and we may perhaps have yet more far-reaching changes in policy, since the Trunk Roads Act of 1936 was criticized from the Government benches as not going far enough.

For years past, the vexed question as to whether Great Britain should have an entirely new road system, as in the case of Germany and Italy, or whether her roads should be improved by the process of widening, bridge construction and the making of by-passes, has been hotly debated. The latter represents the official view, and it is greatly to the credit of the book under review that it is

so designed as to be capable of use under either policy.

The book opens with a short, interesting history of the development of our present road system, rightly stressing the lack of foresight shown by those responsible. An account of the evolution of the various forms of surfacing follows, and the thorny subject of road accidents is dealt with in a very readable way, the necessary statistics being kept to a minimum. This part of the work leads naturally to a consideration of the factors affecting skidding, corrugation and noise, with an able treatment of economic considerations such as the relation between gradient, type of surfacing and running costs.

The principles of route location are illustrated by reference to the Ballachulish-Dochfour and the new Glencoe roads, the only important works of the kind which have been carried out in Great Britain since the Great War. The value of this part would perhaps have been increased if at least one foreign example of completely new location had been included, though the omission is understandable in view of our present policy of patching an old garment rather than investing in a new suit.

The geological section is clearly set out, the illustrations, here and in the other parts of the work, being most useful and well reproduced. It is unfortunate that the portion dealing with the use of local materials is quite inadequate. Great attention has been devoted to this matter in Canada and the United States, where geology has been applied to engineering problems in a way undreamt of in Great Britain, and a survey on these lines has been carried out in the case of the new Glencoe road, though not by official geologists.

Methods of carrying out preliminary, Parliamentary, location and construction surveys follow, and can be commended, though many readers will probably agree that Chapters ix and x, dealing with surveying proper, could with advantage have been omitted. It is to be supposed that all graduates in civil engineering will have covered the work given in these chapters in their university course, though this criticism may not apply to the matter dealing with aerial surveying. Surveying

for private streets is incompletely described, especially in view of the many legal and other difficulties which beset the paths of the local authorities responsible for the construction of many hundreds of miles of such roads yearly.

Horizontal and vertical curves, so important in view of the ever-increasing speeds of modern traffic, are covered in Chapters xi and xii, as is the subject of super-elevation, the variable super-elevations used in racing tracks being very properly condemned as being unsuitable for highways carrying mixed traffic. It is thought, however, that the two pages given to proving a formula used in work of this kind could well have been omitted and the space devoted to such common matters as the widening and improvement of highways, subjects which are not dealt with. The methods of lay-out of road junctions and crossings show the circular type of roundabout now favourably considered by the Ministry of Transport, though it is thought that one of the Y-junctions shown is capable of improvement. Earthworks, including the application of the valuable mass-haul curve, and drainage works, are well covered, though not all engineers will agree that the Ministry of Health formula for run-off gives satisfactory results, more particularly in the case of small areas of ground.

Road foundations and soil mechanics receive detailed attention, the work under the latter head comprising the results of researches not easily available to practising engineers. It is surprising to find no mention in this section of pitched or hard-core foundations, widely used in road con-

struction generally, while the description of construction of concrete roads would probably have been more useful had diagrams and photographs showing arrangements of forms and other such details, been included. The debatable question of reinforcement in concrete roads is treated from a rational point of view, since this problem still awaits elucidation.

Chapter xviii is disappointing, important surfacings such as water-bound macadam, tarmac and sett paving each being dismissed in a page, footpaths—so much to the fore at present—in a few lines, and the data regarding surface dressing are similarly brief. On the other hand, four pages are devoted to a somewhat arid report of the Metropolitan Paving Committee. It is also questionable whether the nine pages of condensed highway law given in Chapter xix are of much value to the highway engineer, especially since the series of which the work forms a part contains an entire volume on the subject. One also looks in vain in either this treatise or the series as a whole for a really good account of highway administration, dismissed in a few pages in the first volume, which in this respect somewhat belies its title.

It would be invidious to over-stress points of this sort in considering a work dealing, as its title states, with the principles of highway engineering, and the authors are to be congratulated on having encompassed so vast a subject in so comprehensive, readable and authoritative a manner. Their treatise can be justly described as a real achievement and a marked contribution to scientific knowledge.

B. H. KNIGHT.

Indian Hydro-electric Technics

The Hydro-electric Practice in India

By Prof. Bhim Chandra Chatterjee. In 2 vols. Vol. 1. Pp. xi+576+vi. Vol. 2. Pp. v+577-1168+vii. (Benares City: Shiva Narayan Chatterjee, 1936.) 50 rupees.

WRITTEN with an Indian purview by an Indian for Indian students, and produced from an Indian press, it is not altogether easy, nor perhaps quite fair, to judge these two substantial volumes by Western standards. The author is professor of electrical engineering at Benares Hindu University and he has had in mind the B.Sc. course for engineering students at that University, though his object has also been "to guide the engineers entrusted with the task of designing and constructing hydroelectric developments or reporting on their commercial success". He has illustrated the principles of his subject by

reference to current practice in the most important hydro-electric schemes of India. At the same time, he indicates that he has drawn freely from all sources of information; and data and a few particulars are given of installations in Canada, the United States and Great Britain.

This being so, it is a little surprising that in a "Comparative Statement of Dams in the World" (p. 832), the only American example quoted is the New Croton Dam (which, by the by, appertains to a water-supply reservoir) and no reference is made to the outstanding examples of water-power dams at Grand Canyon (Boulder Dam) Grand Coulee, Bonneville and other recent American enterprises, or to the Chambon Dam in France and others elsewhere. Furthermore, the use of the term "unprecedented" from a report (dated 1910) in connexion with the Cauvery River

(Mettur) Dam might dispose the reader, in the absence of comment, to infer that a height of 200 ft. or so combined with a length of 5,300 ft. constitutes something unique, whereas the Grand Coulee Dam, though not quite so long (4,300 ft. crest length), has the much greater height of 550 ft. Recent instances of this kind relating to dams of great magnitude should scarcely be overlooked in an up-to-date treatise.

The author certainly deals with his subject in full and commendable detail. He commences with a good chapter on the conditions, financial and economical as well as physical, under which a hydro-electric development project may be considered feasible. Then he proceeds expertly to the theoretical aspect of the matter, surveying the field of hydrology and hydraulics, explaining the nature and purpose of structural features and plant equipment, winding up with a section of 500 pages (nearly half the contents of the whole work) on hydro-electrical installations in India,

and a few notes on management. Among the installations described are the Tata, Cauvery, Kashmir, Mandi and Andhra.

There is, in fact, an immense amount of information comprised in the sixteen chapters of which the work is composed, a good deal of it quoted from various sources, with the limits of quotation not always clearly defined. The index is moderately good. The print is bold and readable, but a number of typographical errors are in evidence. The photographic illustrations might be clearer and some of the diagrammatic figures are blurred. The block on page 846 is upside down! In comparison with other publications of similar origin, the production is apparently up to Indian printing and book-binding standards, but there is certainly scope for improvement in these respects. Taken as a whole, the work should achieve its purpose as a serviceable manual for the Indian student, and, indeed, be of undoubted value for general reference.

B. C.

Keeping Pace with Physics

The Physical Society

Reports on Progress in Physics, Vol. 3. General Editor: Allan Ferguson. Pp. iv+394. (London: Physical Society, 1937.) 20s. net.

THE annual output of papers in physics, including certain branches of electrical science, is at least six thousand. Few if any libraries contain all the original journals, and the time taken up by research, teaching and administration leaves far too little for the physicist to deal unaided with the bulk and diversity of published papers. Monthly classified abstracts are given in *Science Abstracts* and in *Physikalischen Berichte*. The subscriber to these journals receives each month about 480 fragments of physics in the making, from which he selects the few relevant to his own work and uses them as a guide to the original papers. Some kind of co-ordination of the results of the remainder of papers is needed by all who wish to keep pace with current physics.

The Physical Society's "Reports" are designed to cover most branches of physics at yearly intervals, and some special topics after longer periods. This third volume maintains the high standard of the two previous volumes without quite solving the two difficult problems of uniformity of treatment and freedom from overlapping. For example, sound is covered by an excellent 24-page article giving 78 references. The following article on the measurement of noise occupies 13 pages, gives no references, is written

in the style of an advanced popular science lecture and overlaps the sixth section, technology, of the previous article. Each article is excellent of its kind, but the standard of previous knowledge needed to read the two is quite different. The overlapping is no mere repetition, but is wasted when the volume is used for reference, as there is no index. Contributors, unable to meet and discuss, cannot be held responsible for these two characteristics of the reports, but an editorial committee could perhaps help by issuing more detailed instructions formulated to guide the individuals.

Since the reports can be prepared only by experts, any avoidable overlapping is a waste of part of the world's science man-power. From this broader point of view overlapping with independent publications is also to be avoided. For many years the Chemical Society in its "Annual Reports" has issued excellent reports on crystallography. Why then has another group of workers been set the task of preparing for this volume another independent report in which the same subject is covered, as it happens, less adequately? The Chemical Society "Reports" deal also with radioactivity and sub-atomic phenomena. If it be urged that the reports are prepared from different points of view, it may equally well be urged that if physical aspects of phenomena are relevant to chemistry, then chemical aspects are relevant to physics.

At present, to keep pace with physics it is necessary to consult the "Reports" of the Physical

and Chemical Societies, the *Reviews of Modern Physics*, *Chemical Reviews* and *Die Physik*. With the persistence of the Government restrictions placed upon science, German periodicals will become less and less important. To avoid duplication it is therefore necessary to secure co-operation between only English-speaking societies.

The Physical Society is already broadminded enough to adopt in its *Proceedings* an indexing system designed to help in the international co-

ordination of knowledge. Is it too much to hope that the Society will also try to secure the co-operation necessary to present an annual report holding a unique position in journals published in English? Even the present "Reports" are indispensable in any science library, and readers are heavily indebted to the many individual contributors who have had to sacrifice some of their research effort to carry out the arduous task of digesting hundreds of research papers.

W. H. GEORGE.

Light in the Service of Man

Allgemeine Photochemie:

ein Hand- und Lehrbuch für Studium und Forschung für Mediziner, Biologen, Agrikulturchemiker, Botaniker, usw. Von Prof. Dr. J. Plotnikow. Zweite, umgearbeitete und erweiterte Auflage. Pp. viii + 909. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.) 28.50 gold marks.

PROF. J. PLOTNIKOW, who has considerable experience in theoretical and applied photochemical research, has dealt with different aspects of photochemistry satisfactorily in this treatise under notice. He has divided the subject-matter into four sections, namely: (1) sun and mankind; (2) interaction of matter and radiation energy; (3) statics and dynamics of light reactions; (4) different reactions caused by light.

In the first section, the characteristic properties of different radiations (for example, infra-red, visible, ultra-violet, etc.) and the problem of sight are described in detail. In the same section, the subject of nutrition in the future has been considered in an interesting manner from the point of view of the photochemist. A brief historical account of the development of photochemistry from ancient times appears at the end of this part.

In the second section, the laws of light absorption, reflection and scattering, the phenomena of fluorescence, phosphorescence, bioluminescence, etc., the laws and mechanism of photochemical reactions, temperature coefficient, quantum yield and allied problems, are discussed. It is interesting to note that the summary of quantum yields of different photochemical reactions recorded on pages 230-231 shows that the Einstein law of photochemical equivalence fails in the majority of reactions investigated so far. This fact has also been emphasized by the reviewer.

The mathematical aspect of photochemistry is considered in the third part of the book. The experimental technique of photochemical reactions, which has been considerably developed by Prof. Plotnikow and co-workers, is also discussed in this

section. Cases of photochemical catalysis and equilibrium and the relation between the intensity of the incident radiation and the velocity of photochemical reactions have also been included.

In the fourth part, the author describes briefly numerous photochemical reactions involving inorganic and organic compounds. Most of the literature in photochemistry has been condensed in this section, which also contains a good account of the mechanism of photosynthesis in plants and the function of chlorophyll. Photolysis and photo-oxidations are also adequately considered. At the end, work on the sensitization of photographic plates and films to various parts of the spectrum is summarized: to the infra-red radiation by neocyanine, kryptocyanine, xenocyanine, etc.; to red by dicyanine; to orange red by pinacyanol, nigrosin, chlorophyll, etc.; to orange by pinachrome, cyanine, orthochrome-T, methyl violet, ethyl violet, etc.; to blue green by uranine, acridine yellow, etc.; to ultra-violet by sodium salicylate (alcoholic solution), 'Vaseline' (acetone solution) and other fluorescent substances. A brief account of the phenomenon of desensitization of photographic plates and films with phenosafranine and allied compounds discovered by Lüppo-Cramer has also been included.

As light is utilized in the production of food materials in plants, in nitrogen fixation and in other processes in the soil, in photography, in the production of vitamin, in the treatment of disease and in the preservation of health, in the large-scale sterilization of water and milk, in the detection and testing of different materials, etc., photochemistry is of necessity engaging the attention of numerous workers all over the world, and several important books on this topic have recently been published. The present comprehensive work by Prof. Plotnikow is a valuable contribution to knowledge and should be widely read by chemists, physicists, biologists, agriculturists, medical men and others interested in this subject, which has great possibilities.

N. R. DHAR.

Soil Erosion and its Control

By Prof. Q. C. Ayres. (McGraw-Hill Publications in Agricultural Engineering.) Pp. xi+365. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 21s.

ONE of the effects of the recent world depression has been to focus attention on problems of soil erosion. This has been the case particularly in the United States of America. The preceding years of high prices had led to a rapid expansion of mechanized farming, thereby reducing the man-power required to farm arable land. So long as prices ruled high, little notice was taken of the diminishing returns obtained from such expansive and continuous cropping, but as soon as the bottom fell out of the market, farmers discovered, almost overnight, that they could no longer carry on.

It was soon made clear that this was largely due to soil erosion and that the damage thus caused was increasing at an alarming rate. Whereas in 1910 it was estimated that ten million acres of farm land were ruined and abandoned, this figure had increased by 1935 to between thirty-five and fifty million acres. For years previously that "tireless little band of erosion technicians" to whom this book is dedicated, had been as a voice crying in the wilderness, and it required the effects of the depression forcibly to bring the position to the notice of the administration, which lost no time in forming this band of workers into the nucleus of a Soil Conservation Service. This Service, besides continuing research, was able to find employment for large numbers of farm workers and other unemployed in an endeavour to control soil erosion.

Since the initiation of this Service, much has been published in the form of bulletins, leaflets, etc., on soil erosion and its control. The author of the present work has collected and arranged this information under suitable headings, and the diagrams, tables, charts and numerous illustrations add much to the value of the text. Though based entirely on American experience and American farming conditions, the book should prove of value to those in other lands where somewhat similar problems and circumstances prevail.

Revisiting my Pygmy Hosts

By Paul Schebesta. Translated from the German by Gerald Griffin. Pp. 288+31 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 18s. net.

AFTER two visits to the pygmies of the Congo in 1929 and 1930, Dr. Schebesta found himself constrained to pay them a third visit to obtain supplementary data. On this occasion his objective was in the area of Lake Albert and his hosts the Bambuti, as they call themselves. He has thus completed the tour of both the eastern and the western pygmies.

In this story of his sojourn among the little people of the forest, the author has purposefully omitted any formal account of organization and culture where it does not differ from that described in his earlier work. Here again negroes and pygmies live in a relation in which each supplies something lacking in the economy of the other. The negroes need meat

and the pygmy hunter supplies it: in turn, the pygmy needs bananas and vegetable produce, which is obtained from the negro gardens lacking in the pygmy culture.

Dr. Schebesta's lively picture of his relations with his pygmy people affords his readers an opportunity of appreciating their mentality. He has also taken full advantage of his informal method of description to demonstrate the actual working of their social and cultural organization and their magico-religious beliefs. The author is more than ever convinced that the culture of the pygmy is of purely forest origin, and that they are its aboriginal inhabitants.

Exercices d'analyse

Par Prof. Gaston Julia. Rédigés par Dr. Georges Bourion. Tome 4: Équations aux dérivées partielles du premier ordre. Pp. v+230. (Paris: Gauthier-Villars, 1935.) 60 francs.

THIS is the author's fourth volume of exercises in analysis. It is devoted mainly to partial differential equations of the first order, and consists of a discussion of some 55 problems taken from examination papers set at the Sorbonne for the Certificate in Calculus and from Part II of Édouard Goursat's "Course in Mathematical Analysis". The questions selected range from total differential equations to be solved by Bertrand's method, to simultaneous systems and problems in geometry involving partial equations. The solutions are not only complete, but also are characterized by their clarity and elegance. In nine cases, alternative methods, geometrical and analytical, are considered, whilst problem 53 is provided with three solutions. Relevant extensions, particular cases and applications are also indicated wherever possible.

To teachers and students of differential equations, this book should be extremely valuable.

F. G. W. B.

A Marriage Manual:

a Practical Guide-Book to Sex and Marriage. By Dr. Hannah M. Stone and Dr. Abraham Stone. English edition edited, and with an Introduction by, Michael Fielding. Pp. 352. (London: Victor Gollancz, Ltd., in conjunction with John Lane, The Bodley Head, Ltd., 1936.) 7s. 6d.

THE admirable little work by Dr. Hannah M. Stone, medical director of the Birth Control Clinical Research Bureau of New York and Marriage Consultation Centre, and Dr. Abraham Stone, surgeon to the Sydenham Hospital and director of the Marriage Consultation Centre, is written in the form of imaginary conversations between a physician and a young couple about to be married. The subjects on which the pair seek enlightenment are fitness for marriage from the psychological, sexual and eugenic points of view, the anatomy and physiology of the sexual organs, fertility and sterility, prevention of conception, venereal diseases, the art of marriage including the technique of coitus, psychical and somatic incompatibilities and health in marriage. A bibliography of recent English and American literature is appended.

Noise and the Nation*

By Dr. G. W. C. Kaye, O.B.E.

SIMULTANEOUSLY with the remarkable growth of applied acoustics, there has gradually developed in Great Britain a public consciousness of the insidious growth of the social evil of needless noise—a pernicious by-product attributable in great part to an increasingly mechanized civilization. With this growing realization, the nation is beginning to demand and to receive protection against the nuisance of outrageous noise whether generated by private or public bodies. It is looking for ways and means of mitigating excessive transport noises, particularly on the road and in the air, and it is seeking to know why in modern houses or flats it should not be accorded adequate privacy against the natural, though sometimes unreasonable, noises of neighbours.

THE MEASUREMENT OF NOISE

It is common knowledge that most noises are complex in character, containing a variety of components which may be distributed over the entire auditory ranges of frequency and intensity. Such a physical constitution lends itself to objective measurement and analysis, but apart from the psychological aspects, there are subjective factors of prime importance to the listener, namely, pitch, timbre and loudness, and these sensations are not readily appraisable. Experience indicates, however, that while the composition of a noise is not to be ignored, sheer loudness is the determining factor in most cases of annoyance caused by noise, so that the problem largely resolves itself into the correlation of the sensation of noisiness (as assessed by the ear) with the associated energy, which can be quantitatively measured by physical instruments.

Let us first consider the measurement of acoustical energy. For the purpose, we need an intensity meter, this commonly consisting of a microphone and amplifier together with a suitable rectifier and indicator. Moving-coil or ribbon microphones are sometimes employed, though for fundamental work the condenser or the crystal microphone is preferred despite the lower sensitivity. Whatever the microphone used, it is usually calibrated by direct interchange comparison under appropriate

conditions with a standard (pressure) microphone of the condenser type, which in turn has been fundamentally calibrated in absolute units by means of either the Rayleigh disk or the piston-phone.

The Rayleigh disk depends for its operation on the tendency of a small thin glass disk suspended from its edge by a fine fibre to set itself at right angles to a sound field. The torsional constants of the system and the degree of deflection of the disk afford the sound particle velocity, the corresponding sound pressure being calculable from the known relations in the field. The measurements are made either in a stationary-wave pipe or in a room with highly absorbent walls.

The piston-phone, which measures sound pressures directly, consists essentially of a small cavity, one face of which is closed by the diaphragm of the standard microphone, the opposite face consisting of a small piston connected to the moving coil of a loudspeaker unit. The amplitude of motion of the piston, when it is set in vibration, is measured optically and enables the corresponding sound pressures in the cavity to be calculated.

So much for intensity measurements. As regards the associated loudness levels, we turn to auditory diagrams of the ear, such as those of Fletcher and Munson. The various loudness contours for pure tones of different frequencies show that while loudness and energy are manifestly related, the two do not normally keep in step, particularly for notes of very high and very low frequencies. At feeble intensities, the ear exercises pronounced selective preference for notes of medium frequency, and it is only at high intensities that equal increments of energy produce even approximately equal increments of loudness. Furthermore, the thresholds of hearing are much higher for high and low frequencies, so that the corresponding ranges of intensity with which the ear can deal are more restricted than for notes of medium frequency. The situation is worsened in the case of complex sounds or noises since the loudness is affected by their character, there being in general no simple relation between the loudness of a noise and the energy-loudness characteristics of its several components. It is evident that an energy meter, such as a microphone system, cannot unreservedly be used as a direct measurer of loudness.

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THE DECIBEL AND THE PHON

The next step in the measurement of noise is to equip ourselves with units and standards of loudness. In this connexion, we have to cater for the enormous intensity range of the ear, particularly for notes of medium frequency, where the greatest intensity that can be tolerated (the threshold of pain) is some 10 million million (10^{12}) times that corresponding to the threshold of hearing. In such circumstances, we turn, as always, to a geometrical rather than an arithmetical scale, and the unit adopted for the purpose is the *bel*, which is a ratio signifying a 10-fold increase in intensity, power or energy. Two bels signify a 100-fold increase, three bels a 1000-fold increase, and so on.

Equipped with such seven-league boots, and starting at a zero approximating to the threshold of hearing, we can traverse the entire auditory intensity range for a medium-frequency note in as few as thirteen geometrically progressive steps. But the steps are too big for practical convenience and so it is usual to speak of a range of 130 *decibels*, which provides a serviceable energy scale. Arithmetically, a decibel (db.) denotes approximately a $5/4$ energy increase (that is, antilog $1/10$), two decibels a $(5/4)^2$ increase, three decibels a $(5/4)^3$ = a 2-fold increase, . . . 10 decibels a $(5/4)^{10}$ = a 10-fold increase, that is, a bel. More generally, two similar sounds of intensities I and I_0 and corresponding acoustical pressures p and p_0 are said to differ in intensity by n decibels when

$$n = 10 \log_{10} (I/I_0) \\ \text{or } n = 20 \log_{10} (p/p_0)$$

If I_0 or p_0 corresponds to some selected zero, then n becomes the number of decibels above that zero level.

Thus provided with an acoustical intensity scale, we can proceed to set up a loudness scale which is based on the accepted ability of the average individual to compare and match loudness. To this end (just as in photometry we make use of a standard candle) we need a standard sound; and for the purpose a pure reference tone is chosen, which, on the British Standard Scale, has a frequency of 1000 cycles per second. We also require a zero of loudness at or near the threshold of hearing, and this is arbitrarily adopted as corresponding to a pressure of 0.0002 dyne per sq. cm. If now we operate the reference tone by successively increasing decibel steps of energy, the associated changes of loudness are expressed in numerically identical steps on a scale of *phons*. That is, if the reference tone is excited by an intensity of n decibels above the zero, the loudness is n phons. The equivalent loudness of any other sound or noise is evaluated by matching it by ear

under specified conditions against the suitably adjusted reference tone, the numerical value of the latter in phons then giving the equivalent loudness of the sound to be measured. Thus by this procedure we have set up a subjective scale of equivalent loudness, the unit being the phon.

It happens that a phon corresponds roughly to the smallest difference of loudness which can be detected by alternate listening, in the case of a sound of medium frequency and moderate loudness. Experience shows, too, that for many loud noises of common occurrence the loudness level in phons is approximately equal to the intensity level in decibels—a convenient relation for many purposes.

A number of different zeros of loudness have unfortunately been employed in the past; for example, 1 millidyne per sq. cm., which results in numerical values of loudness some 14 phons less than with the British Standard zero. In Germany the phon is based on a zero of 0.0003 dyne per sq. cm., which is equivalent to a 4 db. difference from the B.S. zero. As, however, a different method of listening is employed, the slight discrepancy between the two scales is not known exactly. The American scale agrees with the British, except that in the United States it is customary to use the decibel not only for expressing intensity measurements, but also for loudness levels, it being implied in the latter case that the decibel figure quoted refers to the energy level (above the arbitrary zero) of the standard tone when it matches the sound to be measured. As already mentioned, the British Standards Institution recommends that for greater clarity the decibel should be restricted to energy ratios; and in its definition of the phon, the Institution kept open the way for eventual international agreement on the unit of equivalent loudness.

Happily such agreement came about at an international conference held in Paris last July, when it was unanimously agreed that the decibel and the phon should be adopted respectively as international units of intensity level and equivalent loudness, full agreement being secured on questions of the reference tone (1000 cycles per second), the reference zero (0.0002 dyne per sq. cm.) and the technique of listening. All these matters are in accord with the definitions in the acoustical glossary of the British Standards Institution.

NOISE METERS

Subjective noise meters.—Subjective noise meters depend on the equality matching of the loudness of a noise, as heard by the ear, with a reference tone (usually a pure tone of specified frequency and of graduated intensity) as heard in a telephone

earpiece held tightly against one ear. The reference tone may be produced by an electric buzzer, valve oscillator or other means, various frequencies (for example, 1000 or 800 cycles per sec.) or mixed tones being used in commercial instruments. The usual Barkhausen technique involves simultaneous listening to the noise and the reference tone, but experience indicates that inconsistencies which are found to arise in aural measurements under such conditions are largely resolved when the two sounds are heard alternately for periods of not less than a second. Such a technique has been

unexpected or single impulsive sounds, the aural assessment presents great difficulties to the average observer.

Objective noise meters.—The problem of the designing of objective sound and noise meters, which has received much attention both in Great Britain and abroad, is of considerable complexity. The ideal aimed at by objective meters is to be able to measure every type of sound and noise on the subjective scale of phons, that is, to simulate the selectiveness and response of the average ear in all circumstances.

Approximate loudness levels of common noises.

BS Loudness scale of phons

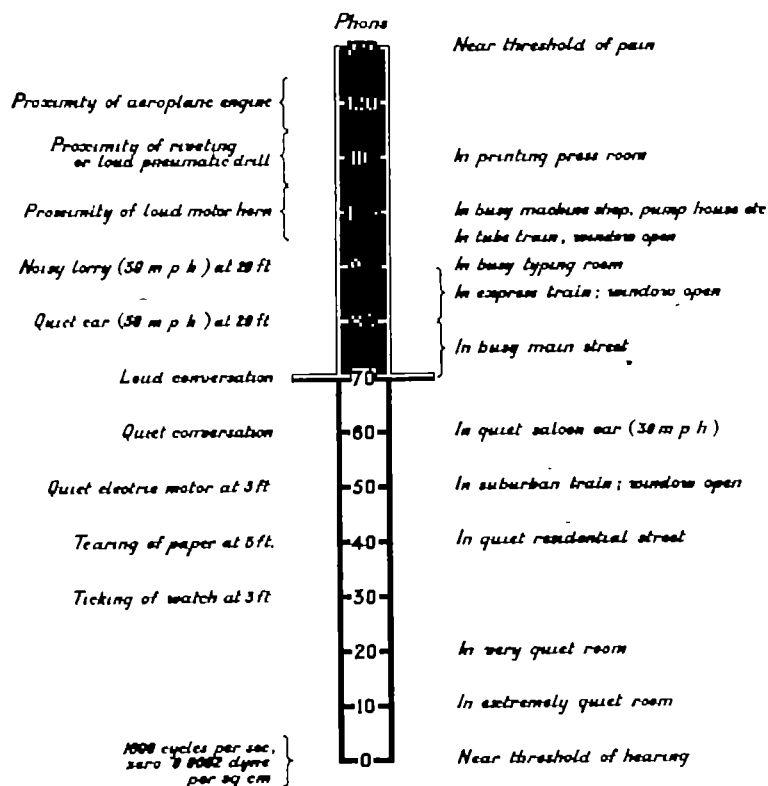


Fig. 1.

facilitated by Churcher in a subjective meter employing two earpieces, so that either the noise or the reference tone can be heard in turn using both ears simultaneously.

Subjective meters are useful for certain purposes, but the aural judging of equality of loudness of the reference tone and of a noise very different in character is not always easy. Observers are found to differ widely in their judgments, and the same individual is not always consistent. The accuracy of appraisal of a single observer is normally low (say 5 phons), and a team of trained observers is essential for higher precision (say 2 phons). In the case of

sounds, the inertia of the instrument has to be of the right order to give readings corresponding to average aural appraisal.

There can be little doubt that the future of sound or noise measurement, from a practical point of view, lies with the objective meter. Even in its present state of development, its practical convenience often outweighs its limitations. It is free from personal bias, rapid in action and direct reading, and can be put into the hands of an untrained observer. Furthermore, as a dial instrument, it is well adapted to the enforcement of regulations or specifications.

The various objective meters on the market all consist essentially of a pressure microphone connected to an amplifier provided with calibrated control, followed by some type of rectifier and an output indicator. As a first essential, objective meters are constructed to give the same reading for a range of steady pure tones which sound equally loud to the ear whatever the frequency. This is achieved by introducing into the amplifier electrical networks designed to modify the shape of the frequency characteristic so that it imitates the ear sensitivity at selected loudness levels. If the network is omitted, the meter measures intensity levels. Objective meters should be further designed to simulate the salient characteristics of the ear in dealing with either steady or impulsive sounds. For example, the ear does not record full strength until a steady sound has persisted for about one-fifth of a second, and in the case of pulsating

NOISE-LEVEL MEASUREMENTS

In connexion with problems of noise abatement, the National Physical Laboratory has made measurements and analyses of many noises of very varied origin. The positions which some of these noises occupy in a scale of phons are shown in Fig. 1, the upper half of which includes various noises the abatement of which would be acceptable in many circumstances. This is illustrated by the homely test which most of us apply as a test of background of noise, namely, the ease with which conversation is possible. At 60 phons, conversation is 'comfortable'; at 90 phons, difficult; and at 110 phons, virtually impossible.

Among the noise problems on which the Laboratory has been consulted in recent years, are the mitigation of the noises associated with aeroplane cabins and engine-testing factories, trains, ships, tube railways, buses, motor horns, pneumatic drills, printing works, transformer substations, cathedrals, assembly halls, business offices, flats, miniature rifle ranges, building operations, and so on. Assistance is also being given in connection with the Home Office experiments on air-raid warnings.

The loudness of a noise depends, of course, on its remoteness and to a less degree on its environment. The inverse square law appears to be followed fairly exactly in the open for average sounds such as those of motor vehicles. In a room or a tunnel, the law does not hold and a noise sounds louder than it would outside, owing to the building up of the sound level by multiple reflection. Similar conditions prevail in a narrow busy

street and contribute to the noise discomfort of the occupants in the upper stories, though to a pedestrian the noise of, say, a passing car is but little louder than in an open space. Incidentally, drivers of cars are familiar with the sudden access of high-pitched components from the engines, exhausts or tyres of their cars as they pass reflecting walls or fencing or even minor way-side objects such as tree trunks or telegraph poles.

One has also to remember that the path of a sound may appreciably modify its composition. For example, the high-frequency components may be abnormally reflected or absorbed as compared with lower notes which tend to pass through or round obstacles. Even in the open, a hedgerow or a barrage of trees may, to a limited extent, so serve as a muffler of traffic noise. The high-pitched components of a sound may further be selectively enfeebled in passing over different types of ground, for which the sound absorption may be three or four times as much for high notes as for low. To judge by experience, the absorption figures for newly fallen snow must be rather high, though I am not aware that they have been measured. High-frequency components may also be selectively absorbed by the air itself if it is humid. Knudsen has shown that the effect is due to interaction between the oxygen and water molecules, the nitrogen playing no part. Incidentally, he estimates that if we lived in an atmosphere of oxygen at a humidity of about 20 per cent, the high notes of the violin and piccolo would be completely inaudible 50 yards away.

(To be continued.)

The Sex Ratio*

By Prof F. A. E. Crew

THE subject of the numerical proportions of the sexes in a population necessarily appeals to so many interests that it is not surprising to find that considerable attention has been paid to it. But so complicated are the problems that cluster around it that even yet our understanding of the significance of the sex ratio is still very incomplete. Recent developments in cyto-genetics have removed many of the difficulties that have surrounded this subject, so that it is possible now to re-examine the problem more hopefully.

The Registrar-General's Report for 1935 shows that the secondary sex ratio was 105:100; that

the sex ratio among those babies who died during the 7th-9th months of intra-uterine life was 110:100; that there is a remarkable swing in the sex ratio, a numerical preponderance of males amongst the earlier age groups of the population giving place to a numerical equality of the sexes amongst the 15-19 year olds, whilst amongst the 20-24 year olds the females actually begin to outnumber the males; and thereafter, as age group succeeds age group, this female numerical ascendancy progressively increases until, among the 85's and over, there are more than twice as many women as men.

This swing in the sex ratio from high to very low is shown to be the result of a sexually selective

* From the presidential address for Section D (Zoology) of the British Association, delivered at Nottingham on September 2.

mortality, for the mortality tables make it clear that at all ages relatively more males are removed from the population by death.

A consideration of these and similar facts ultimately leads to the conclusion that in the case of man, for some reason or other, the male, in virtue of his maleness, is less viable than the female, and that, in unfavourable circumstances, both pre-natally and post-natally, the male, because of this greater inherent fragility, suffers more easily and more severely than does the female, and is removed from the population by death in greater numbers. Furthermore, since this selective elimination of the male occurs before, as well as after, birth, it follows that the primary sex ratio is probably considerably higher than the secondary sex ratio.

A comparison of the secondary sex ratio in different countries, in town and country, as affected by migration, amongst legitimates and illegitimates, amongst whites and coloured, living under the same conditions, in different social strata, and in its relation to infantile mortality would seem to show that the whole course of sex mortality in pre-natal life, in infancy, and in all subsequent age periods is consistent with the view that the male in man is the inherently weaker sex, more prone on account of his relative constitutional weakness to developmental anomalies, to congenital debility and to death from diseases of all kinds.

Male must be contrasted with female in an attempt to discover the cause of this, and a study of the sex ratio in other mammals, birds and insects, wild and domesticated, both in the open and under the controlled conditions of experimentation, must be made, for, in this matter of the sex ratio, to know only man is to understand nothing.

Male differs from female in genetic constitution. In the case of man the male is the heterogametic sex. This being so, it follows that in the homogametic female a mutant recessive gene in one X can be cancelled out by its wild-type dominant allele in the other, whereas the same recessive gene in the single X of the heterogametic individual is unchecked and unrestrained and is expressed to produce its full effect. Upon this firm basis of ascertained fact, the sex-linked lethal theory, which seeks to account for the sexually selective mortality and the swing in the sex ratio, has been built.

It is clear that genetic lethals exist in considerable numbers in all animal and plant stocks that have been subjected to genetical experimentation. They are genes which can be mapped and which have an effect upon the secondary sex ratio that can be predicted. But since differences in chromosome

constitution may imply more than a difference in respect of sex-linked lethals, they may also mean a difference in genic balance. It may be that this difference is itself the cause of unequal mortality, though it is difficult to regard the male as being less well-balanced genically since he has endured as long a course of selection as has the female, and it would be expected that dosage compensation would ensure a proper balance in each sex regardless of dosage ratios.

There are other genetic differences between the sexes which are sex-limited and not sex-linked. It is established that many defects and derangements in man, formerly regarded as recessives, are partial irregular dominants, and that many of these are more often and more completely expressed in the male than in the female. Many characters previously regarded as sex-linked are now known to be sex-limited, being expressed only in the male.

There are other differences, metabolic and physiological, which quickly appear in development and which give rise to endocrinological differences which, when once established, take charge of the further differentiation and the maintenance of sexuality in the higher forms. The initial genetic constitution would seem to determine which of two alternative types of differentiation shall occur and, with the incoming of the gonad and the rest of the endocrine system, maleness or else femaleness becomes finally and firmly established. These two states are to be distinguished by sustained differences in oxidation rate. Experiment has shown that the higher metabolic rate of the male renders him less resistant to unfavourable conditions and more prone to death.

A survey of what is known of the sex ratio amongst livestock and laboratory animals shows that, in general, the male amongst them shares with the male of man a relative frailty and endures a selective elimination both before and after birth.

The figures for birds are somewhat confusing. As a whole, they seem to show that it is the heterogametic sex (the female in birds) upon which death falls more heavily pre-natally. If this is so, it can at once be decided that in the heterogametic mechanism itself a factor of importance is to be found.

As a general rule, the males of all groups, except those derived from wide crosses in which genic balance is more likely to be unusual, appear to show a relatively low viability, irrespective of their homo- or heterogamety, and the difference in the death rates of the sexes appears to be as much correlated with sexuality itself as with any particular type of chromosome or gene equipment. That this should be so is perhaps not surprising

when the relative reproductive values of the sexes are compared. The major task of one generation of gamete producers is the production, economically and efficiently, of a succeeding generation that numerically will be in harmony with the conditions and resources of the habitat. That of the females of a generation is the production of the requisite number of ova; that of the males the production of spermatozoa in numbers sufficient to make the fertilization of every available egg highly probable. The number of spermatozoa required will be determined by many factors—for example, the variety of the fertilization process, the pre-natal and post-natal relations of mother and offspring, the relationship of male to female in respect of parentage. If the male is merely a fertilizing agent, then economy and efficiency are observed if the male dies *in coitu* or is for other reasons shorter-lived than the female, so long as there are more or less equal numbers of males and females of the age when fertilization occurs. If the male is concerned with the protection of and food-finding for the female and her young, then the length of life of the male might be expected to be related to the duration of the period of dependency of the young upon the parents and of the female upon the male, and it might reasonably be assumed that when the male has served his purpose he would be removed so that savings in food energy could be effected and used for further reproduction.

Reference has already been made to the fact that in the Registrar-General's Report for 1935 the sex ratio most nearly approached equality amongst those in the population aged 15–19 years. In the Report on the Census of Scotland, 1931, table 31, vol. 2, it is seen that in this human population, though between the ages of 0–14 there were more males than females and between the ages of 20–100 there were more females than males, the sex ratio of those in the population between the ages of 15 and 19 years was equality. It can be stated, therefore, that in the case of these human populations, the sex ratio is equality only amongst those who stand at the threshold of their reproductive prime. This fact is surely not without significance. The age group in which the sex ratio is equality consists of those who, biologically if not socially, are newly equipped for ardent reproduction. Amongst them there is no surplus: there are equal numbers of males and females. If, during the biological evolution of man, pair-mating attached to itself a definite and positive value, it would be expected that all the mechanisms concerned in the establishment of a sex ratio of near equality among the 14–19 age group would, through selection, come ultimately to be related harmoniously to this end.

Implied in this suggestion is yet another: that in the case of any population of living things and under the conditions that exist in any given place and at any given time, there is an optimum sex ratio amongst those of the ages associated with the fullest expression of the reproductive function, and that through selection all the mechanisms, whatever they may be, which influence this are fashioned into harmony with this 'reproductive' sex ratio. It is necessary, therefore, to discuss the meaning in biological philosophy of mutation, sex and heterogamety, all of which are intimately concerned.

Mutation is a mechanism that has become adapted and elaborated for the provision of material possibilities of evolutionary movement. It takes the form of the replacement of one gene by an allelomorph—the substitution of a gene that, having been tested and found worthy, has come to be in harmony with the rest of the genotype, and through this with the conditions of the external environment, by another, the merits of which have yet to be determined. More often than not, therefore, mutation implies a disturbance of an equilibrium within the genotype itself, and between this and the external environment. It is usual, therefore, to find that mutation leaves the genotype less in harmony with the existing external conditions than was that which it has replaced. Mutation, the inception of a new heritable variation, thus usually equips its possessors with a handicap, imposing on them a disadvantage that can range from inconvenience to complete lethality.

Sex is the mechanism that has become adapted for the dispersal of a mutant gene amongst a population. Through its exercise a new gene can become incorporated into a variety of genotypes, and thus given the opportunity of finding itself associated with other genes with which it can interact. It is established that the quality of the action of a gene is largely determined by this interaction with others, for, as judged by its effects upon the life processes of the zygote, it can exhibit disadvantageous properties when in one gene association, advantageous when in another. For the quiet dispersal of a mutant gene in this way it is necessary that it should be recessive, initially at least, to the gene that it has displaced, for then it can pursue a cryptomeric existence for a considerable period of time.

If the great usefulness of sexuality lies in the opportunities it provides for variety in gene recombination and for the exercise of selection, then its advantages will be best exploited when, among those about to reproduce, there is a sex ratio of equality. This observation would not seem to apply to those instances in which gene combinations that are common or are exceedingly rare are

concerned, but a sex ratio of equality among the parents would seem to provide the greatest variety of recombinations in the offspring in the case of gene combination of intermediate rarity. Be this as it may, a device for the production of a sex ratio of equality has certainly been elaborated.

Heterogamety is a mechanism that has become adapted for the production of a primary sex ratio of equality. In its evolution in the higher forms it has taken the form of the replacement in one sex of an X-chromosome by a wholly or largely non-homologous Y-chromosome. The heterogametic sex, therefore, now possesses one X-chromosome, the homogametic, two. An indirect result of this evolution has been that a recessive mutant gene in the differential segment of the X-chromosome is at once uncovered in the case of the heterogametic individual, and so, if in its action such a gene is disadvantageous, deleterious or lethal, to it no time is allowed for the finding of modifying company and for the pursuit of its own evolutionary development. It is expressed and tested within a very short time of its first appearance, and should it cripple or kill, it is the heterogametic sex that is affected. In this way the sex ratio becomes modified, for the heterogametics either die before birth or else their early post-natal mortality is greater than is that of the homogametics. It is somewhat surprising that so few sex-linked lethals have so far been discovered in mammals. It would seem that the differential segment of the X is relatively insignificant and that the cross-over portion, which could not yield a differential mortality since its genes would not automatically be expressed in the male, is relatively large.

It is thus possible to look upon the inequality in capacity for continued life between the sexes as being partly of the nature of an evolutionary oversight due to a lag in the development of a harmonious relationship between the mechanisms of mutation and heterogamety. But this disharmony has been repaired by the invention of a supplementary device which can provide a compensatory primary sex ratio, high in those species with male heterogamety, low in those in which the heterogametic sex is the female. It is established that in many, though not in all, mammalian stocks, the primary sex ratio is much higher than is the secondary, and it is in such stocks that there is much sexually selective mortality operating to the disadvantage of the heterogametic sex. This being so, it seems reasonable to entertain the view that these three variables—the primary sex ratio, a sexually selective pre-natal and early post-natal mortality and the optimum reproductive sex ratio—are somehow related, the dimensions of the first being connected with the amount of the second.

Should this prove to be the case, then it would follow that in general the greater the incidence of mutation, the more common the sex-linked recessive lethals and the greater the difference in the sex incidence of mortality in adolescence in a stock with male heterogamety, the higher will be the primary sex ratio; and, conversely, the rarer mutation is, the fewer the lethals and the less the difference in the sex incidence of mortality between conception and reproductive prime, the nearer to equality will this primary sex ratio be.

This suggestion, of course, demands that there should be genes which affect the functioning of the heterogametic mechanism, and also that it should be possible, by continued selection, to modify the primary sex ratio of a stock. This will be equality when the heterogametic sex elaborates its two kinds of gametes, X- and Y-chromosome-bearing respectively, in equal numbers, and when both of these are equally functional in fertilization. Conversely, the primary sex ratio will be removed more or less from equality if and when the two forms of gametes are not produced by the heterogametic sex in equal numbers, or when, between these two forms, there is functional inequality. The fact that in those instances where the primary sex ratio is not equality it is the Y-bearing gamete that is either produced in greater numbers or is greatly advantaged in fertilization, so that more XY than XX gametes are produced, is of great interest in view of the observed fact that it is the XY zygote that suffers more through the action of sex-linked lethals.

It has been shown to be possible, by continued selection within an animal stock, to produce high and low sex ratio strains, and thus it would appear that there are genes which can be concentrated in a genotype which, in their action, influence the heterogametic mechanism affecting either the relative production of the two kinds of gametes produced by the heterogametic sex or else their relative functional ability. If, as seems to be the case, the male in many forms and irrespective of his chromosome constitution is the weaker sex, then in those instances in which the male is homogametic an excess of X-chromosome-bearing ova is demanded from the heterogametic females or else there must be some form of selective fertilization, the X-ova being more often or more readily fertilized.

That genes which lead to the production of X- and Y-bearing gametes in unequal numbers do exist is shown very clearly indeed by the work of Sturtevant and others. One such gene was discovered as long ago as 1922 (Morgan, Bridges and Sturtevant, 1925) in a strain of *Drosophila affinis* in which occasional males were found to produce families consisting almost entirely of females. A

definite X-borne gene was suspected. Gershenson (1928) found a similar gene in *Drosophila obscura*, and showed that it was indeed resident in the X-chromosome. A male carrying this gene produces very few sons, regardless of the genetic nature of his mate. More recently, (1936) Sturtevant and Dobzhansky have found that this gene has a very wide geographical distribution in both races of *Drosophila pseudo-obscura*, that it is sex-linked, lying in the right arm of the X-chromosome, and being associated with a small inversion. Cytological study has shown that in these cases the X-chromosome undergoes equatorial division at each meiotic division, whilst the Y-chromosome degenerates, with the result that a male carrying this gene produces nearly all X-sperm instead of the usual 50 per cent. It is to be expected, of course, that a sex ratio gene of this kind would be discovered only if its effects upon the sex ratio were profound. But the existence of such genes permits us to assume that other genes of the same kind, having less severe effects upon the heterogametic mechanism, also exist and are responsible for minor distortions of the sex ratio. If such

genes do exist, then, of course, they can be incorporated into, or extruded from a genotype, and upon them selective agencies can work their will. These sex ratio genes may perhaps provide a partial explanation of the observation that hybridization commonly is attended by marked distortions of the secondary sex ratio.

But all this is so much speculation, and the only justification for toying with such ideas is that criticism may be aroused and experimentation launched. I have presented evidence to show that three possible causes of sex differences in mortality have to be considered: (1) sex-linked lethals, (2) sex-limitation of defects and derangements, and (3) sex-dimorphic physiological and endocrinological differences. It seems probable that sex-linked lethals play only a minor part and that the defects and derangements that have come to be manifested only or more completely in the male owing to his relative unimportance in respect of propagation, constitute the major cause, though as yet too little is known of sex differences in respect of hormones and their effects to permit us to regard these as unimportant.

The British Association at Nottingham

THE British Association opened at Nottingham on Wednesday, September 1, at a time when local residents feared that a pleasant spell of very fine weather was to be rudely broken; but after a severe storm had passed over, the Association settled down to enjoy days of bright sunshine. The attendance of more than two thousand members is regarded as quite satisfactory, and there is no doubt that those visiting the city for the first time were definitely impressed by the delightful setting of the University College and the accommodation it provided. The opening presidential address on the history of evolutionary thought was well supported, and Prof. W. W. Watts, in moving a vote of thanks, suggested that the fact that Sir Edward Poulton had a son who was president of a Section provided a proof of natural selection.

The presidential addresses to the Sections were crowded. Mr. H. G. Wells had some striking things to say about education, but, so far as one could judge, they served only to increase the admiration and adulation of the professional members in his audience. His contentions were, in a way, supported by Prof. E. J. Salisbury's address to Section K (Botany), which one member described as "short, simple and lovable". They were also supported by speakers at a later discussion on the

educational function of a university. Prof. F. A. E. Crew's presidential address was regarded as one of the most stimulating of the whole meeting. It was, however, in Section A that records were broken in an extraordinary manner by Dr. G. W. C. Kaye. Here, for the first time, a president took acoustics as the subject of his address, and delivered it, appropriately enough, in a lecture theatre designed by Prof. E. H. Barton just before his death. Moreover, the address was for the first time illustrated by experiments, in which a selection of some forty motor-horns were used with great effect to produce another record in noise. Perhaps it was the general appeal of the subject which caused Section A to be crowded out and to provide a further record in the nature of a repeat performance of the experiments later in the day. Section A must also be credited with another record, which it certainly did not seek; one of its most pleasant social activities appeared in the programme under the heading "mystery trip".

The general discussions had clearly been well planned. Dr. F. L. Pyman's presidential address to Section B opened a stimulating symposium on various aspects of chemotherapy, while, at the same time, local geologists, headed by Prof. H. H. Swinnerton, had the pleasure of describing the geology of the Nottingham district to Section C.

Section A enjoyed a general discussion on the mode of action of the photographic plate, in which a theory of latent image formation put forward by Prof. N. F. Mott was closely followed. Sections A, B and I gathered to hear a useful symposium on surface action in biology initiated by Dr. Irving Langmuir. Prof. D. Brunt added much interest to a discussion of the upper atmosphere by releasing a sounding balloon, carrying a Dines meteograph to record the pressure and temperature at different stages of its ascent, and a ten-shilling note with an I.O.U. for a like sum to ensure its return. The balloon was released in the College grounds on Monday morning in the presence of an enthusiastic crowd. Less spectacular, but of considerable interest to local members, was the joint discussions of Sections C and E on the potential mineral resources of Nottinghamshire and Lincolnshire and their geographical significance. Perhaps the star turn in the joint discussions was the meeting of Sections C, D, E, F, K and M on Tuesday evening to talk about planning the land of Britain.

There can be no doubt that from a scientific point of view the Nottingham meeting was an unqualified success. From a social point of view it was equally pleasant. The excellent hostel accommodation, situated so close to the College and in the same beautiful surroundings, contributed greatly to the happiness of visiting members. The civic reception was obviously thoroughly enjoyed by guests and hosts alike, the flood-lit gardens of the Castle being much admired. Works visits, garden parties and excursions were heavily booked. Local firms and industrial undertakings were most generous in entertaining the Association. At the same time, the extraordinarily fine series of cinema films on subjects of biological interest, shown to members in the Savoy Cinema, proved to be a great attraction.

Forty-four years is the interval of time between the last two visits of the Association to Nottingham; it is to be hoped that, both on scientific and social grounds, the Association will not wait another forty years before it returns.

On September 3 the General Committee adopted the nomination of the Council of Lord Rayleigh to succeed Sir Edward Poulton as president of the Association. The General Officers will continue to be Prof. P. G. H. Boswell as General Treasurer and Prof. F. T. Brooks and Prof. Allan Ferguson as General Secretaries. The new members of Council are Prof. T. S. Moore, Mr. R. S. Whipple, Prof. H. J. Fleure, Prof. J. G. Smith and Prof. J. C. Philip.

Future places of meeting of the Association are Cambridge (Aug. 17-24, 1938) and Dundee (1939). Invitations have been received for the Association to meet in Swansea in any convenient year, in Belfast in 1941 or any year nearly following, and in 1943 in Birmingham.

Under the arrangement proposed last year by the Council and adopted by the General Committee, the British Science Guild was incorporated into the Association as from November 30, 1936. In accordance with the agreement of incorporation a British Science Guild Committee has been appointed to continue arrangements for lectures already initiated by the Guild, and for any others of similar character which may be approved by the Council. The first of the lectures arranged by the Association under the above scheme was the Alexander Pedler lecture, given in Leicester on May 3, in co-operation with the University College in that city, by Prof. Allan Ferguson. The first Norman Lockyer lecture to be so arranged will be given by Dr. R. E. Mortimer Wheeler in the Goldsmiths' Hall, London, by kind permission of the Goldsmiths' Company, on November 24.

The first of the triennial lectures under the foundation of Mr. G. Radford Mather will be given by the Rt. Hon. J. Ramsay MacDonald, M.P., F.R.S., in the Royal Institution, London, by kind permission of the managers, on October 22.

The Council records with much satisfaction that Lord Rutherford has accepted the presidency of the joint Congress of the Indian Science Congress Association and a delegation from the British Association in January next.

Obituary Notice

Prof. F. C. S. Schiller

PROF. F. C. S. SCHILLER, who died in Los Angeles on August 7 after a long and lingering illness, was born in 1864, the son of Ferdinand Schiller of Calcutta. He was educated at Rugby and Balliol, and graduated in the first class of Literæ Humaniores, winning later the Taylorian scholarship for German in 1887. For a few years (1893-97) he

occupied the post of instructor in philosophy at Cornell University. Then in 1897 he returned to Oxford, and became fellow and tutor of Corpus, where he remained for more than thirty years. His former pupils speak of him as a decidedly stimulating and suggestive teacher, who, although out of touch with the types of philosophical theory prevalent in Oxford, exerted considerable influence there as an

acute critic and searcher after truth. He was president of the Aristotelian Society in 1921, and had from 1906 onwards contributed to its *Proceedings* a large number of papers. At philosophical gatherings he was a well-known figure; he read, for example, a paper at the International Congress of Philosophy, held at Harvard in 1926. To *Mind* he was a frequent contributor, and was for many years treasurer of the *Mind* Association. In 1926 he was elected a fellow of the British Academy. In 1929 he was appointed visiting professor in the University of Southern California, and was accustomed latterly to spend half of each year in the United States and half in England.

Schiller's student life in Oxford began immediately after the death of T. H. Green, but from the outset he was out of sympathy with Green's idealism. In his earliest book, "Riddles of the Sphinx", published under the pseudonym "A Troglodyte" in 1901 (2nd edition, revised, with the author's own name, in 1904, new edition 1910), Schiller followed largely in the line of the evolution theory, as expounded by Darwin; and developed at some length a view, not unlike that of J. S. Mill, of God as a finite individual, immanent in the world as a living activity, but transcendent as a true personality. In the following year, in 1902, the volume entitled "Personal Idealism" appeared, containing contributions from eight members of the University of Oxford; Schiller's essay therein was on "Axioms as Postulates", and in this essay he outlined for the first time the position which, following William James, he designated as that of 'pragmatism', or later 'humanism'.

Truth, Schiller maintained, is *human truth*, and is incapable of coming into being without human effort and agency. Human action is psychologically conditioned; consequently, the concrete fullness of human interests, desires, emotions, satisfactions, purposes, hopes and fears is relevant to a theory of knowledge and must not be abstracted from. The world of our experience is not a ready-made datum; it is essentially what we make of it. Fruitless, therefore, is it to attempt to define it by what it was originally or by what it would be apart from us; it is what is made of it. Accordingly, the world is *plastic* and may be moulded by our wishes, if only we are determined to give effect to them, and are content to learn from experience, that is, by trying *by what means* we may do so. The principles we employ in such construction are, it was urged, in the beginning *demands* we make upon our experience, postulates or hypotheses, "starting-points and stepping-stones". Of these, when tried, many have to be abandoned; others remain precarious, and more or less 'matters of faith'; only a few rise to be unquestioned axioms. The "making of truth" is thus, it was contended, in a very real sense also a "making of reality". For in validating our claims to 'truth' we really 'discover' realities; and we virtually *transform* these by our cognitive efforts, thereby proving our desires and ideas to be real forces in the shaping of our world.

Perhaps Schiller's chief contribution to the thought

of his time is to be found in his sustained insistence on the way in which principles, even those which appear to be the most self-evident and fundamental, are in point of fact tentative, and require to be tested by their success or want of success in enabling the investigator to get into touch with natural events; and in the repeated emphasis which he laid on the manner in which apparent facts receive modification through the growth of science. Furthermore, that man is not to be separated from Nature, and looked upon as a mere observer of a series of events which he can do nothing to alter, that revaluation and not static finality is a main feature of any truth discoverable by man—these are certainly points which it was worth while to emphasize; and upon them Schiller was constantly laying stress.

In addition to the works already referred to, Schiller was the author of "Humanism", 1903 (2nd edition 1912), "Studies in Humanism", 1907 (2nd edition 1912) and "Plato or Protagoras", 1908. He wrote also two books on logic—one, "Formal Logic: A Scientific and Social Problem", 1912, which was a sustained attack on what he regarded as the futility, the verbalism, the self-contradictoriness of the traditional logic; the other, which was a more constructive work, "Logic for Use", 1929. In the latter the logic which he desiderated was not the logic of proof but the logic of discovery, and he has said probably wellnigh everything there is to say on this subject. Nor must one omit to mention the two contributions he made to Singer's "Studies in the History and Methods of Science", on "Scientific Discovery and Logical Proof" in vol. 1 (1917) and on "Hypothesis" in vol. 2 (1921). G. D. H.

We regret to announce the following deaths:

Prof. Hendrik Aldersloff, director of the State Serum Institute at Utrecht, president of the Dutch Society for the Advancement of Medicine, editor of the *Tijdschrift voor Sociale Hygiëne*, aged sixty years.

Prof. P. W. Cloessen, professor of biology in Cornell University, known for his work in economic entomology, on August 16, aged fifty-one years.

Prof. J. E. Duerden, who was associated with the Wool Industries Research Association, Torridon, Headingley, Leeds, and formerly professor of zoology in the Rhodes University College, Grahamstown, on September 4, aged seventy-two years.

Prof. Albert Heim, For. Mem. R.S., formerly director of the Geological Museum and Swiss Geological Survey, Zurich, on September 1, aged eighty-nine years.

Prof. M. Maclean, emeritus professor of electrical engineering in the Royal Technical College, Glasgow, on September 2.

Prof. Pietro R. Pirotta, formerly professor of botany in the University of Rome, on August 4, aged eighty-three years.

Mr. F. C. Thompson, lecturer in the Department of Leather Industries in the University of Leeds, aged forty-six years.

News and Views

The Right Hon. Lord Rayleigh, F.R.S.

THE British Association holds its annual meeting in Cambridge in August 1938, and the General Committee of the Association has elected Lord Rayleigh to the presidential chair for that meeting in succession to the veteran biologist Sir Edward Poulton. Readers of NATURE need little introduction to Lord Rayleigh, whose influence on the development of physical science has been so potent and so profound. First and foremost an experimental physicist, he has his father's flair for recognizing those aspects of an experimental investigation which most need stressing, and for extracting results of fundamental importance from apparatus of simple, even primitive, type. His work on radium and the earth's heat is classic in quality, and he has elucidated many diverse, and yet related, phenomena in his studies of the aurora borealis, the light of the night sky, the green flash, and the fluorescence of mercury vapour. He has lately studied the conditions of optical contact of glass surfaces, and has investigated, by admirably simple methods, the pull required to separate, and the work done in separating, contacted surfaces. He has measured the small amount of reflection between two contacted glass surfaces, and has shown that the blackness of the black centre of the Newton's rings formed between a spherical and a plane surface is by no means perfect.

LORD RAYLEIGH'S services to science on the administrative side are equally varied and weighty. He is chairman of the governors of the Imperial College of Science and Technology, and of the executive committee of the National Physical Laboratory. He had filled the offices of foreign secretary of the Royal Society, of president of Section A of the British Association, and of president of the Physical Society. Lord Rayleigh's contacts with Cambridge are many, and make the choice of the General Committee a singularly happy one. The nature and scope of his address remain to be seen, but, whatever be his choice, the scientific world, and indeed, the world at large, may look forward to receiving a pronouncement of fundamental importance.

Grass and the Nation's Food Supply

DR. R. E. SLADE'S evening discourse at the British Association, delivered on September 3, came well within the category of scientific contributions bearing upon social welfare, for it demonstrated the physical possibility of greatly increasing the nation's home-grown food supply, and incidentally of improving soil fertility and of helping to put the much-suffering farmer upon his financial feet. A conspicuous feature of recent agricultural progress has been the recogni-

tion of grass as a crop, and how by good management and the use of scientific methods of grass conservation, the productivity of pastures can be immensely increased. Early researches on grass as a food for stock were largely confined to hay, and though this form of 'bottled sunshine' is unlikely ever to disappear, the nutrients in grass can be best conserved either as ensilage or as artificially dried grass. No system of cultivating grassland can be adequate unless it takes cognizance of the reaction between the pasture herbage and the grazing animal, for by controlling the time and intensity of grazing or cutting, by judicious manuring, and by timely cultivations, a succession of palatable and nutritious herbage can be maintained throughout the grazing season, and this season can be extended at both ends, that is, in spring and in autumn. The re-discovery by Prof. T. B. Wood and Dr. H. E. Woodman of the high feeding value of leafy, young grass, and the breeding of leafy and highly nutritious strains of indigenous grasses by Prof. R. G. Stapledon and his co-workers at Aberystwyth, have opened up a vista of great possibilities for home agriculture and national food supply.

As an example of what can be done to improve the yield of food material from grassland, Dr. Slade described the results of a highly interesting experiment that has been carried on since 1935 at a large dairy farm near Middlewich, in Cheshire, where the climate is favourable and the management has been scientific as well as practical. Monthly records of milk production and live-weight increase of animals have been recorded throughout, and from these data the amounts of food (protein and starch equivalents) provided by the grass and the hay have been calculated. The average yield of crude protein per acre in 1935 and 1936 was 640 lb., which is three to four times as much as that given by an average pasture in Great Britain. Equally good results have been obtained on a 'farmer's farm' near Middlesbrough, in Yorkshire, over a period of ten years, and it was suggested that yields of crude protein up to 1,500 lb. per acre should be obtainable when Prof. Stapledon's new strains of indigenous grasses become available. A yield of 700 lb. protein per acre is equivalent to a yield of 45 lb. protein as dressed beef, or to 103 lb. protein as milk, which is just about the amount of protein provided for human food by an average acre of wheat. Pigs fed on grass protein could provide 70 lb. of pork per acre of grassland, but for this purpose the grass would have to be defibrinated. What is needed, and what seems feasible, is a protein-rich food made from grass deprived of its fibre, a kind of 'grass cheese', which could be fed to pigs for producing pork, and in times of national emergency could be eaten by the people.

Science and Progress

THE address, "Science in Everyday Life", given at Long Eaton on September 7 in connexion with the Nottingham meeting of the British Association by Dr. J. E. R. Constable, dealt with the more popular side of the activities of the Department of Scientific and Industrial Research and the laboratories engaged in research under its auspices. The National Physical Laboratory has, for example, fostered the use of X-rays for the detection of internal defects in steamship and aeroplane propellers, in almost all types of industrial products and in human teeth, and of foreign bodies in packed foods. It has also undertaken the measurement of noise and suggested methods of diminishing noises in buildings by the use of sound-absorbing devices. The Fuel Research Station has been investigating the best methods of getting the most heat and the least smoke from coal, while the Food Investigation Board has been finding out the best methods of keeping foods of all kinds in cold storage for long periods without its deteriorating.

ANOTHER branch of the activities of the Department to which Dr. Constable referred was that of the Road Research Laboratory, which is determining the best methods and materials for the construction of roads with good wearing qualities and non-skid surfaces. Machines for measuring the durability and non-skid property of sample roads and for determining when a road surface must be condemned as bad have been constructed and are giving valuable information. Closely associated with this laboratory is that for building research, which has succeeded in solving some of the difficulties in the production on a large scale of uniformity in structural materials such as concrete, and in the preservation of the stonework of buildings, and has investigated the best methods of dealing with many of the newer quick-setting plasters and cements. As a result of the work of the laboratory the smoking chimney need no longer be tolerated.

Dr. R. d'E. Atkinson

DR. R. d'E. ATKINSON has been appointed chief assistant in the Royal Observatory, Greenwich. Dr. Atkinson obtained a first class in the Physics Final Honour School in Oxford in 1922 and was elected to a research fellowship at Hertford College. In 1926 he obtained a Rockefeller travelling fellowship and studied in Göttingen for two years under Prof. Franck, taking the D.Phil. degree. After a short period as demonstrator in the physics laboratory of the Technische Hochschule in Berlin-Charlottenburg, he was appointed assistant professor and, in 1933, associate professor of physics in the Rutgers University, New Brunswick. Dr. Atkinson has published many papers. Of particular interest is his work on atomic synthesis and the source of stellar energy, in the course of which he deduced, before the discovery of the neutron, from general considerations of atomic abundance in the sun and stars, that there must be some type of particle that could penetrate a highly charged nucleus more easily than a proton.

Charles Bouchard (1837-1915)

CHARLES JACQUES BOUCHARD, a distinguished French physician, was born on September 6, 1837. He studied medicine first at Lyons and then in Paris, where he became house physician to Charcot, with whom he afterwards collaborated in the study of certain nervous diseases. He is best known for his works on the pathology of cerebral hemorrhage (1866) and autointoxication (1887), both of which were translated into English, and the diseases caused by diminished nutrition (1870-80). He was also co-editor of a system of medicine with Charcot and Briassaud (1891-94) and of a treatise on general pathology in collaboration with H. Roger (1895-1903). In 1887 he founded the *Revue de la Tuberculose* with Verneuil, and in 1899 the *Journal de Physiologie et de Pathologie Générale* with Chauveau as his co-editor. Bouchard was one of the first physicians in Paris to take an interest in radiology, and installed a radio-scopic apparatus at his own expense for the examination of his patients at the Charité hospital, where he was physician. In addition to occupying the chair of general pathology and therapeutics in the Paris faculty of medicine (1877) his distinctions included the presidency of the second French Congress of Medicine (1895), Société de Biologie (1896) and Academy of Sciences (1908). His death took place on October 28, 1915. The work entitled "Un Médecin Philosophe: Charles Bouchard, son œuvre et son temps", by Paul Legendre (1924), forms one of the outstanding medical biographies.

Trades Union Congress and Science

THE announcement made by Mr. Ernest Bevin in his presidential address to the Trades Union Congress meeting at Norwich of the formation of a scientific advisory council will be widely welcomed. Mr. Bevin paid tribute to the progress that science has made, but pointed out that society has not kept pace with it in making the fundamental readjustments and assimilating the results of research, discovery and invention. The General Council of the Congress believes that men of science can make a further contribution to progress by assisting such a movement as the Trades Union Congress with counsel and knowledge. It has accordingly decided to establish a Scientific Advisory Council, the purpose of which will be to enable the Congress and its constituent unions to secure the help and advice of leading scientific workers in some systematic and regular way. "The General Council are convinced that their prevision and foreknowledge of the significance of scientific discovery in all fields of research would be of incalculable value not only to the trade union movement, but to the community." Mr. Bevin gave a warning that this does not mean that scientific workers are to be invited to frame the policy of the Congress; the General Council wishes to be in touch with representative men of science by means of such an advisory council and panels of scientific workers, from which it will be able to obtain information and advice in dealing with its own problems. It would

clearly be to the advantage of both science and labour if the Congress were represented upon research boards and research associations concerned with industrial developments. The human factor in industrial progress has often been neglected in the past, and by bringing representatives of labour into close association with scientific and inventive work, the degrading results of some of their past applications to industry may be avoided.

Racial Doctrine

A NEW periodical publication with the title *Races et Racisme* is devoted to the record of current development in the application of theories of race to the doctrine of nationalism, with special reference to Germany (office of publication, 47 rue de Miromesnil, Paris VIIIe, price 1 fr.). Its main object is to keep the French people abreast of the progress of a movement of supreme importance in the world of to-day, upon which, it is thought, they are not sufficiently well informed. It should also prove valuable to those who desire first-hand and trustworthy information in readily accessible form of the increasing restrictions and penalties which are being imposed on freedom of thought and scientific and intellectual development in the nationalist-socialistic State. The utility of such a publication must clearly depend upon its freedom from the taint of the selective activity of the propagandist. The names which appear on the lists of the Comité de Patronage and the Comité Directeur are a guarantee that an objective impartiality will be exercised in the selection of material for publication. The lists include such well-known names as M. Gabriel Hanotaux, Prof. Lucien Lévy-Bruhl, Prof. Paul Pelliot, Prof. G. Bouglé, P. Maurice Léonardt, le Comte Jean de Pange, and Prof. Paul Rivet, with Prof. E. Vermeil as one of two secretaries. *Races et Racisme*, of which numbers will appear at two-monthly intervals, will represent the trend of German thought in racial doctrine by verbatim reports, or full abstracts, of official documents, new laws and regulations, official pronouncements, articles and speeches of authority, as well as by analyses of books and a record of relevant events—all, as a rule, without comment, except when further explanation is considered necessary.

AN example of the commentary which the editorial body considers appropriate is afforded by the opening article, which runs through the two numbers before us and is still in progress. This is an exposition of the development of racial ideas in Germany by M. Edmond Vermeil. It begins with Leibniz and Herder and the concepts of the eighteenth century, and shows how the Germanic idea has progressed from the universalism of the philosopher to the Pan-Germanism upon which the doctrine of 'race' and 'blood' has been engrafted to implement Hitlerian nationalism. M. Vermeil, who takes a broad and philosophic view of his subject, will, in his later instalments, demonstrate how and why what appears to be no more than a political manoeuvre, when judged by its objective, must necessarily permeate and transform

activities, apparently remote from the political arena when functioning freely, to produce 'German' art, a 'German' science and a 'German' religion. It is to be noted, however, that the sweeping official claims for purity of race and the coincidence of Nordic and Aryan are so far abandoned that Prof. Oswald Kron of Tübingen is permitted to say that there are five or six races among the German people, while he claims for them a psychological unity.

Native Lands in South Africa: A "New Deal"

CONSIDERABLE progress has been made in the provision of additional reserves for the native population of South Africa since the passing of the Native Lands Act, which was promulgated in August, 1936. Up to July last, according to a dispatch from the Cape Town correspondent of *The Times*, which appears in the issue of September 3, £800,000 has already been spent on the purchase of farms from Europeans. The farms which have been bought up to the present are mostly situated in the Transvaal, where the need for native land is greatest, as this is the principal area of native location on European farms, a practice which will not be permitted in future. The land is being allotted to the natives and settlement will proceed as the present European holders vacate. They have been permitted to remain in possession until after their harvest, and land is being provided for them elsewhere. Under the provisions of the Native Trust and Land Act, 1936, the South African Native Trust, representing the Government, is authorized to acquire 7,250,000 morgen (about 15,000,000 acres) of lands for native use. It is anticipated that the work of settling the native on these lands, which will now go on steadily, will occupy a period of several years. It is clear, however, that if the situation is not taken in hand drastically, and the conditions which prevail on native lands, not only in South Africa, but also in territories to the north, are allowed to continue unchecked, a situation similar to that for which the present measures are intended to be a remedy will again arise before many years have passed, and probably then be more difficult to meet.

THE present deplorable condition of the existing native reserves and the agitation and discontent to which the shortage of native lands has given rise is not entirely due to overpressure of population, though this has been an important factor. Traditional methods of native agriculture and grazing, of which the ill effects were negligible when a practically unlimited area allowed freedom of movement and gave exhausted soil an opportunity to recover, have led, under the system of European restriction of boundaries and suppression of tribal raids, to a general impoverishment of the land, which has further deteriorated through the erosion consequent on the overstocking which follows from the Bantu regard for cattle as a sole and almost sacrosanct form of wealth. Since the passing of the Act, the Native Affairs Commission has been busily engaged in framing a policy which is intended to remedy these

adverse conditions. Regulations and remedial measures are to be applied to the existing reserves, such as fencing, irrigation, parcelling out the land for occupational and agricultural use, as well as for rotational cropping and the like, by which it is hoped to introduce into native tribal custom a more economical use of the land. On the new reserves agricultural officers will be appointed to instruct and, if necessary, discipline the natives in modern methods of cultivation. The educational process is bound to be slow; and its success, as previous experiments have shown, will depend very largely upon the discretion with which new methods are welded into traditional custom.

Physics and Society

IN an address before the American Physical Society, Washington, on April 30, on Science and Society (*J. Applied Phys.*, 8, 373; 1937), D. Sarnoff, president of the Radio Corporation of America, referred to the relation of the physicist to the far-reaching social changes which follow his discoveries. The radio industry had its origin in the purely theoretical reasoning of Clerk Maxwell when in 1865 he advanced reasons for the existence of electromagnetic waves, although it was only in 1895 that Marconi gave the world a practical system of wireless telegraphy. Already 150 social effects have been traced directly to radio, and the end is not yet in sight. The major obstacles to the public introduction of television no longer lie in the field of research and engineering. The creation of a new art form has demanded new techniques of writing, direction and studio control. Here as elsewhere a scientific approach to the solution of human problems is required, and it is essential that mankind should learn how to use the assets which are the product of the scientific mind. Civilization depends for its advance upon our expanding knowledge of the social as well as of the physical sciences, for no society can solve its problems by intuition or rule of thumb. The advance of social science no less than that of physical science, calls for the creative imagination of a Newton and a Maxwell, an Edison and a Marconi. Obsolescence is a factor in social as well as in industrial machines.

THE social investigator must approach the problems of society in the clear light of an unbiased mind. He must collect and analyse facts, seek to fathom causes and establish principles, which he must always be willing to reconsider in the light of results. The permanent advance of society depends on our following procedure similar to that of the experienced surgeon. We must not be afraid to operate but must know when a less spectacular and safer treatment will be adequate. Social and economic facts must be investigated, verified and analysed, and the analysis and conclusions disseminated widely by popular education and debate. Industry is continually entering new realms of knowledge, and close understanding and co-operation are required between its leaders and the investigators in the universities.

Industry which has not learnt to employ scientific workers is doomed. Moreover, the problems created by technical science can only be solved by increasing and applying our knowledge of social science, and Mr. Sarnoff urged that the immediate goal of social science should be to achieve economic justice, peace and prosperity in a free democracy. Because that involves collective effort, it does not mean the suppression of individual liberty. Freedom of the individual is essential to the full expression of his creative faculties. Science and society depend upon each other, and when the basic lesson of science, that knowledge of the truth without fear or prejudice is indispensable to progress, is rejected, science—and society with it—goes backward instead of forward.

Education and Training for the Oil Industry

THE days when a liberal education and an effective personality were sufficient qualifications for entry into the petroleum industry are now over. As Prof. A. W. Nash pointed out in a paper presented to the Chemical Engineering Congress, World Power Conference, 1936 (*J. Inst. Pet. Tech.*, 22; 1936), specialized vocational training is the only adequate background for technical men seeking employment in the industry. Moreover, this specialized training should be directed towards one particular branch of the industry, for example, geology, production, or refining, for in each of these branches different sciences are involved and correspondingly different technical knowledge is necessary for the solution of such problems as may be encountered. Before proceeding to specialize, however, the student must acquire a sound knowledge of the fundamental principles of physics, mathematics and chemistry, together with a working understanding of engineering and chemical engineering. Finally, having mastered these fundamentals and specialized in a particular branch of the industry, the technician should familiarize himself at least with the basic principles underlying the remaining branches of the industry, for in this way alone will he acquire a clear conception of any problem which may present itself from the point of view of the industry as a whole. Universities and other institutions which provide such training for the industry, are fully alive to the fact that, apart from the actual acquisition of knowledge, the student is there primarily to learn how to apply such knowledge, to interpret it and make use of it in the solution of new problems, and their curricula are adjusted accordingly. For the man who has made full use of any such training, there are openings in the industry unrivalled in any other from the points of view of scope and advancement.

The Spread of the Sahara

THERE is abundant evidence that early in the Quaternary age the Sahara was inhabited by man and that desiccation has since been proceeding. In so far as this process is one of climatic change, it is beyond the control of man; but there is also much evidence that the increase of desert conditions in both north and south is largely due to human interference.

In a pamphlet entitled "The Threat of the Sahara", reprinted from the *Journal of the Royal African Society*, Prof. E. P. Stebbing reviews the available evidence of progressive desiccation and discusses the causes. These can be summarized as war, primitive methods of agriculture, excessive grazing and pasturage and fire. Intertribal warfare has laid waste great tracts and so promoted soil erosion. The method of shifting cultivation, entailing the cutting down of successive areas of forest and their abandonment when annual burning produces too poor a supply of fertilizing wood ash, has allowed the spread of scrub land. This degraded forest is given over to pasturage which tends to destroy the vegetation, the last stage in its use being the pasturing of goats. Prof. Stebbing sees little evidence that the desiccation can be attributed to climatic oscillations, and is extremely doubtful that the succession of a wet period will reverse the present trend.

The Zoological Society of Scotland

THE increase in the number of visitors to the Zoological Park near Edinburgh to just short of half a million, and a surplus on the year's working of £1,708, indicate the material success of this Society (*Ann. Report Zoo. Soc. Scot.*, 1936-37). In other ways it has made notable progress. The new open-air enclosure for tigers, which occupies the site of an old sandstone quarry, is a most striking example of the use of natural rock, and a new restaurant, made necessary by the increase of visitors, has been completed and opened. During the year five king penguin chicks were hatched, of which three were successfully reared, and amongst mammals there were born and reared lion cubs, four beavers, three llamas, a nilghai and Barbary sheep. The chimpanzee born in January 1936 has developed well, and for many years the breeding of tropical freshwater fishes has been a feature of the Carnegie Aquarium. A successful innovation was the holding of a series of meetings of members at which lectures upon, and illustrated accounts of, their investigations of animal habits and behaviour were given by experts.

Survey of India

IN 1905 the hope was expressed by the Survey of India that in twenty-five years maps of the whole Indian Empire on a scale of one inch to a mile would be available. The Annual Report for 1936 (Calcutta, 2s. 6d.) points out that this hope is far from realization, and that a little more than half the area is now mapped on that scale. When it was realized in 1913 that the scheme could not be completed for many years, it was decided to reduce the scale of survey for the less populous areas. As a result, two-thirds of the country is now covered by modern maps ranging in scale from one inch to a quarter inch. In the year under review more than fifty-three thousand square miles was surveyed, in addition to a certain amount of revision. The report contains full index sheets to all the scales, including the sheets of the Carte Internationale on a scale of one million which cover India and adjoining lands.

Motor-boat Speed Record

ON September 1, Sir Malcolm Campbell, driving his new motor-boat *Bluebird* on Lake Maggiore, made two runs over a measured mile at an average speed of 203.3 km. an hour. His boat is equipped with a single Rolls-Royce engine of 2000 h.p., similar to that of his motor-car *Bluebird*. Sir Malcolm has thus achieved the distinction of holding the speed record for both land and water.

Announcements

MR. J. D. GRIFFITH DAVIES, an administrative assistant in the Higher Education Department at Leeds, has been appointed assistant secretary of the Royal Society as from September 1 in succession to Mr. R. Winckworth, who at his own request has reverted to his previous position in charge of the Society's publications.

THE following appointments and promotions have recently been made in the Colonial Service: E. F. Allen, to be agricultural officer, Malaya; D. B. Fanshawe, to be assistant conservator of forests, British Guiana; D. E. Faulkner, to be veterinary officer, Gold Coast; K. D. S. MacOwan, to be veterinary officer, Kenya; J. W. Ewart, to be assistant curator of gardens, Malaya; F. R. Mason (agricultural field officer, Malaya), to be deputy director, Department of Agriculture and Fisheries, Palestine; R. W. R. Miller (director of science and agriculture, Barbados), to be director of agriculture, Zanzibar; W. D. MacGregor (senior assistant conservator of forests), to be conservator of forests, Nigeria; H. G. Wiltshire (pathologist, Zanzibar), to be senior pathologist, Uganda; W. Horsfield (staff surveyor), to be district surveyor, Lands and Mines Department, Tanganyika; H. M. Pendlebury (curator, Selangor Museum), to be director of museums, Federated Malay States; J. L. Tetley (assistant analyst, Imports and Exports Department, Hong Kong), to be chemist, Institute for Medical Research, Federated Malay States.

DR. ROBLEY D. EVANS, assistant professor of physics at the Massachusetts Institute of Technology, recently received the first Theobald Smith award in medical science, consisting of a bronze medal and one thousand dollars, for his researches, which have led to a method of detecting radium poisoning before its fatal stage and a treatment for extracting radium from bones.

A USEFUL little volume on most aspects of map-making has been published under the title of "Cartography" (Special Publication No. 205. U.S. Dept. of Commerce. Coast and Geodetic Survey 1936. 60 cents). The pamphlet opens with a short historical survey, after which is a discussion of different kinds of maps and charts and their requirements. Then follows a chapter on compilation of the material for a map and a clear, though brief, account of the chief projections. The last section treats of the technique of construction. There are many reproductions of sections of various maps, American and others.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 468.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Asymmetry in Metals of Hexagonal Structure

THE axial ratio, c/a , of the majority of metals having a hexagonal close-packed type of structure differs appreciably from the value $2\sqrt{2}/3 = 1.633$ which corresponds to a hexagonal close-packed system of spheres. The two most notable deviations are for zinc and cadmium, for which $c/a = 1.86$ and 1.89 respectively, while for beryllium, titanium, zirconium, hafnium, yttrium, ruthenium and osmium, c/a lies between 1.58 and 1.59 . These facts have sometimes been expressed by describing the atomic domains as having the forms of prolate and oblate spheroids when c/a is respectively greater than and less than 1.633 ; but it is only recently that experimental evidence has been obtained which throws light on the nature of the asymmetry in these metals.

X-ray measurements for zinc¹ and cadmium² have shown that the atomic vibrations in these metals are markedly asymmetric, the mean atomic displacement along the hexagonal axis, the c -axis, being greater than normal to the axis; this suggests that the high values of the axial ratios arise partly, if not wholly, from the asymmetric character of the vibrations. This is further supported by X-ray measurements by us for magnesium³, similar to the previous experiments on zinc and cadmium, which indicate that the lattice vibrations in magnesium are much more nearly isotropic; this may be correlated with the fact that c/a for magnesium is 1.624 , which approximates closely to the ideal value, 1.633 .

Results have recently been obtained, however, indicating the existence of an appreciable atomic asymmetry. It was first pointed out by one of us⁴ (G. W. B.), that the $(10\bar{1}0)$ reflections from zinc and cadmium give abnormally high scattering factors compared with the adjacent reflections, and since these reflections occur at small angles for which lattice vibration has relatively little effect, it was thought that it might be an indication of atomic asymmetry. This has since been confirmed in the case of zinc by Jauncey and Bruce⁵, who also have accepted it as evidence for atomic asymmetry, and by other workers in Jauncey's laboratory⁶; Wollan and Harvey⁷ especially have carried the matter a step further by making measurements at two temperatures. In the light of this evidence, it appears well established now that the atoms in metallic zinc and cadmium are asymmetric and are more diffuse along the c -axis than normal to it.

We have recently investigated ruthenium, a hexagonal metal with $c/a = 1.58$, which has provided evidence for a different type of atomic asymmetry. The lattice vibrations at room temperature are relatively small, so that this metal is particularly suitable for studying atomic asymmetry. The X-ray scattering factors of ruthenium are shown in Fig. 1, the length of the line attached to each reflection indicating

the possible experimental error. Among the lower order reflections, 2 and 5 are well above the mean curve and 1, 3, 4 and 6 fall either on or below the curve, depending on how it is drawn. The indices of the reflections are given in the key attached to the figure. The curve is extrapolated to 42.8 at $(\sin \theta)/\lambda = 0$, which is the atomic number, 44 , less a dispersion correction of 1.2 . An interesting feature of these results is that whereas the second reflection

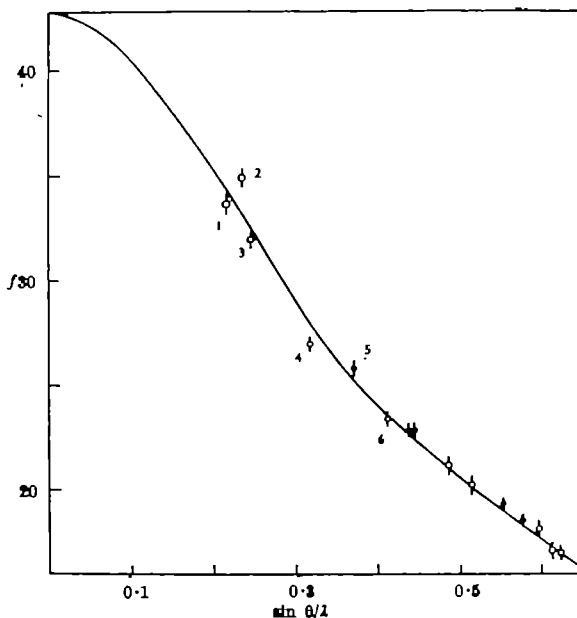


Fig. 1.

X-RAY SCATTERING FACTOR OF RUTHENIUM

1, $10\bar{1}0$	4, $10\bar{1}2$
2, 0002	5, $11\bar{2}0$
3, $10\bar{1}1$	6, $10\bar{1}3$

comes from the basal plane, the fifth reflection, which is also high, comes from a plane parallel to the c -axis, that is, normal to the basal plane. Evidently, then, a simple extension of the atoms either in the direction of the c -axis or in the basal plane will not explain these results.

An explanation is obtained, however, if we suppose that there is a concentration of electron density having its centre of gravity at the mid-point of every triangle formed by three atoms in the basal plane, as in Fig. 2, where the black circles represent the atoms and the clear circles the additional electron density. It is seen that the additional charge lies between planes of the type $(10\bar{1}0)$, $(10\bar{1}1)$, $(10\bar{1}2)$, etc., corresponding to reflections 1, 3, 4 and 6, and so gives low

scattering factors, but lies on planes of the type $(11\bar{2}0)$ and also on the basal plane (0001) , the plane of the diagram. As to why there should be a concentration of electron density, which need only be of the order of 1-2 electrons to account for the observations, we cannot yet say; but it may perhaps be due to the overlapping of the wave-functions of the incomplete $4d$ shell, which for ruthenium have a considerable spread. An objection to this simple

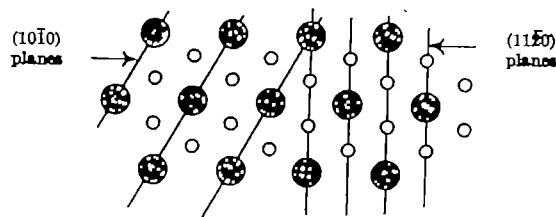


Fig. 2.

explanation is that it would require concentrations of electron density at other points in the lattice which would not agree with the present observations. Whatever may be the ultimate explanation, however, the experimental results point strongly to a concentration of electron density of the type indicated in Fig. 2.

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(Mackinnon Student of the
Royal Society.)
P. RIDLEY.

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July 7.

¹ Brindley, G. W., *Phil. Mag.*, **51**, 790 (April 1936).

² Brindley, G. W., *Proc. Leeds Phil. Soc.*, **2**, 200 (April 1936).

³ Brindley, G. W., *Nature*, **138**, 290 (August 15, 1936).

⁴ Jamieson and Bruce, *Phys. Rev.*, **50**, 408 (1936).

⁵ Miller and Foster, *Phys. Rev.*, **50**, 417 (1936). Miller, *Phys. Rev.*, **51**, 969 (1937).

⁶ Wollan and Harvey, *Phys. Rev.*, **51**, 1064 (1937).

A New Equilibrium Diagram for the System Fe—C

Two equilibrium diagrams, the single diagram and the double diagram, have been proposed for the system Fe—C and we cannot, as yet, decide upon which is the correct one. The single diagram assumes that graphite never separates directly from molten iron, which was, however, recently experimentally disproved by different workers including myself. It meets with a second difficulty as it represents a metastable equilibrium; but a stable diagram for such an important alloy as Fe—C is required.

The double diagram indicates that graphite may sometimes be formed directly from the melt; it is free from the above difficulties, but it encounters more as follows:

(1) Two diagrams (stable and metastable) are drawn with an interval less than 10°C ., and such a coupled diagram makes the matter difficult to understand. Several double diagrams have been proposed by different authors, and it is extremely difficult to choose from them.

(2) Two eutectic temperatures (austenite-cementite and austenite-graphite) are expected by the double diagram, but many authors have been able to find only one.

(3) The lower (metastable) lines of the double diagram express a super-cooling. We have now about 400 binary equilibrium diagrams and only three of them, Cd—Sb, Cd—As, Fe—C, include super-cooling. Super-cooling in the systems Cd—Sb and Cd—As is abnormal. Ordinary super-cooling is added only in the double diagram of Fe—C, which is unreasonable. We must have important reasons to justify the addition of super-cooling in the diagram, and the metastable equilibrium lines added should have been clearly proved by experiment; but neither condition is fulfilled. The double diagram includes the super-cooling at the eutectic but not that at the eutectoid (martensite formation is never included). This, again, is a self-contradictory feature of the double diagram.

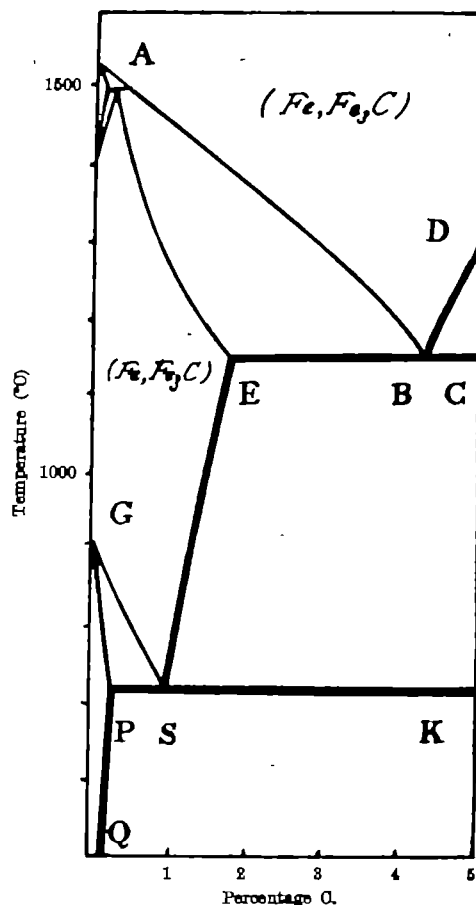


Fig. 1.

NEW EQUILIBRIUM DIAGRAM. LOW TEMPERATURES:
STABLE EQUILIBRIUM Fe—C; HIGH TEMPERATURES:
STABLE EQUILIBRIUM Fe—Fe₃C.

Fig. 1 shows a new equilibrium diagram. Super-cooling is omitted, thus avoiding all the difficulties of the double diagram. It shows a stable equilibrium, assuming Fe₃C to decompose on solidifying or on separating from austenite, eliminating the two difficulties of the single diagram.

The details will be published in the report of this Institute.

ICHIRO IITAKA.

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July 9.

Diffraction of Slow Positive Ions

AN experimental method has been developed which permits photographic recording of the scattering of slow positive ions through angles of a fraction of a degree. This is accomplished by using a very fine, electrostatically focused incident beam and accelerating the ions, *after the scattering*, to a velocity high enough to affect a photographic plate. The high-voltage electrostatic lens used to give the acceleration also produces an angular magnification of the scattered rays.

Fig. 1 shows the scattering of lithium ions by a jet of sodium vapour, photograph *a* for 292 volt ions, *b* for 149 volt ions. Around the central spot is a sharply defined disk of nearly uniform intensity, having an angular radius of 0.0083 radians for the faster ions and 0.0161 for the slower ions. The plates also show a faint halo surrounding the disk and separated from it by about a quarter of the disk's diameter.

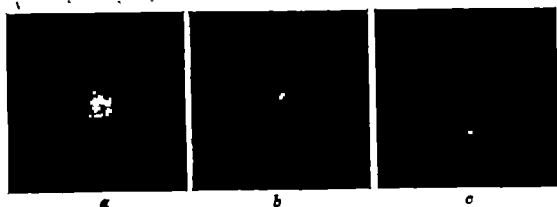


Fig. 1.

The pattern appears, at first sight, to resemble the diffraction of light by an opaque circular obstacle. However, a wave theory in which the atom and ion are treated as hard spheres gives a value of only 1 Å. for the collision radius and also predicts a wrong variation of disk radius with ion energy. The repulsive field model considered theoretically by Massey and Smith¹ gives a monotonic decrease of elastic scattering with increasing angle and therefore also fails to account for the effects.

A satisfactory explanation of the results has been found which seems definitely to establish the wave nature of lithium ions. The essential features of the theory are the inclusion of the attractive force due to polarization of the sodium atom, and the division of the ion wave-front into three distinct parts corresponding, respectively, to exceedingly small, large and intermediate scattering angles.

The first part is taken in such a way that the retardation produced by the potential field of the atom is everywhere less than half a wave-length. Under these conditions there is negligible refraction of the wave-front and only slight diffraction corresponding to a large circular obstacle (in atomic units). This gives a central Airy's disk of about 0.0006 in angular radius, which is considerably less than the angular radius of the incident beam. The second or innermost part of the wave-front is where the retardation varies very rapidly, corresponding to large angle scattering.

The remaining annular part of the wave-front is what produces the observed pattern. Now, the calculations show that the retardation varies almost linearly across the width of this region and a hollow cone of rays would therefore be produced, were it not for diffraction. This has the effect of filling up the inside of the cone and also producing fringes, spaced in accordance with the width of the annulus.

The fringes inside the cone are smoothed out by overlapping, thereby giving the observed uniform disk. The separation of the halo from the edge of the disk is related directly to the width of the annulus.

The calculations have been made for a force of the form²

$$F(r) = \frac{2\alpha s^2}{r^6} \left[1 - \left(\frac{r_0}{r} \right)^4 \right]$$

where α is the polarizability of the sodium atom and r_0 the equilibrium nuclear separation of Na Li⁺. For both 292- and 149-volt ions the observed radii of disk and halo agree, within the limits of the experiment, with those calculated for $\alpha = 2.5 \times 10^{-24}$ cm.³ and $r_0 = 2.36$ Å. Since only two observations are needed to fix both α and r_0 , this means that the theory correctly accounts for the observed variation of both radii with energy. The value of α fits in with the values found experimentally for Li, K and Cs by Scheffers and Stark³, and r_0 is consistent with the spectroscopic values⁴ of 2.67 and 3.07 for the neutral molecules Li₂ and Na₂. From the values of α and r_0 the binding energy of Na Li⁺ works out at 2.9 volts.

Fig. 1, *c*, shows the grazing-angle scattering of 292-volt lithium ions by a red-hot nickel target. As with sodium, there is a sharp intensity discontinuity, but the pattern has an approximately elliptical, and not circular, outer boundary.

A qualitative explanation of the effect is possible in terms of diffraction by single protruding surface atoms, using the same annular slit model as before, but with some allowance for the underlying atoms. The latter have the effect of smoothing out the potential behind the diffracting atom and consequently lessening the retardation gradient across the slit at that point. The pattern should accordingly be contracted in a direction normal to the target surface, as it actually is. It must be noticed that the retardation gradient across the slit bends the wave-front *towards the atom*, and therefore the part of the wave-front passing in front of the atom does not contribute to the pattern.

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¹ *Proc. Roy. Soc., A*, **142**, 143 (1933).

² *Hame and Cook, Phil. Mag.*, **12**, 551 (1931).

³ *Phys. Z.*, **35**, 625 (1934).

⁴ *Sponer, "Molekularspektren, I", Tabellen.*

Vibration Temperature in relation to Rotation Temperature in Band Spectra

THE problem of exciting band spectra of two different molecules in the same source has attracted some attention of late. Investigation of excitation temperatures of molecules under these conditions has given interesting results which require elucidation from theory. For example, Lochte-Holtgreven¹ found by examining CH and C₂ bands in the same discharge tube a temperature difference of more than 1,000° between the two. On the other hand, van Wijk² arrived at a common effective temperature from the negative (N₂⁺) and second positive (N₂) bands of nitrogen in the same discharge tube. In view of these results, it was deemed necessary to undertake further work on the same lines.

The present investigation deals with AIO blue-green and CN violet systems excited in the same

arc and photographed simultaneously. The gross intensity measurements of all the bands in the two systems have been made by the methods of photographic spectral photometry by comparison with a standard source of known energy distribution. On the assumption of a Boltzmann distribution of vibrational energy in the initial state, temperatures have been calculated. These are shown below and compared with the results from the rotational energy distribution of previous authors for the same molecules examined in the carbon arc.

Band systems	Vibration temperatures (T. and T.)	Rotation temperatures (Ornstein and Brinkman)
CN, $B^2\Sigma \rightarrow \alpha^2\Sigma$	6300° K.	6500° K.
AlO, $^2\Sigma \rightarrow ^2\Sigma$	3460° K.	3275° K.*

* This is taken as the mean of two temperatures from 0,0 and 1,0 bands of AlO

It may be noted that the effective vibration temperatures of column 2 above agree fairly closely with the rotation temperatures of Ornstein and Brinkman. They are an indication of temperature equilibrium in the source (carbon arc) examined, as the values are supposed to be in the neighbourhood of the true temperatures for the zones concerned, for the CN bands are emitted from the inner violet part and AlO bands from the outer green halo.

The details of the investigation are being published elsewhere in a separate paper.

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August 5.

S. Phys., 64, 443 (1930); 67, 590 (1931).

S. Phys., 69, 313 (1930).

Proc. R. Acad. Amsterdam, 84, 498 (1931).

Intensity and Structure Changes of the $L\alpha$ Emission Lines of Cu and Fe on Intense Cooling of their Anticathodes

THE only previous experiments on the effects of temperature of the anticathode on the changes in the character of X-ray lines either in absorption or emission, are those of H. S. Read¹, J. H. Purks² and F. O. Chalklin³. These investigations, as also those of J. D. Hanawalt⁴, who studied changes in the fine structure of X-ray absorption spectra dependent on the physical and chemical nature of the absorber and temperature, were all concerned with the effects of high temperature alone. So far as we are aware, except for the experiment of Swedenborg and Claesson⁵, whose results were published while our experiments were in progress, there seems to be no record of any experimental investigations of the effect on the character of the X-ray lines emitted of intensely cooling an anticathode.

For effectively cooling the target, we had recourse to rapid evaporation of liquid oxygen from a specially designed anticathode tube. A plane grating spectrograph of the type devised by Siegbahn and Magnusson and constructed by Messrs. Adam Hilger, Ltd., was employed; while a molecular pump supplied by Leybold Nachfolger backed by a suitable oil pump was used for exhausting the apparatus. The grating used was ruled at Uppsala and had 900 lines in a space of 8 mm. Exposures were made first with liquid oxygen evaporating and then with tap

water circulating through the anticathode tube, on the same photographic plate. The time of exposure, bombarding electronic current (70 ma.) and the accelerating potential (4.8 kV.) were all kept constant during the two exposures. Although the grating used did not possess sufficient dispersion to resolve the L lines clearly, making quantitative measurements difficult, yet microphotometric studies of the photographs obtained have yielded the following interesting preliminary results:

(a) The line-curves of Cu and Fe L -lines possess considerable spread on the long-wave side but are steeper on the short-wave side at both the liquid oxygen temperature ($-188^\circ\text{C}.$) and room temperature ($25^\circ\text{C}.$) of the targets.

(b) The intensity of the Cu $L\alpha$ -line at the liquid oxygen temperature of the target is only 70 per cent of that from the target at room temperature. The corresponding figure for Fe is about 60 per cent.

(c) Although L -lines are not clearly resolved by the spectrograph used, which has a dispersion only of 4.95 Å. per mm., there is unmistakable evidence of their shift relatively to one another with the temperature change of the target.

(d) Some changes in the widths of the lines are also suggested with the change of temperature of the target.

The experiment is being repeated with a new plane grating possessing double the dispersion of the former, the experimental arrangements remaining more or less the same. It is hoped that it will be possible, on the conclusion of the experiments now in progress, to give definite quantitative results of measurements.

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¹ Read, H. S., *Phys. Rev.*, 27, 373 (1926).

² Purks, J. H., *Phys. Rev.*, 26, 352 (1927).

³ Chalklin, F. O., *Proc. Roy. Soc., A*, 155, 306 (1936).

⁴ Hanawalt, J. D., *Phys. Rev.*, 27, 715 (1931); 41, 399. (1933).

⁵ Swedenborg, H., and Claesson, M., *Ann. Phys.*, 23, 159 (1937).

Surface Tension of Strong Electrolytes

Jones and Ray¹ have recently found that on adding a salt to water the surface tension at first decreases, then passes through a minimum and finally at concentrations above about 0.001 N increases with increase of concentration. The interionic attraction theory of surface tension developed by Wagner² and Onsager³ on the basis of the Debye solution theory and the principles of electrostatics requires, however, the slope of the surface tension-concentration curve always to be positive and greater at the lower concentrations. The accurate results of Jones and Ray are thus seen to be in complete disagreement with theory.

By postulating that the surface structure of water is such that there is a small number of surface locations where negative ions can become adsorbed from the interior of the solution with a large diminution of potential energy, it is possible to derive statistically the following equation for the number of moles of an ion kind adsorbed per sq. cm.

$$\Gamma_i = -ck_i \left[\frac{a - \{b - ck \sum v_i\} e^{-W/RT} - ck_i v_i}{(b - ck \sum v_i) e^{-W/RT} + ck_i v_i} \right] \quad (1)$$

which when coupled with the Gibbs adsorption isotherm yields (neglecting activity coefficients)

$$\gamma - \gamma_0 = RTkc \Sigma v_i + \frac{aRT \Sigma v_i}{\sigma W_- / RT \Sigma v_i - v_-} \ln \left[1 - \frac{(\sigma W_- / RT \Sigma v_i - v_-)kc}{\sigma W_- / RT} \right] \quad (2)$$

The term $\sigma W_- / RT \Sigma v_i$ can be shown to be very much smaller than v_- , with the result that (2) reduces to

$$\gamma - \gamma_0 = RTkc \Sigma v_i - \frac{aRT \Sigma v_i}{v_-} \ln \left[1 + \frac{kv - \sigma}{\sigma W_- / RT} \right] \quad (3)$$

where γ is the surface tension at concentration c (moles per litre), a is the number of adsorbing points per sq. cm., b is the number of water molecules per sq. cm., W_- is the potential energy of the negative ion at the surface in excess of its value in the interior of the liquid, and k is the ratio between the concentration in moles per sq. cm. and moles per litre, and depends on the thickness of the adsorbed layer, which we take as the diameter of the water molecule plus that of the adsorbed solute.

Knowing the diameters of the water molecule and of the solute ions, and estimating a and W_- from the data of Jones and Ray, it is possible to calculate the surface tension from (3) for potassium chloride solutions, for example (lower solid line of Fig. 1), and to compare with the experimental results (crosses of Fig. 1). The agreement is satisfactory.

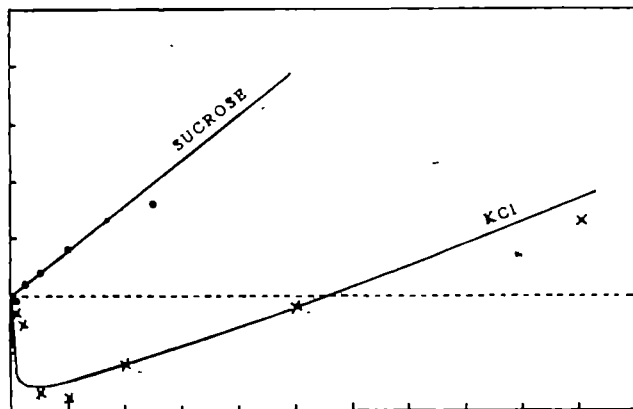


Fig. 1.

In the case of capillary inactive non-electrolytes like sucrose, a will be equal to zero and (3) becomes

$$\gamma - \gamma_0 = RTkc. \quad (4)$$

From the density of solid sucrose one can calculate an approximate value of its molecular diameter allowing an evaluation of k to be made and a computation of the surface tension from (4). The upper solid line of Fig. 1 represents the theoretical calculations, while the circles are the experimental data of Jones and Ray. Again the agreement seems to be satisfactory, and lends support to the original postulate.

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July 19.

¹ Jones, Grinnell, and Ray, W. A., *J. Amer. Chem. Soc.*, **59**, 187 (1937).

² Wagner, O., *Phys. Z.*, **25**, 474 (1924).

³ Onsager, L., and Samaras, K. N. T., *J. Chem. Phys.*, **2**, 528 (1934).

Viscosity of Monomolecular Films

ALTHOUGH the viscosity relations of films are of fundamental importance for an understanding of their structure, it has not in the past been possible, with the surface viscosimeters used, to determine the viscosity of a true film, that is of a monolayer. Two viscosimeters which are sufficiently sensitive are described below, and others are in process of development.

1. *Capillary slit viscosimeter for liquid surface films.* The film is allowed to flow under its own pressure, or a difference of pressure, through a long transverse slit in a barrier which confines the film. The following relation gives the viscosity (η):

$$\eta = \frac{f}{Q} \frac{d^3}{12l} \text{ dyne sec. cm.}^{-1},$$

where f is the surface pressure in dynes per cm., d is the diameter; and l the length of the slit, and Q is the number of sq. cm. of film which disappears through the slit per second.

VISCOSITY OF SURFACE FILMS OF FATTY ACIDS IN SURFACE PORES

No. of C Atoms	Saturated Acids at 25°C.
14	Myristic 0.000161
15	Pentadecylic 0.000228
16	Palmitic 0.000248
17	Margaric 0.000317
18	Stearic 0.000307
19	Nonadecanoic plastic solid
20	Arachidic 0.001790
18	Unsaturated Acid at 20°C. 0.000162
	Oleic

2. Torsion ring surface viscosimeter for liquid and plastic-solid films.

A torsion pendulum, with a horizontal circular disk at the bottom, was constructed. This disk may be allowed to vibrate in the surface, but is insensitive to the film. A thin metal cylinder, 1 cm. high, was soldered to the outside of the ring in such a way that only the sharp lower edge of this cylinder could be put in contact with the surface of the water. By allowing this ring (10 cm. in diameter) to vibrate in contact with the clean surface, and then with a film outside, but not inside the ring, the viscosity of the film could be calculated from the logarithmic decrements of angle between successive swings.

This instrument gave data of great interest. For example, cetyl alcohol on 0.01 molar hydrochloric acid at 22°C. compresses at very low pressure to a liquid monolayer of 21 sq. A. area per molecule. As the pressure is increased, the viscosity of the liquid film increases, as is shown by both types of viscosimeter. The force-area relation is linear to 11 dynes and 19 sq. A., and at this kink point a change of phase occurs, in which a plastic solid film of very much higher viscosity and lower compressibility appears. The viscosity of this film increases rapidly with pressure. Pentadecylic acid, which forms an expanded film the pressure of which begins to increase above 0.1 dyne per cm. at 44 sq. A., forms a liquid film both below and above the kink, and the solid plastic form appears where no kink is visible at a molecular area of 21 sq. A.

The viscosity of monolayers is found to be highly dependent upon the tightness of packing of the molecules in the film, and, as the table indicates, it increases rapidly with the length of the molecule in condensed films which exhibit an orientation of the molecules perpendicular to the surface.

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University of Chicago.

ROBERT J. MYERS.

Spectroscopic Observations of Reactions between Lactoflavin, the Coulter Compound, 'Cytochrome b', and Cytochrome c

FROM diphtheria toxin, one of us (M. D. E.) has prepared a solution containing the "complex porphyrin" of Coulter¹, and also a compound characterized by an α -band located in the same position as that of cytochrome b (563 m μ). The preparation will be described elsewhere.

When oxidized lactoflavin was added to this solution, at 30° C. and pH 7.4, the 574 m μ and 563 m μ bands disappeared instantly. When lactoflavin was reduced by hydrosulphite, the 574 m μ and 563 m μ bands reappeared at once. The 574 m μ and 563 m μ compounds must therefore be in the reduced state.

Reduced cytochrome c was added next to this solution. A paradoxical phenomenon was observed: the 574 m μ and 563 m μ bands again disappeared, as if reduced cytochrome c had oxidized the reduced 574 m μ and 563 m μ substances. Cytochrome c was obtained from a stock solution by acetone precipitation; the stock solution had been prepared in Prof. Keilin's laboratory by Dr. F. Stare.

In a separate experiment, oxidized cytochrome c was added to the solution of 574 m μ and 563 m μ substances. All the bands remained unchanged, indicating that no reaction had occurred.

Lactoflavin is not necessary for the reaction between reduced cytochrome c and the reduced 574 m μ and 563 m μ substances. This was shown by adding reduced cytochrome c to the 574 m μ and 563 m μ compounds. The 574 m μ and 563 m μ bands disappeared. This reaction can be partly reversed by the immediate addition of a few drops of 5 per cent potassium ferriyanide solution. Oxidized cytochrome c appears, and the 574 m μ and 563 m μ bands re-appear in diminished strength. The 574 m μ and 563 m μ substances alone do not react with ferriyanide. A solution containing the 574 m μ compound alone reacted exactly like the mixture of the 574 m μ and 563 m μ compounds.

The following hypothesis summarizes the observations and interprets the paradox: when the iron atom of cytochrome c is in the divalent state, the 574 m μ and 563 m μ compounds can be oxidized by the porphyrin ring of cytochrome c; but when the iron is in the trivalent state, the porphyrin ring cannot oxidize the 574 m μ and 563 m μ substances.

These reactions between cellular catalysts are interesting in themselves. In addition, a more exhaustive investigation will bring out whether or not they are related to the Pasteur reaction.

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¹ Coulter and Stone, *J. Gen. Physiol.*, 14, 583 (1930/31).

Oxidation of Cholesterol and Dehydroandrosterone by Means of Osmic Acid

UNSATURATED compounds are known to add, under the action of osmic acid, two hydroxyl groups at the place of their double bond¹, these groups being in *cis*-position with regard to each other. The reaction course is analogous to that produced by KMnO_4 . However, action of the latter on cholesterol¹ yields but 4-5 per cent of *cis*-cholestan-triol. Thus KMnO_4 is unsuitable for the oxidation of the double bond in

sterol-derived hormones, in particular in dehydroandrosterone.

After we had obtained *trans*-androstan-(17)-one-(3,5,6)-triol from dehydroandrosterone oxide² we desired to obtain also the *cis*-compound for the sake of comparing their physiological activities. The method has been worked out for cholesterol⁴, then transferred to dehydroandrosterone.

Equivalent amounts of anhydrous cholesterol and osmic acid, dissolved in water-free ether, are allowed to react for 2-3 days. The ether is then distilled off and the black residue boiled with an aqueous-alcoholic solution of Na_2SO_3 for two hours. When working with cholesterol only traces of the looked-for product—cholestan-triol—are found in the water-alcohol filtrate; most of it is obtained by extracting the black residue with boiling alcohol. The *cis*-cholestan-triol obtained melted, after washing with ether, at 238.5-239.5°. Mixed with the *trans*-compound it caused depression of the melting point.

On oxidizing dehydroandrosterone with OsO_4 , almost the whole of the androstanone-triol passes into the aqueous-alcoholic solution (after boiling with sulphite). Yield of the crude product: 70 per cent. Recrystallized from ethyl-acetate; transparent rectangular prisms, m.p. 243.5-244° (corr.; sinters at 242.5°). Analytical data agree with the formula $\text{C}_{19}\text{H}_{28}\text{O}_4$.

We intend applying the same method also to androstene-diol, androstene-dione and testosterone.

The present work is to be published shortly in detail.

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¹ Details in the recent paper by Orlegue, R., *Ann.*, 532, 75 (1936), where the literature is cited.

² Windaus, A., *Ber.*, 40, 257 (1907).

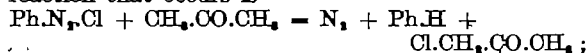
³ Ushakov, M., and Lutenberg, A., "Dehydroandrosterone oxide", in press in *Journal Obshchey Khimii and Bull. Soc. Chim. de France*.

⁴ Orlegue (loc. cit.) mentions having obtained some *cis*-diols of the sterol group; he does not give any details, nor mention what sterols he worked with.

Decomposition of Benzene-Diazonium Chloride

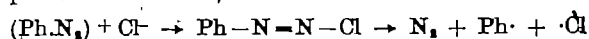
To test the suggestion¹ that the decomposition of aromatic diazo compounds might be non-ionic in mechanism, I have been investigating the decomposition of benzene-diazonium chloride in the presence of non-aqueous solvents. When suspended in an organic liquid, benzene, diazonium chloride appears to melt at about 50° C. and then immediately a violent decomposition sets in. There is great heat evolution, and, except on the small scale, the reaction tends to become explosively violent. Often hydrogen chloride is evolved, and whenever its formation has been observed, chlorobenzene has been found amongst the reaction products.

From an examination of the decomposition in acetone, it appears possible that the chlorobenzene is produced by a secondary reaction between the decomposing benzene-diazonium chloride and the hydrogen chloride, since when an excess of chalk is added to keep the mixture neutral, the principal reaction that occurs is



for both benzene and chloroacetone were isolated in good yield.

Since chloride anions do not attack acetone, it follows that the decomposition of benzene-diazonium chloride, $(\text{Ph.N}_2) + \text{Cl}^-$, is not a direct decomposition of a diazonium cation, nor yet an intramolecular process. The mechanism:



diazonium salt covalent diazo-compound free neutral radicals

will accord with facts. When this decomposition in acetone, kept neutral with chalk, is carried out in the presence of the relatively inert metals antimony, bismuth, lead and mercury, a rapid reaction occurs at room temperature and the metal is attacked. With mercury, phenyl-mercuric chloride is produced.

These reactions with metals are undoubtedly similar to those which I have previously observed during the decomposition of benzene diazo-acetate¹, and are closely paralleled by the observations of Neamejanov and his colleagues², who have obtained organometallic compounds by decomposing certain diazonium double salts with metals such as copper, tin and zinc.

To substantiate the experimental evidence reported above, the work is being extended to reaction in other organic liquids.

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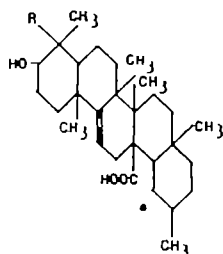
Aug. 6.

¹ Waters, *J. Chem. Soc.*, 114 (1937).

² *Ber.*, 68, 1010, 1018 (1929); 68, 1877 (1935).

Structure of β -Boswellinic Acid

THE investigations of Ruzicka, and of Winterstein and their co-workers, have shown that the majority of the triterpene acids (hederagenin, gypeogenin, oleanolic acid, sial- and suma-resinolic acids) are in all probability θ -hydroxy- γ : δ -unsaturated mono-basis acids, as indicated in the accompanying formula¹. On



the other hand, β -boswellinic acid, $\text{C}_{30}\text{H}_{48}(\text{OH})\text{COOH}$, one of the principal triterpene constituents of frankincense, evidently possesses a somewhat different constitution, for on mild oxidation with chromic anhydride this acid is converted into a monoketone $\text{C}_{30}\text{H}_{46}\text{O}$, m.p. 196° (found: C, 84.53; H, 11.11. $\text{C}_{30}\text{H}_{46}\text{O}$ requires C, 84.80; H, 11.30 per cent), which has been characterized by the preparation of an oxime. Oxidation under similar conditions of β -boswellinic methyl ester, however, furnishes the corresponding keto-ester, m.p. 160° (found: C, 79.12; H, 10.20. $\text{C}_{29}\text{H}_{44}\text{O}_2$ requires C, 79.41; H, 10.33 per cent), which forms an oxime, m.p. 200° .

These findings necessitate the assumption that β -boswellinic acid is a β -hydroxy-acid, the expected

facile elimination of carbon dioxide from the β -keto-acid first formed during the oxidation giving rise to the ketone $\text{C}_{30}\text{H}_{46}\text{O}$. The requisite grouping

$-\text{CH}(\text{OH})\cdot\text{C}\cdot\text{COOH}$ may be derived from structure I by putting $\text{R} = -\text{COOH}$.

It is of interest to note that in gypeogenin $\text{R} = -\text{CHO}$, and in hederagenin $\text{R} = -\text{CH}_2\text{OH}$, and it is significant that oxidation of the primary alcoholic group of the latter compound gives a β -hydroxy-acid, the further oxidation of which is exactly analogous to that of β -boswellinic acid².

A full account of this investigation will be published elsewhere.

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July 26.

¹ Ruzicka, Goldberg, and Hofmann, *Helv. chim. Acta*, 20, 325 (1937).

² Jacobs and Gustus, *J. Biol. Chem.*, 60, 641 (1923).

Succession of Broods in *Lebistes*

IN connexion with the note by G. L. Purser in NATURE of July 24 on "Succession of Broods of *Lebistes*", it has long been known that several of the viviparous fish, such as *Lebistes*, are fertilized for a long time after one copulation. E. Philippi has described this phenomenon in *Glaridichthys*¹. Johs. Schmidt found it in *Lebistes*². He says that he had observed seven broods in succession. I have noted up to eight broods³.

In my paper in 1922 I gave a photomicrograph showing the spermatozoa lying ready in the ovary for the next fertilization, with their heads as near the immature eggs as possible. Plainly enough there is competition between the spermatozoa, and it is remarkable that when a female has been fertilized by a male of one race of *Lebistes* and has produced some few broods within a few months, and then a new male of another race of *Lebistes* is put into the tank immediately after a birth, the next brood will be from fertilization by the new male. The old spermatozoa cannot compete with the fresh ones. Ordinarily a mixed brood is only obtainable when both males are together with the female at the same time.

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Carlsberg Laboratory,
Copenhagen.
August 13.

Zoo. Jahrb., 27 (1906).

² *Comptes-rendus Laboratoire Carlsberg*, 14 (1920).

³ *J. of Genetics*, 12 (1923); 13 (1927).

Homologous Loci in Wild and Cultivated American Cottons

ON cytological grounds¹, the New World cultivated cottons are thought to be allopolyploids with two genomes each of thirteen chromosomes derived from species cytologically homologous with the present Asiatic *arborum-hortacorum* group of species and with the North American thirteen chromosome species (*aridum*, *Armourianum* and *trilobum*). Genetical confirmation of the part played by the present cultivated Asiatic cottons or their ancestors in the origin

of the New World cultivated group, was later provided by my demonstration² that a gene could be transferred from an Asiatic to a New World cotton by repeated back-crossing.

Genetical confirmation is now available regarding the existence in the thirteen-chromosome North American species of genes which have alleles in the cultivated cottons with $n=26$ chromosomes. Hybrids between *G. barbadense* L. (Sea Island) and the wild species *G. aridum*, *G. Armourianum* and *G. trilobum* were found to be weakly fertile on the male side. After making two successive back-crosses of the hybrids with *barbadense* or *hirsutum*, fertility was completely restored, and the following transferences of genes from the wild to the cultivated species were effected:

1. Normal (σ^r) from *aridum* to *barbadense* (σ^r).
2. Normal (σ^r) from *Armourianum* to *barbadense* (σ^r).
3. Normal (σ^r) from *trilobum* to *barbadense* (σ^r).
4. (S^B) Petal Spot from *aridum* to *barbadense* and *hirsutum*.
5. (SAB) Petal Spot from *Armourianum* to *barbadense*.

The slight impairment of dominance of the crinkled heterozygotes of *aridum* and *trilobum* which persists in the second back-cross of *barbadense* crinkled,

suggests that the normal alleles of these species may not be identical with the *barbadense* normal allele, but may differ in dominance potency. If they prove to differ in this way, they will resemble the weaker normal alleles at this locus established to be present in upland cotton (*G. hirsutum* L.).

The genes for petal spot of *aridum* and *Armourianum* respectively appear to be different from the petal spot genes of either *barbadense* or *hirsutum*, but their relationship with the spot genes of these species has not yet been elucidated.

To sum up: it is now established on genetical as well as cytological grounds that the New World cultivated cottons are amphidiploid in origin and that thirteen-chromosome species from both Asia and North America have played a part in their formation. My previous hypothesis³ that the New World group originated in late Cretaceous or early Tertiary time in a former Polynesian land mass also receives further support.

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July 19.

¹ *Ann. Bot.*, **47**, 227 (1933). *J. Genet.*, **23**, 407 (1934). *Emp. Cotton Grow. Corp.*, Rept. 2nd Cong., 46 (1934). *J. Genet.*, **20**, 447. *J. Agric. Res.*, **51**, 1047.

² *J. Genetics*, **30**, 465.

Points from Foregoing Letters

Dr. G. W. Brindley and P. Ridley discuss the two kinds of asymmetry found in certain metals having a hexagonal structure—symmetry of the lattice vibrations and asymmetry of the atoms. It is pointed out that in ruthenium the atomic asymmetry is of a different type from that found in zinc and cadmium.

A new equilibrium diagram for the system iron-carbon has been prepared by Dr. I. Iitaka. The author claims that it eliminates the difficulties of the 'single' diagram by assuming Fe_3C to decompose on solidifying or on separating from austenite, and overcomes those of the 'double' diagram by omitting super-cooling.

Photographs showing the scattering of lithium ions by sodium vapour and by a red-hot nickel target (at grazing angle) are submitted by A. G. Emalie, who also supplies an explanation which, he considers, establishes the wave nature of the lithium ions.

By photographing AIO blue-green and CN violet bands simultaneously in the same arc, gross intensities of both have been measured by Dr. N. R. Tawde and S. A. Trivedi by the methods of photographic spectral photometry. Vibration temperatures have been calculated and compared with the available rotation temperature data on these molecules.

Intense cooling of copper and of iron anticathodes changes the character of the X-rays which they emit. Prof. K. Prosad and A. T. Maitra find that the intensity of the copper L_{α} line is decreased at liquid oxygen temperature. The L -lines shift relatively to one another, and there are indications of changes in width.

Prof. M. Dole suggests a formula for calculating the surface tension of strong electrolytes which gives calculated values in satisfactory agreement with those found experimentally for potassium chloride solutions, including the observed decrease in surface tension at low concentrations. The formula is obtained by postulating a small number of surface

locations where negative ions can be adsorbed from the interior of the solution with a large diminution of potential energy.

Two methods for measuring the viscosity of monomolecular films are described by Prof. W. D. Harkins and R. J. Myers: one, in which the film flows through a transverse slit in a barrier confining the film, and another method depending on the vibration of a ring the inner circumference of which is in contact with a pure surface while the outer is in contact with the film. A table giving viscosities of fatty acid films shows that the viscosity increases rapidly with the length of the molecule.

Prof. F. Urban and Dr. M. D. Eaton describe several reactions between laetoflavin, cytochrome *c* and the "complex porphyrin" of Coulter (prepared from diphtheria toxin). The authors infer that the porphyrin ring of cytochrome *c* can oxidize the compounds in Coulter's complex (which are responsible for the absorption bands at 574 m μ and 583 m μ) only when the iron atom of cytochrome *c* is in the divalent (reduced) state, and not when it is in the trivalent state.

The oxidation of the male sex hormone, dehydroandrosterone, by osmic acid to produce the α is form of androstanone-triol, by addition of two hydroxyl groups, is described by Prof. M. Ushakov and A. Lutenberg.

Dr. W. A. Waters finds that when benzene-diazonium chloride decomposes in acetone in presence of chalk, benzene and chloroacetone are formed, and if metals such as lead, antimony or mercury are present, these are attacked. The reactions are explained by supposing that free neutral radicals are liberated as the diazo compound decomposes.

From the products of oxidation of β -boswellinic acid (one of the principal constituents of frankincense) Dr. J. C. E. Simpson concludes that the compound is a β -hydroxy-acid.

Research Items

Antiquity of Man in Rhodesia

WITH the view of determining the disputed question of the age of the stone implements of the Zambesi gravels, first described in 1905, the Rhodesian Archaeological Expedition of 1929 undertook to investigate the antiquity of man in Rhodesia as demonstrated by the implements occurring in the gravels south of the Falls, their cultural sequence and the relation, if any, of the gravels and their contents to the stages in the recession of the Falls and the excavation of the Zambesi gorge. The results of the archaeological investigation have now been reported by Mr. A. Leslie Armstrong and the Rev. Neville Jones, while the necessary geological preliminary considerations are embodied in notes on the geology of the area by H. B. Maufe, director of the Geological Survey of Southern Rhodesia (*J. Roy. Anthropol. Inst.*, 66, 2). The conclusions are summarized as follows: Over the area examined south of the Falls, the Zambesi formerly flowed over the site of the existing gorge at a level comparable with that of the river to-day north of the Falls, and more than 400 ft. above its present level. The terrace gravel and the old river-bed gravel are true residual Zambesi gravels, deposited when the river flowed over the site of the present gorge. The contained implements of Lower and Middle Palaeolithic type are at least as old as the gravels in which they occur. The implements belong to a definite sequence of seven cultural groups from Pre-Challeian to Bambata (Aurignacian). With the exceptions of groups (1) and (7) the cultures represented are South African equivalents of the recognized European series, occurring in the same order of succession, at least as ancient in time, and showing close parallels in type and technique thereto. The Pre-Challeian implements are the earliest recognizable traces of man's occupation of the valley, and antedate the erosion of Gorge 5, the Falls then being to the south. The successive stages in the recession of the Falls and erosion of the Gorge since Pre-Challeian times can be related to the successive stages of culture. Since Pre-Challeian times, two arid and two pluvial periods have supervened. Man in Rhodesia is of an immense antiquity, at least equal to man in Europe.

Colour Changes in Elasmobranch Fishes

THE question of the control of the colour changes that occur in the elasmobranch fishes is a vexed one, and indeed the method may not be the same in different members of the group. Light has been thrown on the subject by G. H. Parker (*Proc. Amer. Phil. Soc.*, March 1937). The animals were anaesthetized by immersion in very cold water, a method that has advantages over anaesthetizing by drugs. The dark phase is induced by a neurohumour produced by the posterior lobe of the pituitary gland. The pale phase in *Raja erinacea* is due to the absence of a dispersing factor and in *Mustelus canis* and *Squalus acanthias* in part to nervous action. The concentrating neurohumour in the last two species is in the nature of a lipohumour soluble in olive oil but not in water, and a stable substance possibly a sterol.

Feeding Mechanism of *Apsoudes*

THE Crustacean *Apsoudes* is of special interest to the morphologist since it links the Isopoda with the primitive Mysidacea, which are presumed to form the starting point of the Peracaridan series. Very little, however, is known of its habits and mode of life. This deficiency is in part supplied by R. Dennell in a finely illustrated memoir (*Trans. Roy. Soc. Edin.*, 59, Pt. 1, No. 2, 1937) in which the method of feeding is discussed in relation to the evolution of the feeding mechanisms in the Peracarida. The exact relations of mouth-parts, carapace and associated structures are described in greater detail than has hitherto been done, and the mode of action partly described from observations on the living animal and partly inferred from a study of anatomical relations. It is concluded that the essential features of the primitive Peracaridan filter-feeding mechanisms are represented, but that this method of obtaining food is of little importance and is in process of replacement by raptatory feeding, which is the method followed by most Isopoda. Modifications in the carapace and particularly in the organs concerned in maintaining the respiratory current are adaptations to life in a muddy habitat.

Egg-Killing Washes

It has been shown that the ovidical properties of tar oils to *Oheimatobia brumata* L., *Lygus pabulinus* L., *Plesiocoris rugicollis* Fall. and *Psylla mali* Schm. increase with increase in boiling range. Petroleum oils, however, although their general insecticidal properties are known to increase with boiling range, fail to inhibit the hatching of aphid and psyllid eggs, which has led to the suggestion that ovidical action to such eggs is associated with a chemical toxicity possessed by tar oils but not, in general, by petroleum oils. Moreover, some diversity of evidence exists regarding the relative toxicity of high- and low-boiling tar oils to *Aphis pomi* De Geer. Kearns, Martin and Wilkins (*J. Pom. and Hort. Sci.*, 15, 1, 56; 1937) have investigated this discordance in an examination of the comparative ovidical efficiencies of high- and low-boiling oils, the validity of solubility in dimethyl sulphate as a criterion of toxicity and the importance of chemical composition. A wide range of tar and petroleum oils was tested and parallel chemical analyses carried out together with determinations of boiling ranges and solubilities in dimethyl sulphate. Ovidical efficiency showed no relation to the total content of hydrocarbon oil in the emulsions, but was highly correlated with the content of neutral oils soluble in dimethyl sulphate. The toxicity of oil from which certain oxygenated derivatives were removed by fractionation with hydroferriehloric acid was not significantly different from untreated oil, and an examination of a number of individual compounds for possible toxic properties gave no indication of any specificity of this kind. In the absence of any large differences in the ovidical properties of high-boiling neutral oils soluble in dimethyl sulphate derived from various sources, the solubility test is regarded as an adequate practical method of assessing the toxicity of hydrocarbon oils to *A. pomi*.

Run-off after Rainstorms

A PAPER by Mr. J. R. Daymond, an abstract of which is published in the *Journal of the Institution of Civil Engineers* (No. 7, 1936-37; June 1937), discusses the estimation of run-off from areas subjected to rainstorms in connexion with a law first proposed by Mr. Emil Kuichling in a paper contributed to the American Society of Civil Engineers (*Trans. Amer. Soc. Civ. Eng.*, 20; 1889) that "... in drainage areas of moderate size the heaviest discharge always occurs when the rain lasts long enough at its maximum intensity to enable all portions of the area to contribute to the flow. For large areas, on the other hand, a more elaborate analysis becomes necessary in order to find under what conditions the absolute maximum discharge will occur, ..." As the law is often misquoted to the extent of ignoring the proviso and is thus misinterpreted, the object of Mr. Daymond's paper is to show that the reservation regarding large area is valid and important. In addition, an important general conclusion is arrived at, applicable to all areas, namely, that provided the rain falls at a constant intensity, the storm that gives the maximum run-off is one which lasts for a time less than, or equal to, the time of flow from the farthest point of the drainage area to the point of outfall from the area.

Precursors of a Volcanic Eruption

THE tilting of the flanks of the volcano Asama (Japan) in 1936 is described by R. Takahasi and T. Minakami in a recent *Bulletin of the Earthquake Research Institute* (15, 463-491; 1937), while the changes in depth of the crater in 1934-36 are recorded by Minakami (*ibid.*, 15, 492-496; 1937). Tiltmeters were erected at three stations, 4 km. east, 5 km. north, and 12 km. south-west of the crater. In 1936, explosions were frequent in February-March and July-August, and, during intervals of 7-30 days before then, marked changes of tilt were recorded almost simultaneously at the three stations, the variations being about five times as large as those observed during intervals of quiescence and being clearly independent of changes in air temperature. The tilts were accompanied by remarkable uplifts of the crater floor as a whole. The depths of several points on the floor were determined by triangulation from stations on the crater rim. After a pause of inactivity in July-October 1934, the floor began to rise, the uplift being about 70 m. by the time of the violent explosions on April 20, 1935.

Surface Layers on Glass and Silica

LORD RAYLEIGH (*Proc. Roy. Soc., A.*, 160, 514) observed that there was always some reflection from the boundary when polished glass surfaces were put in optical contact. Further investigations were made by immersing plates of glass or silica in a liquid adjusted to have the same refractive index as the bulk material. The reflection from fire-polished surfaces was found to be very low, but the reflection from surfaces which had been polished was quite appreciable, indicating the existence of a surface film of refractive index different from the bulk material. The refractive index of the film could be determined by finding a liquid mixture which gave minimum reflection. The index rises with the violence of the polishing treatment. In the case of fused quartz ($\mu = 1.46$) the index of the surface film could be brought up to 1.6 by polishing. The modified

surface film could be removed by hydrofluoric acid. It appears to be in fact a modified form of silica, probably with a depth of about 300 Å. Similar but much less marked effects were observed with glasses, and a very small effect with crystalline quartz. Crystalline quartz surfaces can therefore be optically contacted without much reflection at the interface, due to the akin effect. It is shown that most of the reflection observed in this case is due to the distance between the contacted surfaces, which is found to be about seven times the crystal spacing of the silicon atoms.

Built-up Molecular Films

K. B. BLODGETT and I. LANGMUIR (*Phys. Rev.*, 51, 964) have been able to build up films of various stearates on glass or metal surfaces by dipping the plates through a monomolecular layer of stearic acid spread on water containing salts of barium or other metals. The monolayer is kept under two-dimensional pressure. The first layer attaches itself to the surface by its carboxyl groups as the plate is raised from the water, the second layer attaches with its molecules reversed when the plate is dipped again, and so on. The layer is thus folded back on itself at each dipping. The presence of a little copper facilitates the production of thick films, and films containing 3000 layers have been built. The films are uniaxial crystals with the optic axis perpendicular to the surface. The optical properties of the film have been studied and the ordinary and extraordinary refractive indexes are 1.491 and 1.551 respectively. If a film which has been built up on a barium solution at pH 8.5 is treated with benzene, stearic acid is dissolved out and the resulting skeleton film has a nearly unaltered thickness but a much lower refractive index.

Double Stars and Relativity

IN a paper delivered at the Tercentenary Conference of Arts and Sciences at Harvard on September 4, 1936, Prof. T. Levi-Civita shows that the relativistic equations of motion of two bodies of comparable size can be integrated by treating relativistic effects as perturbations (*Amer. J. Math.*, 59, 225; 1937). Two results are obtained, which, it is hoped, may be tested by observation of double stars. The first gives a formula for the angular precession of the periastron of the satellite star. The second is more striking. It predicts that the acceleration of the centre of mass of a double star lies entirely in the plane of the relative orbit. This acceleration may be divided into a fluctuating periodic part, and the secular part, the effects of which accumulate during the successive revolutions. The secular acceleration of the centre of mass is directed along the major axis towards the periastron of the principal star. A formula is obtained for the increase of the velocity of the centre of mass during a century, which ought to be detectable eventually by spectroscopic observation. Prof. Levi-Civita has also considered the general case of n bodies (*ibid.*, 59, 9; 1937), but in this case no definite results capable of observational test have been reached. In a discussion on this paper at Princeton (October 7, 1936), Prof. A. Einstein suggested that an extra term, corresponding to the stresses keeping a body together, was needed in the equations. Prof. Levi-Civita adopted this suggestion, but found that it did not affect the conclusions previously reached.

International Population Congress in Paris

A VERY successful Congress to discuss population problems was held in Paris on July 29–August 1 last, under the presidency of M. Adolphe Landry. The Congress was honoured by the patronage of M. Albert Lebrun, President of the Republic, who attended the opening session. Before this, on July 28, a meeting of the General Assembly of the International Population Union took place; and it may be noted that the Congress was held under the auspices of the Union, which took a definite part in the arrangements for the Congress. At the General Assembly, M. Adolphe Landry was elected president of the Union in succession to Sir Charles Close. M. Landry is a former Minister of State, whose interest in demographic matters is well known. He has written several works on the subject, particularly "La Révolution Démographique" (1934). His management of the Congress was most happy.

During the four working days of the Congress, about 170 papers were presented for reading and discussion. Abstracts of the papers were available at the opening of the Congress, but, as always happens at international meetings of this kind, individual delegates must select their lectures and must necessarily miss some contributions of importance. Some of the papers, particularly the mathematical ones, were difficult to follow at the time, but will be available for study when the proceedings are published. Perhaps the real value of these congresses consists largely in the personal contacts established between workers of different nationalities, who cease to be abstractions to each other and can use the occasion for informal discussions and exchange of views.

The Congress was divided into five sections which were simple and sufficiently comprehensive to cover the whole field. A few of the titles of the lectures will serve to give an idea of the kind of questions which were discussed, thus: "The Calculation of Death-Rates"; "Sur les possibilités de retour à l'équilibre pour une population régressive ou rétrograde"; "A Population Growth-Curve for England and Wales"; "Essai d'établissement d'un indice de densité économique de population"; "Considérations sur la politique démographique d'Auguste et ses effets"; "The Length of Life in the Early Roman Empire"; "Recent Population Movements in the Irish Free State"; "Les types de migrations"; "Die natürliche Bevölkerungsvermehrung Wiens"; "L'évolution sociale de la population italienne à travers les recensements"; "Growth of Urban Population in the United States"; "Fécondité et classe sociale en Suède"; "L'influence du chômage sur la famille"; "Die neue deutsche Bevölkerungsentwicklung"; "Rural Population and Government Policies in the United States"; "Biotypes et fécondité"; "Constitution physique de la jeunesse polonaise".

Now, this is a very mixed bag; but the various aspects of the subject are inter-linked and affect one another. It would be a mistake, for example, to discuss only the statistical side of the population question and to omit consideration of quality. In the same way, an adequate examination of present-day tendencies necessarily involves a study of what has happened in the past; and a discussion of demographic facts in one country is imperfect without reference to what is happening elsewhere.

In view of the considerable range of matter discussed and of the impossibility of being present at more than one section at a time, one can only get a limited, personal impression of the meeting, an impression to be corrected by a study of the proceedings when these are eventually published. Meanwhile, no one can have attended this Congress without having learnt something more about the intricacies of the subject than he knew on arrival. Such papers as that of Prof. Burgdörfer, for example, which dealt chiefly with the effect on the birth-rate of Germany of the new population policy in that country, have an importance for all of us. The abstract of his paper ends with the following sentence: "L'exemple de l'Allemagne prouve que, dans notre civilisation occidentale, il est possible de lutter avec succès contre la baisse du taux de natalité".

Amongst numerous other important contributions to the proceedings may be mentioned the paper by Prof. A. M. Carr-Saunders and Mr. R. S. Walshaw, on "Recent Population Movements in Ireland". The authors remark that, "There is less emigration [from Ireland] than formerly, and it is going to the United Kingdom instead of to the United States. This raises important problems for the United Kingdom, which is faced with the prospect of a declining population. The United Kingdom is still pursuing a policy of giving financial assistance to emigrants going to the Dominions. It is doubtful if this can be continued, and it is a question whether the United Kingdom will not be peopled from Ireland".

RACE AND RACIAL DOCTRINE

ONE section of the International Congress was devoted to matters coming under such heads as biometry, biotypology and heredity. Opportunity was thus afforded for the discussion of a variety of problems connected with the racial question, of which advantage was taken by the Management Committee of the Groupement d'Etude et d'Information "Races et Racisme", an organization which has undertaken the dissemination among the French people of information relating to the fallacies and consequences of the racial doctrines now current in Germany, and is responsible for the publication of the periodical *Races et Racisme* (see p. 458). Arrangements were made for presentation to the Congress of a number of communications dealing with questions bearing upon "race" and their formal discussion. The following account is based upon a report furnished by the organization.

Among those present were the veteran Prof. Franz Boas, who notwithstanding his advanced years had crossed the Atlantic from America for the special purpose of taking part, and Prof. Lips and Prof. Fairchild, also from the United States. A certain 'liveliness' developed in the proceedings owing to the presence of numerous representatives of Germany, among whom were Prof. Rüdin, director of the Kaiser Wilhelm Institute, Prof. Verschuer of the University of Frankfurt, and Prof. Hellpech of Heidelberg.

In opposition to views put forward by German delegates on 'purity' of race and 'nordization', Prof. Boas, basing his remarks on the experience of half

a century, contended that a definition of race more in accord with realities was an urgent necessity. In even the most inbred populations there were family lines of descent which included different genetic characters, while in every family line were frequently included individuals of most diverse genetic types. There was, he maintained, no population which from the racial point of view was so uniform as to be considered either anatomically or physiologically a unity. The different groups of the white races so far resemble one another that often extremes of the same type are more diverse than the means of two different types. He stressed the influence of environment, and showed how, in the United States, attitude and gesture, which have been said to be determined by race, were modified in the American-born descendants of immigrants.

Prof. J. Brutzkus dealt with the racial bearing of his research on the blood groups of Jews, which he said pointed to a differentiation of four types: Semitic, Western European, Mixed Eastern European and Mongoloid. Further, this differentiation corresponds with the differentiation of head-form. The diversity of Jewish types is due on one side to the crossing of the Semitic type with the proselytes of the Roman Empire, and on the other with those of the Khazar. He maintained that according to the evidence of the blood group the Jews of Berlin are more purely European than the Germans themselves, while the Jews of the Crimea and the Caucasus are more purely Asiatic than the autochthonous Tartars.

The fundamental principle of racial doctrines was attacked by Dr. Zolleshan of Prague, who maintained that recent research among the most remote peoples in Europe and the most primitive in other parts of the world had shown that the doctrine of the persistence and immutability of racial type was untenable. The claim to a superiority of racial type was based on the desire to dominate. In conclusion, he suggested a world-wide collaboration of scientific institutions, concentrating on the investigation of the problems of race.

This proposal was strongly condemned by Prof. J. Thurnwald of Berlin, who maintained that no man of science was capable of considering any scientific problem whatsoever without importing into his conclusions elements which were the immutable outcome of his race.

Considerable discussion was also aroused by a communication from Dr. Ritter on the racial composition of the gipsies of Central Europe, in which it was shown that their mixed racial character justified the measures of 'purification' which had been taken by the Third Reich. This contention was opposed by Dr. Brutzkus, who maintained that the "Bohemians" were the most authentic and the purest descendants of the Aryan race.

Debate became particularly lively in discussion of the report on "The Eugenics of Mental Disease", presented by Prof. Rüdin, in which the necessity was urged for the sterilization of all persons known to be affected by hereditary disease. Prof. Schneerson argued in opposition that it had been proved that certain men of genius descended from families subject to hereditary disease, while they themselves were often abnormal, quoting the cases of Dostoevski and Nietzsche. The doctrine of mental eugenics meant the elimination of outstanding personalities and in the end the lowering of the intellectual standard of humanity. The increase in mental disease, notwithstanding the progress of medical science, was due to the increased nervous tension of modern life, and suggested a remedy in the improvement of material and social conditions. The surest eugenic measure was the instinct of love. Any other detracts from the dignity of man and deprives him of all his faculties of intellectual and moral progress. The proposals of the report were also criticized by Prof. Beck of Prague, who pointed to the contradiction inherent in the application of all racial doctrine and theories of "the blood", which while imputing insubordination to the law of the blood, maintained that a blind racial destiny imposed a determinism, which denied freedom of will to adopt such measures of eugenics as would foster the intellectual advancement of the species—the voluntarist conception of the problem.

Among other communications may be mentioned Mme. Hauser (Amsterdam) on the effects of environment on the sounds of language, and Dr. Schneider's report on biometric investigations among the Otomi of Mexico. The proceedings of the section closed with a full session devoted to consideration of a masterly report by Mlle. Weinberg on "Differential Biometry and Biotypology in the Classification of Individuals and Groups".

The Central (Native) Medical School, Suva, Fiji

By Sir James Barrett, K.B.E.

THE major problem in the attempt by a civilized nation to develop people who, by our standards, are regarded as backward, is the control of disease and the preservation of health.

It is difficult of solution for several reasons. The native is not inclined to co-operate, as he does not understand—and finds it difficult to understand—the mode of thought and the technique of the European medical officers. The employment of many European medical officers is economically impossible, hence the training of the native himself is essential. Knowing the language, customs and mode of thought of his countrymen, he can effect changes which otherwise would be out of the question. For these reasons the Central (Native) Medical School at Suva,

Fiji, furnishes a great object lesson, since it represents a sincere and successful attempt to apply the principles of Western medicine to Polynesians, Melanesians and (now) Indians in the South Pacific. Like most British institutions, the growth has been gradual and the adaptation to needs has been effected as occasion arose.

The Principal Medical Officer in Fiji in 1885—Dr. Coney—obtained the passage of an ordinance providing that any native student who had received hospital training and practice for three years and been examined in medicine and surgery might be enrolled as a native medical practitioner. There was no medical school building and the training was effected at the Colonial Hospital, Suva. In 1900 a

lecture room and a hostel for the residence of students were built, and with diagrams, models, text-books and lectures a more comprehensive system was organised. At this date there were about twenty practitioners. In 1918 there were forty-eight, who did fine work in the influenza epidemic of that year, but during which eight of them lost their lives.

In 1923 the hospital was rebuilt and re-organized and called the Colonial War Memorial Hospital, and with subsequent development has become an excellent and extensive institution. Students from other Islands than the Fiji group were admitted and the School became a central school for the Western or Southern Pacific.

At this stage Dr. Montague was Chief Medical Officer, and in co-operation with Dr. Lambert—director of the Rockefeller Foundation in the South Pacific—a notable development took place. A School was built with the generous aid of the Foundation, containing lecture rooms, dissecting rooms, chemical and physiological laboratory, library and museum. Accommodation was provided for forty resident students. Quite recently the Foundation has given an excellent pathological, bacteriological and biochemical block and a post-mortem theatre. It is hoped that this laboratory will become the centre of investigation for scientific study in the South Pacific. The staff of the School consists of a whole-time tutor and fourteen honorary lecturers. The teaching in the old school was in the Fijian language. In the new school good knowledge of English is required of all students, and an entrance examination on the basis of the New Zealand proficiency examination is required. The course of study until 1931 was of three years' duration, but it was then increased to four years' and post-graduate courses came into existence.

Whilst this development has taken place, the training of native nurses was organized on a three-year basis, and in 1935 there were fifty-five nurses in the department and stationed throughout Fiji. It is hoped to make the hospital a central School for Nurses in the South Pacific by similar methods to those adopted in the Central Medical School. Such then is the mechanism of this really useful institution.

The students are divided into two groups—junior and senior. The junior course occupies 1½ years and the senior course 2½ years. The junior course covers chemistry, physics, biology, anatomy and physiology with some voluntary out-patient hospital work. The senior course includes medicine, surgery, public health and the smaller clinical subjects, including the study of diseases of children, diseases of the eye and some dentistry. The number of students in 1935 and their source is set out in the accompanying table:

	1st year	2nd year	3rd year	4th year	Post- graduates	Total
Western Samoa	3	—	—	1	—	4
Eastern Samoa	1	—	—	—	—	1
Tonga	1	—	1	2	—	4
Gilbert and Ellice Islands	1	—	1	2	1	5
Solomon Islands	1	1	1	1	—	4
New Hebrides	—	1	—	—	—	1
Nauru	1	—	—	—	—	1
Cook Islands	2	—	—	1	—	3
Fiji—Fijians	4	—	5	5	1	15
Rotumahans	—	—	2	—	—	2
Indians	1	—	1	—	—	2
	15	2	11	12	2	42

During the year there were 40 students in residence at the two dormitories. The two post-graduates in the above list are qualified native medical practitioners, and do not reside in the students' dormitories. The 12 Fijian students who reside in the smaller dormitory are required to keep their rooms and grounds in good order. The remaining 28 students who live in the large dormitory are expected to keep their own bedroom tidy and clean, but an Indian servant is provided to assist in the general management of the other rooms and the surrounding grounds. The students' dining-room is in the large dormitory, so that during the continuous rainy weather, which lasted for about six months during 1935, the Fijian students were put to great inconvenience as the two dormitories are about a quarter of a mile apart.

Recently Dr. Hoodless, the medical tutor, in answer to some questions of mine, furnished the following information:

Roughly, the 40 students at present (October, 1936) at the Central Medical School, include 19 Polynesians, 6 Melanesians, 6 mixed Polynesian and Melanesian, 7 mixed European and Polynesian and Melanesian, and 2 East Indian. The Polynesian students win most of the prizes at class and yearly examinations, but this is due to their numerical ratio, 19 out of 40 students: and also due to the fact that the mission and Government schools in the Polynesian islands are much superior to those in the Melanesian islands, so that the Polynesian students enter the Medical School with a very satisfactory preliminary education while the pure Melanesian students come here with very little elementary education. Indian students generally speaking are very good at book learning, but they do not make the same success at practical work. For steady regular work and good progress in medical knowledge, the mixed type of student, part Polynesian, is perhaps the most successful of all, but here again there are other factors at work.

Supervision of the students when they return to their own Islands is entirely in the hands of the local administrations. For Tonga, the Gilbert and Ellice Islands, and the Solomons, the native medical practitioner ordinances in each Administration can be controlled from Fiji through the Western Pacific High Commissioner, who is also Governor of Fiji. For Eastern Samoa (U.S.A.), Western Samoa (N.Z.), Cook Islands (N.Z.) and the New Hebrides (Fr. and Brit.) the position is different. The success of the native medical practitioner system in each of these Administrations depends on: (a) A sympathetic understanding and control from the Administration concerned. (b) A close personal and very sympathetic understanding from the European medical officers in any of these Administrations in regard to the native medical practitioners sent back from Suva to that Administration. (c) A continuously developing *esprit de corps* among all the qualified native medical practitioners far and wide in the South Sea Islands. This is obtained through the *N.M.P. Journal*, personal correspondence, and occasional post-graduate courses.

Pensions have been granted for retired native medical practitioners in Fiji only. The native medical service is only a few years old in the other Administrations, and the question of retirement on pension has not yet arisen, nor is it likely to arise for another fifteen years or more. It is anticipated that pensions will be granted in Tonga and in Western

Samoa, but in the other Administrations it is probable that increased salary and allowances will be given during the actual period of service and that no pensions will be granted.

The native medical practitioners receive salaries varying from £60 to £150 per annum, which apparently meet their wants adequately. They are medical officers and do not seek private practice as we understand it. Their journal, *The Native Medical Practitioner*, is an excellent publication which will interest any European practitioner.

In the *Tropical Diseases Bulletin* of November 1936 a detailed account of the working of the Central School is published by Dr. Clunie (Medical Superintendent of the Colonial War Memorial Hospital, Suva) and Dr. McGusty (late Inspecting Medical Officer, Fiji). The Islands served contain about 500,000 people, and at present there are 84 medical practitioners distributed as follows: Fiji 56, Samoa (Western) 9, Samoa (Eastern) 0, Tonga 4, Cook Island 2, Gilbert and Ellice 10, Solomon Islands 2, New Hebrides 1, total 84; native obstetric nurses, Fiji, 47.

Their conclusion is as follows: "Taken individually the Administrations participating in the Native Medical Practitioner scheme have not the means to embark on elaborate enterprises to provide adequate medical services, but by a pooling of their resources, as is now the case at the Central Medical School, it is felt that they will be able to elaborate a common form of health organization that will bestow further benefits on the native peoples. In Fiji the system has proved successful after a long and searching trial, and if it is too early yet to claim the same success with regard to its more recent ramifications into the other Pacific Administrations, the similarity of conditions and the favourable reports that are coming to hand appear to provide full justification for the confidence which those of us who are in the closest touch feel with regard to the future of the Native Medical Practitioner in the Pacific. As the system becomes more permanently established everywhere

it will suffer progressively less from the effects of destructive criticism, but there will always remain the danger that some over-enthusiastic supporters may lose sight of the fundamental cause of its success and in a misguided attempt to raise the status of the Native Medical Practitioner may defeat the purpose for which the school was created, namely to make a health service available to these native peoples at a low cost and in the form that is most easily assimilable by their society."

The School is administered economically, the average cost per student being about £75 per annum; that is, total cost about £3,000 per annum. Amongst the many tributes to the efficiency of the School place must be given to the observation of Prof. Buckmaster and Dr. Wright made after a visit to the School when returning to England in 1931 from Australasia. Their comment was as follows: "The Hospital and Medical School at Suva for Natives of Fiji, Samoa and Other Islands is really a wonderful place to find in the South Pacific. We not only saw all over the Hospital, but conducted a short class in anatomy and physiology in the School and both thought the students equal to what we might have expected to find in an ordinary Medical School in London. Indeed we were both astonished at the information they had acquired. I ask how many Englishmen know anything about this remarkable Hospital in Fiji?"

In conclusion I have one caution to emphasize. If enthusiastic people try to extend the course and to increase the expense, much damage may be done in seeking something economically impossible. There is, I am glad to say, no evidence at present of any such intention. Depopulation has ceased in Fiji and with prudent administration the Central School may prevent depopulation in the other Islands. I am very grateful to Dr. A. H. B. Pearce, Principal Medical Officer, Fiji, and his staff for the information furnished on several visits, for the personal contact obtained with these fine young men and for many reports.

The Radio Exhibition at Olympia

THE annual radio exhibition at Olympia, which this year was held on August 25-September 4, is generally a partial disappointment to those interested in the scientific and technical aspects of broadcasting, as it is usually quite difficult to ascertain what technical progress and improvements are being displayed. The exhibition is largely an elaborate display of the external cabinets, although most firms nowadays provide simple means for inspecting the internal construction and layout of the receiver itself. This year there was abundant evidence to show that most manufacturers have realized that the modern broadcast receiver has to take its place as an article of domestic furniture, and as such it must not be made especially conspicuous by its curious shape and appearance. Another notable advance in what may be termed the external features of the receiver is constituted by the enlargement of the tuning scale and its ease of operation. There is, however, still room for greater uniformity in the location of the control knobs among receivers of different makes.

In order to appreciate the improvements made in the internal portion of broadcast receivers, the visitor to the exhibition was fortunate in having as a guide the detailed reports given by such technical journals as the *Wireless World*, which has published three special show numbers on this occasion. A general survey of this year's exhibits of the various manufacturers indicates that many fundamental features of the broadcast receiver have become sufficiently stabilized for the designer to concentrate upon the steady improvement of detail. The great majority of receivers now manufactured are of the superhetrodyne type, since this provides both the sensitivity and the selectivity required by modern broadcasting conditions. The selectivity has now generally been made adequate by the incorporation of a properly tuned amplifying stage operating at the incoming signal frequency. A noteworthy advance this year is the incorporation of a correctly designed short-wave range as a standard feature; and the division of the short-wave broadcasting band into

two ranges is a factor which adds considerably to the ease of operation of the receivers so fitted. Those familiar with difficulties of tuning in short-wave stations will also appreciate the improvements in the mechanical portion of the slow-motion drive to the tuning condensers, as well as the large easily read scale which is generally provided nowadays. Several of the receivers shown at the exhibition were provided with a wave-length range in the ultra-short wave band, so that they may be used for the reception of the sound portion of the television programmes.

This year's exhibition was not so conspicuous as some of the previous ones for radical modifications in the types of valves incorporated in receivers, but two points here are worthy of note. The development of the tetrode output valve has caused the rating of most mains-operated receivers to be raised from the previous value of 2-3 watts to 5 watts or above. Secondly, one manufacturer of an all-wave superregenerative heterodyne receiver is experimenting with the use of the Harries all-stage valve. In this receiver all six valves are of the same seven-electrode type, the valves being adapted for their functions in the various stages by suitable external connexion to the electrodes. It will be interesting to observe the results of this innovation, since the advantages of using the same type of valve in any position in a receiver are self-evident.

In the case of battery-operated sets, the main problem all the time is to obtain sufficient output of good quality without overloading the normal high-tension battery, the size of which has now become fairly well standardized. Although the output from such receivers seldom exceeds half a watt nowadays, considerable improvement in acoustic sensitivity has been attained by the use of improved magnetic alloys for the small permanent magnet loud-speakers generally employed in such sets. There is ample evidence that the portable wireless receiver has still a wide field of service, and the attractions of several of this year's models are enhanced by the inclusion of a properly designed short-wave range.

Probably the most interesting feature of Radiolympia this year, from a technical point of view, was the fact that more than a dozen manufacturers showed fully developed television receivers suitable for the programmes now regularly provided from the London station. Direct reception of these programmes was carried out at the exhibition, and facilities were provided for each firm to give demonstrations to the public under comfortable viewing

conditions. So far, little uniformity is noticeable in the design of the television receivers produced by the different manufacturers, although they naturally all employ the cathode ray tube for the reproduction of the picture image. There is a tendency to favour the use of the superregenerative heterodyne receiver, although in a number of sets the amplification is carried out at the ultra-high frequency employed for the television service. There is as yet no uniformity in the methods employed for the control of the electron beam in the cathode ray tube, as both magnetic and electric methods are employed for focusing and deflection. One of the most interesting television receivers exhibited employs a tube of only 4 inches diameter; the image produced on the fluorescent screen of this tube is projected on to an etched glass screen giving a picture of size 20 in. $\times$ 16 in. The more normal method, however, is to produce the final picture on the screen of the cathode ray tube and to view this either directly or through an inclined mirror. The normal size of picture for receivers priced at 60 guineas upwards is about 10 in. $\times$ 8 in.; but some cheaper receivers are now available giving a picture size of about 7½ in. $\times$ 6 in. With the view of obtaining the utmost economy in the production of a television receiver, one type shown provides the circuits for the vision signal only, a normal broadcast receiver being required in addition to reproduce the sound accompaniment. In this way, a receiver giving a picture about 6 in. $\times$ 4½ in. in size can be obtained for about £35. This is a development likely to be worth exploring in the attempt to produce a television receiver at a price sufficiently low to appeal to a large number of listeners who already possess a normal broadcasting receiver.

In concluding this review of the exhibition organized by the Radio Manufacturers Association, mention must be made of the interesting museum provided to illustrate the evolution of the modern broadcasting receiver, and of the extension to the television field of the interesting demonstrations provided by the Post Office to illustrate the deleterious effect of various classes of electrical interference on the conditions of broadcast reception. Finally, it must not be forgotten that one of the most popular attractions of Radiolympia is the provision by the British Broadcasting Corporation of daily variety concerts in a specially constructed hall, which this year contained accommodation for an audience of more than 5,000.

R. L. S.-R.

Isotopes of Strontium

WORK on the isotopes of strontium has recently been reported by Mattauoh, and by Hahn and co-workers. Mattauoh (*Naturwissenschaften*, 25, 170; 1937) has determined the packing fractions of the isotopes ^{86}Sr and ^{87}Sr by the doublet method, using $^{31}\text{SiF}_3$ and $^{32}\text{SiF}_4$, respectively, for comparison. Using the data of other workers for the masses of ^{28}Si and ^{29}Si , the packing fraction of ^{86}Sr is found to be -8.7 ± 0.3 , and its mass 86.924 ± 0.004 . The packing fraction of ^{87}Sr is -9.0 ± 0.5 , and its mass 86.922 ± 0.004 .

The radioactive transformation of rubidium into the strontium isotope of mass 87 has been investigated by Hahn, Straßmann and Walling (*Naturwissenschaften*, 25, 189; 1937), who examined the strontium occurring

in a mica from Silver-leaf mine, Manitoba. The mica was comparatively rich in rubidium (containing 2-3 per cent of it), but contained only a very minute amount (a few hundredths of a per cent) of alkali earth metals. Careful treatment of the mineral resulted in the isolation of 250 mgm. of strontium carbonate. If rubidium breaks down by radioactive disintegration to give strontium, it would be expected that the product of disintegration would be present in the mineral in comparatively small amount. As alkali earth metals were actually almost entirely absent, it is very likely that the small quantity of strontium present was derived from this disintegration. The geological age of the mica is estimated at

500-1,000 million years, whilst the half-life period of rubidium is between 2×10^{11} and 4×10^{11} years.

An investigation of the isotopic constitution of the strontium from the mineral throws much light on its origin. This has been carried out by Mattauch (*Naturwiss.*, 25, 189; 1937), who finds the strontium to contain 99.97 per cent of the isotope of strontium of mass 87. It is therefore very probable that the β -radioactive disintegration of ^{87}Rb results in the formation of ^{87}Sr . This is in agreement with the rule that stable isobars of neighbouring elements do not exist. A rough estimate of the quantity of strontium produced during the life of the mica shows that the half-life period of radioactive rubidium is more nearly 2×10^{11} years than the upper limit mentioned above.

University Events

CAPE TOWN.—Prof. A. W. Falconer has been appointed to succeed Sir Carruthers Beattie as principal and vice-chancellor of the University. Sir Carruthers Beattie will retire at the end of the year. Prof. Falconer is at present professor of medicine in the University.

CAMBRIDGE.—T. R. C. Fox, of Jesus College, and J. Diamond, of St. John's College, have been appointed demonstrators in engineering.

Dr. R. A. Lyttleton and M. H. L. Price have been appointed Faculty assistant lecturers in mathematics.

J. Hart-Mercer has been elected to the Gwyneth Pretty studentship and to the Nita King scholarship.

At St. John's College, a Strathcona exhibition for physics has been awarded to R. E. B. Makinson, University of Sydney, and a Hutchinson studentship for zoology to J. H. Sang, University of Aberdeen.

Science News a Century Ago

J. D. Forbes among the Dolomites

IN the course of his Continental tour of 1837, J. D. Forbes after leaving southern Germany explored the Tyrol and early in September entered the then little-known 'Dolomite' country, proceeding in the direction of the peak of Marmolata. In his journal, under the date September 14, he said: "This morning, whilst warming myself dreamily during the rain at the kitchen fire at Cavalese, I got an excellent geological lesson from the boiling of certain thin porridge made of Indian corn (polenta) and milk. The air-bubbles disengaged during the process formed the most beautiful elevation craters, often with little interior ones, formed by the immediate sequence of another bubble at the same point. . . . I walked from Cavalese to Vigo, in order to understand fully Von Buch's section of the adjacent beds of rock, and in this I succeeded beyond my expectations. But the strata of limestone and sandstone do not all dip towards the axis, as he has represented, but some from it, and with evident disturbance. I went in search of minerals to a dealer's, but only found some very indifferent specimens.

"The scenery from Vigo to Campedello, and from that to Canazea, is in the highest degree striking—in fact, I know nothing of its kind to compare with it: one is entirely surrounded by jagged peaks of

dolomite. The amazing crags of the Lang Kofel come into view near Campedello, and afterwards the magnificent outworks of the Marmolata and Sasso di Val Fredda are seen in all their majestic beauty. As I wished to examine the Lang Kofel more minutely, as well as Von Buch's sections between Gröden and Colfusco in the Abteier-Thal, I availed myself of a tolerable horse track which wound through the forest, and after passing close under the precipices of the Lang Kofel, entered the Grödener-Thal. . . ."

Prof. William Ritchie, F.R.S.

ON September 15, 1837, William Ritchie, the professor of natural philosophy at the Royal Institution and also in University College, London, died at the age of forty-seven years. Born in Scotland in 1790, he was educated for the ministry and became Rector of the Royal Academy of Tain, Ross-shire. Having saved money he went to Paris, where he attended the lectures of Thénard, Gay-Lussac and Biot and on his return to England became known to Sir John Herschel. Papers he contributed to the Royal Society on a differential thermometer and radiant heat brought him into notice, and in 1829 he was given the professorship at the Royal Institution and in 1832 that at University College. He published papers in the *Philosophical Magazine* and other periodicals and made researches in electricity and electric magnetism. He was also known as a skilful experimentalist, and at one time was engaged on experiments connected with the manufacture of glass for optical purposes.

Animal Magnetism

THE *Gentleman's Magazine* of September 1837 gives the following information: "At the North London Hospital, M. Duportet, the French professor of animal magnetism, lately performed some experiments before a party. He commenced his operations on a young girl, about 17 years old, an inmate of the hospital, who has been ill for some time, but who is at present almost convalescent. She was seated in a chair in the middle of one of the wards, and M. Duportet seated opposite to her commenced the operation of magnetizing, which is done by waving the hand up and down in a perpendicular line before the face and body, as closely as possible without almost actual contact. After these motions of the hand had been continued for some minutes without effect, the professor, nothing disconcerted, left off, and another patient was introduced, who, we understood, had been operated upon more than once, deriving, it is stated, some benefit in her health. She was a young woman named Lucy Clarke, who having for some time past been subject to epileptic fits, had been induced to come to the hospital from Tottenham, where she resided, that the experiment might be made upon her. As soon as she was seated Prof. Duportet commenced the waving of his hands, and in a few seconds an appearance of extreme drowsiness became evident to all who stood around his chair, and she frequently rubbed her eyes as children do when sleepy. She at length ceased to have the power of opening her eyes. The magnetizer, however, who had placed her under the spell, had the power also of restoring her to a state of wakefulness. This he did by placing his fingers on the centre of the forehead and drawing them asunder towards the temples, and afterwards waving the hand to and fro before her face."

Cholera in Europe

AN editorial in the *Lancet* of September 23, 1837, gives the following account of a pandemic of cholera at that time: "The cholera—that terrible epidemic, which after having exercised its ravages in all parts of the old and new world, seemed on the point of returning to the country which gave it birth, has again appeared raging with unabated violence not only in many of the southern States of Europe, but in some of the northern kingdoms, already more than once visited by the pestilence. Our readers are doubtless aware that the Asiatic cholera has been stalking along the Mediterranean shores of Europe for the last two or three years, and that, at the time we write, it has reached the capital of the Papal dominions. The progress of the disease through countries, the inhabitants of which are forcibly kept by their rulers in a state of ignorance, has been almost universally accompanied by disorder of the most serious nature."

"At Palermo the Governor has fallen a victim to the fury of a terrified and excited populace; and at Rome, if we are to believe the reports which have just reached us, the medical men are everywhere compelled to conceal themselves in order to avoid sharing the fate of several of their brethren, who are massacred during the period of excitement and consternation, which are produced at the onset of the malady. Marseille also has been attacked, for the third time, by the epidemic, which during several days carried off nearly 100 persons daily, and we are sorry to announce that the disease is spreading rapidly throughout the department of which that city forms the capital".

Societies and Academies

Paris

Academy of Sciences, July 5 (*O.R.*, 205, 1-98).

WOLFGANG DOEBLIN: The elements of a general theory of the simple constant chains of Markoff.

KENTARO YANO: Totally geodesic non-holonomic spaces.

MARCEL BRELOT: The best harmonic majorant of a sub-harmonic function.

RAPHAËL SALEM: A method of summation nearly always valid for Fourier's series of continuous functions.

NATAN ARONSZAJN: A theorem of the theory of analytical functions of several complex variables.

JEAN LERAY and LOUIS ROBIN: Complement to the study of the movement of an unlimited viscous liquid.

PIERRE VERNOTTE: Navier's equations and the dissipation function, in a hydraulic system. The thermal phenomena produced in the fluid by a rapid movement.

MAX THISSIM SOLIER, LUIS CASTAGNETTO and MARCEL SABATHÉ: The beats which accompany the formation of the alternate vortices of Bénard-Karman.

ANDRÉ LICHTENROWICZ: Extension of the Gauss-Whittaker theorem.

FRITZ LONDON: The quantum theory of the diamagnetism of aromatic compounds.

TH. DE DONDER and J. GÉHÉNIAU: The electronic model of Dirac's wave mechanics.

JEAN JAFFRAY: Observation of the stratified Geissler discharge in different gases at atmospheric pressure. Under certain conditions, described in

detail, stratification can be seen and photographed in Geissler tubes containing various gases at nearly atmospheric pressure.

FRANTZ PERRIER: The action of an electric field on an electrified insulator placed in air: the ionization of the latter.

ALEXANDRE DAUVILLIER: A universal counter. A modification of the Geiger-Müller counter, utilizing Richter and Geffcken relays with Neher and Harper mounting. The working voltage can be reduced to 300 volts, and the arrangement is suitable for measuring the intensity of the cosmic rays with captive balloons.

GEORGES AHIER: Christiansen filters. These filters are cells containing a transparent powder mixed with a liquid of the same refractive index. Study of the results obtained by varying the solid (flint and crown glass, fused silica, fluorspar) and the liquid.

CASIMIR JAUBERAN, LÉON GRILLET and MICHEL DUFFIEUX: The fine structure of the 5998.9 band of nitric oxide.

BERTRAND GOLDSCHMIDT: Study of the fractionation coefficients of salts possessing several hydrates. Study of the crystallization of barium acetate, with actinium X as indicator, and of strontium nitrate in presence of a trace of lead nitrate, with thorium B as indicator.

JEAN PERRIER: The equation of solubility of a pure substance forming a solid compound with the solvent. Control of a differential equation obtained theoretically by an experimental study of the system sodium iodide and acetone.

MARTIAL FÉLIX TABOURY and MARCEL BILLOT: The action of light on the Liesegang phenomenon.

HALDUN N. THREM: The oxidation of beryllium bronzes.

EUGÈNE CATTELAÏN and PIERRE CHARRIER: Contribution to the separation of the phosphoric ion and its estimation by a volumetric method.

JEAN BARON and PAUL LAFFITTE: The inflammation of acetaldehyde. Determinations of the temperatures of spontaneous inflammation of various ternary mixtures of acetaldehyde and oxygen with nitrogen, argon or carbon dioxide as diluent.

MABO TIPPENHAU, PAUL WEILL and BIANCA TOHOUBAR: The isomerization of cyclohexane methylene oxide into hexahydrobenzaldehyde, and the conversion of the corresponding amino-alcohol into cycloheptanone.

MARCEL SOMMELET: A particular mode of intramolecular rearrangement. Study of the decomposition by heat of $(C_6H_5)_2CH-N(CH_3)_2.OH$.

WERNER LIPSCHITZ and ERNST BÜDING: The *d*- and *l*-borneolglucosides.

PANOS GRAMMATIKAKIS: Some modes of hydrolysis of the substituted *N*-benzaloximes.

JEAN KANDEL: The hydrocarbons, halogen derivatives, ethers and esters corresponding to tetrahydroionol.

JOSEPH HOOK: Contribution to the study of substances with female hormone properties. The synthesis of 2-oxo-6,7,8,9-tetrahydro-4,5-benzooceanaphthene.

ANDRÉ GUILLEMONAT: The oxidation by selenious oxide of cyclohexene and of the 3 and 4 nonenes.

RAYMOND HOGART: The structural scheme of proustite and pyrrargyrite.

ANDRÉ VATAN: The comparative mineralogy of the sandy sediments of the Paris basin.

J. GOURCO and FRANCK BOURDIER: Pollen analysis and stratigraphical position of the Quaternary lignites of the Chambéry region.

THÉODORE MONOD: The geological constitution of the Mauritanian Adrar.

ALEXANDRE GUILLERD and **PIERRE ETRILLARD**: The persistence of fluorescein in the soil. The influence of ferruginous formations.

NICOLAS STOYKO: The periodicity in the irregularity of the rotation of the earth.

ARTHUR BRUNEL and **ROBERT ECHERIN**: The evolution of nitrogen, appearance of allantoinase and of urease in the germination of rust (*Agrostemma Githago*).

JOSEPH LEPÈVRE: The reversal of polarity produced in cuttings of *Salix*.

A. GUISSYSE-PELLISSIER: The presence of striated muscular fibre in the pulmonary arteries of the rat and the mouse.

MAURICE VILLARET, **HENRI BÉNARD**, **LOUIS JUSTIN BESANÇON** and **MILLE ANDRÉE ABADI**: The mathematical study of the kinetics of hæmolysis (kinolysis).

LIÓN KÉPINOV: The antiglycogenolytic action of insulin.

RENÉ SALGUES: Nutrient leucocytosis in reptiles in bad conditions of captivity.

JEAN LOHMELHUR: The adsorption of polypeptides by proteins. The behaviour of a solution of peptone.

Forthcoming Event

FARADAY SOCIETY, September 13-15.—General discussion on "Reaction Kinetics" to be held in the University of Manchester.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER AND A DEMONSTRATOR IN ELECTRICAL ENGINEERING in the Imperial College of Science and Technology (City and Guilds College), Prince Consort Road, S.W.7.—Secretary (September 13).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Manchester Municipal College of Technology.—The Registrar (September 20).

LECTURER IN PHYSICAL CHEMISTRY (Grade II) in the University of Bristol.—Secretary and Registrar (September 24).

SOIL CHEMIST for the Rubber Research Scheme, Agalawatta, Ceylon.—The Chairman (November 15).

INSPECTORS OF MINES in the Colonial Mines Service.—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Special Leaflet No. 1: Pit-Props. Pp. 8. (London: Forestry Commission.) [178]

Iron and Steel Institute. Special Report No. 18: Reports upon Blast-Furnace Field Tests. 1: An Investigation of a Blast-Furnace smelting principally Limestone Ores at the Frodingham Works of the Appleby-Frodingham Steel Co. Ltd. Pp. v+98. 10s. Special Report No. 19: Foamed Blast-Furnace Slag. By Dr. T. W. Parker. Pp. v+32. 6s. (London: Iron and Steel Institute.) [208]

Forestry Commission. Bulletin No. 14: Forestry Practice; a Summary of Methods of Establishing Forest Nurseries and Plantations with Advice on other Forestry Questions for Owners and Agents. Revised edition. Pp. 99. (London: H.M. Stationery Office) 1s. 6d. net. [238]

The Journal of the Institute of Metals. Vol. 60. Edited by G. Shaw. Book. Pp. 456+59 plates. (London: Institute of Metals.) [238]

Air Ministry. Meteorological Office. Southport Auxiliary Observatory (the Fernley Observatory of the Corporation of Southport). Annual Report, and Results of Meteorological Observations, for the Year 1936. By Alfred Goodwill. Pp. 32. (Southport: Fernley Observatory; London: Air Ministry.) [238]

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1760 (2458 and 2459): Progress of Experiments in Aero-Engine Exhaust Shrouding. By A. W. Morley. Pp. 18. 2s. 6d. net. No. 1761 (2362): The Stress in Certain Tubes of Rectangular Cross Section under Torque. By D. Williams. Pp. 24. 4s. 6d. net. No. 1766 (2607): Experiments on a Sphere at Critical Reynolds Numbers. By A. Faga. Pp. 20. 2s. net. No. 1771 (2723): Tests of Four Airspeed Sections in the Compressed Air Tunnel. By D. H. Williams, A. F. Brown and H. Smyth. Pp. 20. 2s. net. No. 1774 (2675): Aerodynamic Characteristics of Tapered Wings with Flaps and Slots. By Dr. S. H. Hollingdale. Pp. 48. 6s. net. No. 1779 (2693): Experiments on the Use of a Static Tube in the Wing Wake and a Short Pitot Tube in the Leading Edge as an Airspeed Indicator. By the Aerodynamics Staff, R.A.F. Pp. 6. 1s. net. (London: H.M. Stationery Office.) [258]

Other Countries

Government Museum, Trivandrum. Administration Report for the Year 1111 M.E. Pp. 8. A concise Guide for Visitors. Pp. 8. (Trivandrum: Government Museum.) [168]

U.S. Treasury Department. Coast Guard. Bulletin No. 19: The Marion and General Green Expeditions to Davis Strait and Labrador Sea under direction of the United States Coast Guard 1928-1931-1932-1934-1935. Scientific Results, Part 2: Physical Oceanography. Pp. vi+259. (Washington, D.C.: Government Printing Office.) 75 cents. [168]

Report of the Kodakikan Observatory for the Year 1936. Pp. 4. (Delhi: Manager of Publications.) 8 annas; 4d. [196]

Madras Fisheries Department. Administration Report for the Year 1935-36. By Dr. B. Sundara Raj. Pp. iii+63+8. (Madras: Government Press.) 8 annas. [196]

Meteorological Office. Note No. 17: Climatic Notes—New Zealand Districts. By Dr. B. Kidson. Pp. 32. (Wellington: Government Printer.) [238]

Statens Meteorologisk-Hydrografiska Anstalt. Tillgods Årsbok 18, 1936. Årsberättelse for 1936. Pp. 19. Årsbok 18, 1936. 1. Månadsöversikt över väderlek och vattendrängning. Pp. 76. 2.50 kr. (11s.) Nederborden i Sverige. Pp. 15. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [238]

Anales del Museo Argentino de Ciencias naturales. Antropología, Historia y Arqueología. Publicación No. 78: Fósiles y Lagunas, posición actual de la raza Paleo-americana o de Lago Santa. Por J. Imbelloni. Pp. 79-104. Publicación No. 79: Deformación del cráneo en la región de los Atacameños y Diaguitas. Por el Prof. Ricardo H. Latcham. Pp. 106-124. (Buenos Aires: Museo Argentino de Ciencias naturales.) [238]

Report of the Botanical Survey of India for 1935-36. Pp. 11. (Calcutta: Government of India Press.) [238]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 105: Investigations on the Associated Growth of Herbage Plants. By H. O. Trumble, T. H. Strong and R. M. Shapter. Pp. 40+10 plates. Bulletin No. 106: Investigations on "Spotted Wilt" of Tomatoes. 8: Infection in Field Plots. By Dr. J. G. Bald. Pp. 32. (Melbourne: Government Printer.) [238]

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 2: Trends in Secondary Education. Pp. vi+44. 10 cents. Pamphlet No. 71. An Annotated Bibliography on the Education and Psychology of Exceptional Children. Prepared by Hilde H. Martens and Florence H. Reynolds. Pp. iii+42. 10 cents. (Washington, D.C.: Government Printing Office.) [238]

Classified List of Smithsonian Publications available for Distribution, August 10, 1937. (Publication 3394.) Pp. vi+25. (Washington, D.C.: Smithsonian Institution.) [238]

Smithsonian Miscellaneous Collections. Vol. 96, No. 1: Archaeology of St. Lawrence Island, Alaska. By Henry B. Collins, Jr. (Publication 3411). Pp. xi+431+84 plates. (Washington, D.C.: Smithsonian Institution.) [238]

Proceedings of the United States National Museum. Vol. 84, No. 2017: Revision of the North American Species of Ichneumon-Flies of the Genus *Hexatoma* Gravenhorst. By R. A. Cushman. Pp. 243-312+plates 16-21. Vol. 84, No. 2018: A Revision of the Clapper Rails (*Rallus longirostris* Boddaert). By Harry O. Oberholser. Pp. 313-354. Vol. 84, No. 2019: Moths of the Genus *Rupela* (Pyralidae: Schoenobinae). By Carl Hemmrich. Pp. 355-388+plates 22-23. (Washington, D.C.: Government Printing Office.) [238]

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1936. Pp. 18. (Zomba: Government Printer.) [238]

Publikationer fra det Danske Meteorologiske Institut. Communicationes magnéticas, etc. No. 18: Contribution à la connaissance de l'effet magnétique de l'électroformation des chemins de fer. Par Dr. Edm. Hoge. Pp. 11. (København: G. H. O. Gad.) [238]

Mauritius Institute Bulletin. Vol. 1, Part 2: Revised Catalogue of the Testaceous Mollusca of Mauritius and its Dependencies. By R. Vlader. Pp. xiii+111. (Port Louis: Government Printer.) [238]

Bernice P. Bishop Museum. Bulletin 143: Revision of the Polynesian Species of *Peperomia*. By T. G. Yuncker. Pp. 78. Bulletin 144: Polynesian Botanical Bibliography, 1773-1936. By H. D. Merrill. Pp. 194. Bulletin 145: Ethnology of Uvea (Wallis Island). By Edwin G. Burrows. Pp. 176+8 plates. Bulletin 147: The Genus *Goudia* (Rubiaceae). By F. Raymond Fosberg. Pp. 83+3 plates. Bulletin 149: Report of the Director for 1936. By Peter H. Ravn (Te Rangiroa). Pp. 23. (Honolulu: Bernice P. Bishop Museum.) [248]

Nutrition. Final Report of the Mixed Committee of the League of Nations on the Relation of Nutrition to Health, Agricultural and Economic Policy. (Official No.: A.13.1937.II.A.) Pp. 227. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 7s. 6d. [248]

Proceedings of the California Academy of Science, Fourth Series. Vol. 23, No. 9: Mammals of Death Valley. By Joseph Grinnell. Pp. 115-169. (San Francisco: California Academy of Sciences.) [248]

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SATURDAY, SEPTEMBER 18, 1937

Vol. 140

Philosophy of Early Education

IT was a foregone conclusion that so original and stimulating a contributor to contemporary thought as Mr. H. G. Wells—on this occasion we are almost invited to dub him Dr. H. G. Wells—would have things to say to Section L (Education) of the British Association calculated to provoke lively interest and discussion. Few listeners to his presidential address, many of whom were working teachers, could have adopted the language of Tennyson's "Northern Farmer": "An' I thowt a said whot a owt to 'a said, an' I ooom'd awa'y". The address was probably the better for being plain-spoken and provocative, for only so could Mr. Wells have been at his characteristic best.

Notwithstanding certain of his earlier experiences, Mr. Wells disclaimed the right to appear before his audience as a teacher, but preferred to introduce himself as a citizen at large. We take this to mean, what is indeed sufficiently obvious, that he is no expert in the art of teaching a class and managing a school, but that he claims the right of every intelligent citizen to criticize the results of the teaching and the output of the schools. Mr. Wells, however, is something more than a distinguished outsider. In his later phase at least, his writings have been those of a public teacher, who definitely sets out to show what young people ought to learn, if they are to become efficient citizens in the world of to-day. In other words, though he makes only a limited claim to talk about methods of teaching, he makes, rightly as we believe, an emphatic claim to talk about the content of teaching, the mental fare which the schools provide for potential citizens. His now famous "Outline of History", followed by the companion outline of "The Science of Life"—both of them necessarily written with much collaboration

—indicated his general view as to the kind of thing which an educated person ought to know. An acquaintance with the fifteenth chapter of his later book, "The Work, Wealth and Happiness of Mankind", further prepared one for the opinions to which he has now given full and forcible expression.

Mr. Wells began and ended his discourse with an almost solemn warning as to his self-imposed limitations. Questions of "drill, skills, art, music, the teaching of languages, mathematics and other symbols, physical training and development, and the rest", he deliberately placed outside the scope of his message. He felt he could be most helpful by concentrating on the sort of world picture we are presenting to young people, the essential framework of knowledge that should be established betimes in the normal citizen of our modern community. Whether he was fundamentally right in making all these exclusions from the essential framework is bound to be a sharply controversial topic, upon which we cannot fully enter. Suffice it to say that, according to Mr. Wells's judgment of educational values, the indispensable and irreplaceable structure of fact, the main beams and girders of which structure must be laid down, soundly or unsoundly, before the close of adolescence, should rest upon a threefold foundation of history, biology and geography, widely interpreted. These three, says Mr. Wells in effect, are the things that abide, and it is probably safe to add that in his view the greatest of these is history. But merely to quote these familiar labels would be to convey a totally inadequate idea of the length and breadth of his message.

What Mr. Wells means by history was already familiar to many, we hope to most, of his listeners. But he took the opportunity of denouncing once

more the sort of history which, at any rate until recently, has been taught in our schools, and in great measure accounts for that "crazy combative patriotism" which now threatens to destroy our civilization. Equally mischievous, he added, is the "furtive anti-patriotism of the leftish teacher". We suggest, however, that if Mr. Wells thinks that the sort of history denounced long ago by Herbert Spencer as "an obituary of kings and queens" and denounced later by John Richard Green as "drum-and-trumpet history", is still encouraged in our schools, he ought to make further inquiries. But the rest of his indictment is not so easily disposed of. He demands that school history should not only shed its insularity, its narrow nationalism and its contempt for the lesser breeds without the law, but that it should also be nothing less than the story of man's great adventure upon this planet. He claims that the archaeologists, and the historians of the rise and fall of empires, have provided far finer material for the mental equipment of modern youth than the 'hole-and-corner' history of a single nation. Here he will have many sympathizers and some severe critics. It was to be expected that this part of his address would receive special comment in the daily Press.

As regards the rest of the informative content of the curriculum as conceived by Mr. Wells, there will be general agreement with his ideas about the teaching of geography and simple economics; and indeed the modern teacher in schools of every kind has already gone a long way towards satisfying his requirements. The chanting of lists of capes and rivers is mostly a thing of the past. Where geography passes over into biology his strictures are just. Too many young people leave school ignorant of the wonderful story of life upon the earth, and equally ignorant of the working of their own bodies. But, asks Mr. Wells in effect, who is sufficient for these things? Certainly not, he declares, the present generation of teachers, two-thirds of whom ought to be re-conditioned or superannuated. Here again, having regard to the work done in summer schools and refresher courses, and the activities and publications of such large and important professional bodies as the Science Masters' Association and the Geographical Association, Mr. Wells should have made further inquiries. Also even a cursory examination of the text-books or reading-books now available for pupils of all ages, and exhibited by publishers at such meetings as those of the Annual Conference of Educational Associations, would have shown him

that the school books of to-day are vastly superior in every respect to those of the past.

The present position is that teachers as a body are more mentally alert and educationally active than ever they were. True, they may not be sufficiently intent upon the informative components of the curriculum as advocated by Mr. Wells, but their general attitude suggests plenty of room for hope. A generation ago, teachers were too much occupied in fighting for reasonable conditions of service. To a great extent they are now occupied in fighting for a better chance for the pupils.

But we wish to close these comments upon a note of appreciation. In one of his charming and vigorous philosophical essays, William James took up strongly the position that the great philosophic thinkers, however much they might try to sink the fact of temperament, could never succeed in doing so. The philosopher's temperament, declared James, "really gives him a stronger bias than any of his more strictly objective premises. It loads the evidence for him one way or the other, making for a more sentimental or a more hard-headed view of the universe". James proceeded to a broad classification of the great philosophic thinkers as the tender-minded and the tough-minded. The tender-minded he described as rationalistic (devoted to abstract and eternal principles), idealistic, optimistic, religious, free-willist and dogmatic. The tough-minded he described as empiricist (devoted to facts in all their crude variety), materialistic, pessimistic, irreligious, fatalistic and sceptical.

Not for one moment would we wish to apply to Mr. Wells every item in the second of these lists of adjectives. But he is one of the outstanding public teachers of our time, accustomed to take the broad philosophic outlook upon every problem that he touches; and if we were asked in which of the two categories we would place him, we should inevitably place him among the tough-minded. Few of our prominent thinkers could, for example, have got to the end of *any* sort of discourse on education without ever mentioning Shakespeare; but Mr. Wells forgot even to mention literature among the skills, etc., which he designedly excluded from his survey. Perhaps the British Association will next year seek to restore the balance by inviting one of the tender-minded brotherhood to address the Education Section. Meantime, the tough-minded Mr. Wells has given to all interested in education, something to think about and something to follow up.

Social Theory and Discipline

(1) *The Development of Sociology*

By Prof. F. N. House. (McGraw-Hill Publications in Sociology.) Pp. viii + 456. (New York and London: McGraw-Hill Book Co. Inc., 1936.) 24s.

(2) *Control in Human Societies*

By Prof. J. Dowd. (The Century Social Science Series.) Pp. xvii + 475. (New York and London: D. Appleton-Century Co. Inc., 1936.) 16s. net.

(3) *Ideology and Utopia:*

An Introduction to the Sociology of Knowledge. By Karl Mannheim. (International Library of Psychology, Philosophy and Scientific Knowledge.) Pp. xxxi + 318. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1936.) 15s. net.

CURRENT interest in the co-ordination of views on the social responsibilities of scientific workers gives topical interest to these three volumes. From different angles they are all concerned with the contribution which science could offer to the solution of social problems, and more especially with the conditions and principles of scientific thought in this field. In turn they give us a broad historical survey of the subject, a practical study suggestive of lines of research and a stimulating contribution to original thought on the underlying principles of social theory and discipline.

(1) About half of Prof. House's comprehensive but not exhaustive account of the development of sociology is concerned with the growth of sociology in the United States, and particular aspects and characteristics of that growth. As an introduction to the extensive literature of this field and as a reasonably balanced survey of the development of thought on social questions, it can be commended to the growing number of scientific workers who, in considering the social consequences of their work or the place of scientific thought and method in social and political questions, are anxious to gain some background of theory and experience.

Some such background is essential whether we are concerned with the theoretical aspects of social science or with its actual technique in the handling of social and political problems on scientific lines, if only because nowhere in the field of science is the question of values more important than in social problems. The historic background gives the clue to the meaning of many social phenomena and has a practical bearing in the interpretation of present-day conditions and problems. It is a fundamental objective in the preservation and transmission of the social heritage.

Prof. House is sometimes a little too comprehensive to be as lucid as is desirable in the furtherance of the objectives so clearly set forth in his introduction, and more judicious selection would have made the work less tedious and increased its value to the general reader and student. None the less, he has traced clearly the development of social thought from its origin until it commenced in the eighteenth century to take on a form which may reasonably be styled scientific, and in the first two parts of the book ample justice is done to writers and thinkers in this field both in Great Britain and in Europe. His survey of American conditions notes a number of weaknesses of social research in that country which have already received trenchant criticism from Flexner, but suggests that the belief that sociology has important practical bearings on problems of citizenship, personal conduct and occupational problems may lead to it being regarded less as a subject to be taught to college students. On the other hand, he is a little sceptical as to the prospects of the integration of sociology, economics, political science and anthropology into a social science.

(2) Prof. Dowd, limiting himself to the evolutionary or dynamic aspects of society, gives us a comprehensive study of the controlling influences which determine the evolution of human societies and enters a strong plea for research on the lines advocated by Prof. W. McDougall in "World Chaos". The major part of the book, following a brief discussion of the origin and functions of control in society and a summary of the development of control in such varied fields as industry, religion, art, government and family life, which he summarizes as a transition from paternal to social control accompanied by an increasing individual opportunity, incentive and development, is devoted to a highly stimulating examination of the varied factors which are involved in problems of control which confront us at the present time.

This is a book which anyone who is interested in social problems to-day, whether of leadership or of the re-integration of society under the impact of science, can read with profit and with interest. Prof. Dowd gives a well-balanced treatment of the many factors which complicate these studies. His chapter on control in industry is highly suggestive and is an admirable corrective to the narrow angle from which industrial administration is sometimes approached. We have in it one more plea that industrial efficiency cannot be dissociated from social efficiency. No individual can be inspired to do efficient work unless he has opportunity,

like the professional worker, to exercise his initiative, to share responsibility for the product and to receive recognition for his part in it, and the author lays a good deal of stress on the value of developing group loyalties and incentives of the professional type. He clearly believes that in the society of the future the motive of private profit will be insignificant and unnecessary.

Particularly to those who are concerned with the preservation of democracy and freedom of thought in the face of clashing systems of totalitarian States and social organization should this study make its appeal. The author never fails to recognize the need for discipline, and whether he is concerned with order in the State, in industry, or in the religious institution, he regards its development as of the first importance. Recognizing the fundamental principle of discipline that loyalty to group ideals and standards progresses from the smaller to the larger fellowship groups, he points out that the very existence of dictatorship is a confession of failure to engender the primary loyalties. Discipline, however, is not mere conformity to a fixed standard, but the acceptance of some ideal or principle as the determining influence in conduct and action.

This study of social control is in fact primarily a study of the meaning of liberty and its preservation. The ultimate object of social control is to facilitate the flowering of whatever genius or talent the individual may possess, and the main purpose of the book is to discuss the principles which may be applied in the development of a social order in which the individual can best express his personality and in which human relations may be most felicitous. This can only be achieved as a measure of discipline is accepted, at least sufficient to prevent a relapse to the social chaos which demands paternalism for its correction. Scientific workers at least should respond to the plea for the acceptance of group disciplines and larger loyalties, which will enable the individual to resist transient appeals likely to throw him out of his social orbit, no less than to the plea to enter on the wide fields of research now open to us.

Prof. Dowd makes many wise observations suggestive of lines of thought or study in respect of such matters as recreation as a social function, the relation between physical, moral and social efficiency, and professional or other occupational ability, or the growing significance of the service motive in industrial and business enterprise. He believes that if private business cannot be organized primarily to serve the public, it must give way to some form of State control, and he directs attention to the difficulty of effective discipline for citizenship if conditions are perpetuated which overstimulate man's desires for material possessions.

(3) Mannheim's work is scarcely one for the general reader, but is unquestionably the most significant of the three works as a contribution to the theory of sociology. Even in his discussion of the relation between social theory and political practice entitled "The Prospects of Scientific Politics", the author eschews the practical side and is concerned essentially with the fundamental principles by which effective action is determined. If, however, the book is primarily one for the specialist, apart possibly from the fifth section, which is little more than a scientific outline of the sociology of knowledge, written essentially as an article for an encyclopædia, it would be unjust to suggest that even the general reader will not find stimulating and suggestive passages in this work.

Prof. Mannheim lays a welcome stress on the necessity for precision of thought and on the interdependence and sensitivity to change and varying emphasis in the meaning of words. Thought, he points out, is a particularly sensitive index of social and cultural change, and few things have hampered progress in the development of the social sciences more than the loose and inaccurate terminology so often employed. Moreover, it is a rapidly changing intellectual world which makes possible the effective criticism of ideas and values formerly regarded as fixed. We need continually to recognize that every point of view is particular to a certain definite situation, and must be ready to determine by analysis the nature of this particularity. Knowledge is distorted when it fails to take account of the new realities applying to a situation, and when it attempts to conceal them by thinking of them in inappropriate categories. One of the weaknesses of the cultural sciences to-day is that they view their knowledge and formulate their problems abstract and torn from their concrete settings. To recognize more clearly this confusion is an enrichment rather than a loss, for the way out is to be won by the gradual extension and deepening of our insight and by careful advance in the direction of control.

The plea for fundamental thinking does not, however, lead Prof. Mannheim to understate the necessity for practical politics, though he does not attempt to elaborate even programmes for research in such fields. He clearly does not believe that the sphere of human activity on the mastery of which our fate depends will not yield its secrets even to scientific research. Nor is he to be numbered with those social scientists who believe that science must restrict itself to the causation of actual phenomena, that science is not concerned with what should be done, not with what ought to be but rather with what can be done, and with the manner of doing it. He has sought to trace the connexion between the actual interest groups

in society and the ideas and modes of thought they espoused. He has shown that these complexes of ideas which direct activity towards the maintenance of the existing order do not merely direct thought from the object of observation, but also fix attention upon aspects of the situation which might otherwise be observed or unnoticed.

Prof. Mannheim has thus given us an effective instrument for fruitful empirical research. He also insists on the acuteness of the problem of objectivity in the social sciences, and the interest of the observer in the observed and the overwhelming influence of beliefs about the ends of action. He shows clearly also that the factors at work in the human mind impelling and disturbing

reason are the same dynamic factors that are the springs of all human activity. The new discipline he outlines, which promises to give a fresh and profound understanding of social life, is supplemented by a clarification of some of the major moral issues of to-day. If the treatment is not always as lucid as might be desired, the book is none the less a significant contribution to thought in a field with which not merely the specialist but also all scientific workers and others interested in the deeper problems of to-day are increasingly concerned, and not the least of our thanks are due to the translators for the critical preface contributed by Louis Wirth.

R. BRIGHTMAN.

Fluorine Poisoning

Fluorine Intoxication:

a Clinical-Hygienic Study; with a Review of the Literature and some Experimental Investigations. By Kaj Roholm. Pp. xi + 364 + 47 plates. (Copenhagen: Arnold Busck; London: H. K. Lewis and Co., Ltd., 1937.) 20s. net.

FLUORINE intoxication from domestic or industrial causes is rare in Great Britain. For this reason the knowledge of its occurrence, causes and results is inadequate and restricted. In this recently published excellent survey in English of the clinical and experimental work on the subject, much useful information has been presented and the main points will be reviewed.

All fluorine compounds are toxic to man and animals. Taken orally, hydrofluoric acid solutions, sodium fluoride, hydrofluosilicic acid and sodium fluosilicate are highly toxic, calcium compounds being less toxic. Cases of acute poisoning from accidental and premeditated use are increasing. The compounds in the fatal preparations were either sodium fluoride or fluosilicate. Death occurred in all in less than twelve hours.

The cases of chronic poisoning can be divided into three groups. A small number of sporadic distribution are due to the use of insecticides for plants or animals, or rat poisons. A larger number occur in certain industries. Cryolite workers provide the largest number of cases, and it is the study of these that has been the important original contribution of Roholm's work. The other group of chronic cases represents the mildest but yet obvious form of fluorine effect, namely the 'mottling' of teeth. This occurs in localized regions, many instances of which have been recorded in

the United States. Mottled teeth occur in Italy, Spain, Holland and England (Maldon, Essex). In all these regions the effects on the teeth are similar in type but different in degree. The teeth can only be affected during development; they are chalky white and later they become stained with unsightly dark brown patches or 'mottled'. The cause is the presence of sodium fluoride in the drinking water. Even two parts per million fluorine in the water can cause this, and so calls for a change of supply.

In Morocco and the Argentine there is a form of chronic poisoning called 'darmous' which results from the extensive fluorine-containing phosphorite rock deposits. The cattle are badly affected with a form of osteomalacia. Feeding rock phosphate can lead to this condition. The use of bone meal has so increased that the supply is inadequate and rock phosphate is used instead. It is essential that the latter should be fluorine-free. Vegetation in the neighbourhood of chemical works emitting fluorine is affected and can be a source of danger to grazing animals. Similar results have followed volcanic eruptions in Iceland.

The distribution of fluorine has been considered. This part of the subject is not in a satisfactory state because of the difficulty of determination of fluorine, especially in animal material. Fluorine is not a necessary element in nutrition, nor is it present in more than a trace in average teeth; even mottled teeth only contain 0.05 per cent of fluorine.

Roholm's special work has been the study of fluorosis among workers in a cryolite factory. Cryolite (Na_3AlF_6) deposits occur in Greenland, are quarried and shipped to the United States and Copenhagen. In the latter the working of the

crude mineral to a fine pure state takes place. Those therein employed have been studied. The danger, one similar to that in silicosis, lies in the fine dust produced during the working. In all, sixty-eight workers, male and female, were examined (*questionnaire*, urine analysis and X-ray of limbs and pelvis). Gastric disturbances, palpitations, dyspnoea and rheumatism were the commonest complaints made by the workers themselves.

The X-ray examination revealed that intoxication was generalized, all bones being affected with a diffuse osteosclerosis accompanied by a calcification of ligaments. This was considered the most serious effect because it led to a decreased mobility of joints, in particular of the spinal column. The children of female workers in a few cases, where suckling had been prolonged, showed mottling of their permanent teeth. Experiments in which cryolite was fed to rats, pigs, calves and dogs verified the clinical findings, so that a clearer understanding of the workers' symptoms has been gained.

Convinced, then, of the toxic properties of fluorine, it is important to emphasize the sources of danger and possibilities of prevention. Danger lies in the manufacture and use of compounds of fluorine for insecticides, plant sprays, rat poisons and rock phosphate, for manure or cattle supplement. Prevention should aim at restricting the handling and hence the use of fluorine compounds. Where handling of minerals takes place, similar precautions are required as for silicosis prevention. Industrial waste containing fluorine should be converted to the least toxic compound, calcium fluoride.

My own inquiries in Great Britain have indicated that fluorosis has not yet been recognized as an industrial danger. Apparently fluorine minerals are not dealt with here. The danger, however, exists in the use of insecticides. A case of poisoning from accidental use of a chicken disinfectant was reported a little more than a year ago.

It is fortunate that a volume of such industrial, clinical and scientific value is available, in English, should the danger of fluorine intoxication become more common.

M. M. MURRAY.

The Living World

Science of Life Series

By H. G. Wells, Julian Huxley and G. P. Wells. Vol. 1: *The Living Body*. Pp. xi+223. Vol. 2: *Patterns of Life*. Pp. x+239. Vol. 3: *Evolution—Fact and Theory*. Pp. x+271. Vol. 4: *Reproduction, Heredity and the Development of Sex*. Pp. x+222. Vol. 5: *The History and Adventure of Life*. Pp. x+259. Vol. 6: *The Drama of Life*. Pp. x+316. Vol. 7: *How Animals Behave*. Pp. x+263. Vol. 8: *Man's Mind and Behaviour*. Pp. x+271. Vol. 9: *Biology of the Human Race*. Pp. ix+205. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1934-1937.) 4s. net each.

WE confess that we commenced to read with a certain prejudice, for we thought of the many distinguished authors who combined to write the "International Science Series" and cheaper "Primers" of still earlier date. Each wrote on his own speciality, and we assumed a certain virtue in this. We were sceptical in respect to this combination of literary capacity, of imagination and of learning, perhaps expecting that the latter on account of its 'youthfulness' would not be allowed its full play. However, we found ourselves reading Volume 1 on a train journey, and a volume has been our inseparable companion on all such for the last three months. We admit 'second

childhood' with its consequent loss of memory—and thus our reading gave us pleasure, point following point as to life and the methods thereof, in such definite order that they produced in us a happy restfulness, not the boredom that induces sleep. We found a well-authenticated story and could read without the worry of hybrid names, too often coined to glorify an author rather than of necessity. "We ought to have a name for it." "Why?" "Well, someone else will give one, anyhow!" Far from valid reasoning.

Our authors are so merged that they might have been one. They start with "The Living Body"—and it is the human body—a machine reacting to its varied surroundings, its driver a nervous system, and efficient so long as it is properly fuelled and cleaned, until in course of time it wears out. This leads naturally to the various 'patterns' affected by animals and plants, and then our attention is directed to the way in which they may have been evolved. We are not allowed to assume without ample evidence the overwhelming positions of evolution and natural selection, which sometimes are rejected owing to man's pride or fear. 'Heredity' is all-important here, reproduction, sex and the body changes as the individual grows—a happily written and clear series of essays.

"The History and Adventure of Life", weaving it into the conditions of each geological stratum, naturally appeals, but a map showing the proportional length of time of each period is not accessible where we want it, the table given devoting two-thirds of its length to man, its post-War column especially in our opinion being out of place; this we disliked, but we found the rest of the volume corrective and admirable. The "Drama of Life" is scarcely a self-explanatory title for life in the sea and on land and in its waters, and the swaying balance between the animals and plants in communities (ecology). To us this quite learned volume shows a curious lack of those personal and humorous touches which we had become accustomed to expect, and which recur in full measure in the consideration of 'behaviour'—a separate volume is devoted to man—and of the "Biology of the Human Race".

Our suggestion to parents who have children going to a university for any science course, and to teachers, is to use these volumes so that their children or pupils may be educated, not merely crammed. There are nine of them, one for the summer vacation before the first term, and then one in each vacation until the student sits for final honours. The examinational result—whether the student is biologist, physicist or chemist—a certain understanding, will be great, and the candidate will have something which will add permanently to his interest in life, and will help him in his relationship with his fellows and his community.

The series is a reproduction in convenient form of the volume entitled "Science of Life", originally published in 1929 and reviewed in *NATURE* of March 28, 1931; the separate and handy little volumes now before us have been appearing at intervals since 1934.

Theism Restated

The Philosophical Bases of Theism

By Dr. G. Dawes Hicks. (Hibbert Lectures.) Pp. 272. (London: George Allen and Unwin, Ltd., 1937.) 8s. 6d. net.

THE substance of Prof. Dawes Hicks' book was delivered as the Hibbert Lectures in 1931. The volume is designed primarily for the general reader, especially for those "who have abandoned the resort of basing their religious trust on a miraculously attested revelation", and for whom, therefore, the philosophic approach to religion is indispensable. The author admits that "philosophy can as little provide us with a new religion as the science of ethics can provide us with a new morality"; yet "a religious mind which has reflected upon the principles upon which its religion rests, is clearly an advance upon the religious mind which has not so reflected".

Dealing with what is known as the cosmological argument for the existence of God, we may note that Prof. Dawes Hicks rejects the idea of a creation out of nothing. "This idea of Nothing, in the sense in which we take it when we oppose it to that of existence, is a pseudo-idea, and the problems which are raised round it are pseudo-problems." Furthermore, "the idea of creation as an event which occurred at a definite date in the past calls to be unhesitatingly rejected. . . . If the notion of 'creation' is to be sustained at all it can only be in the sense of continuous creation—of a constant dependance of the world on the supreme Being". The gist of the argument for the existence of God from the existence of Nature,

is that "we are logically driven to acknowledge that there is a real existence beyond nature, unless we are prepared to rest in ultimate inexplicability, and to relinquish the attempt to frame any intelligible conception of nature at all".

In framing the teleological argument, Prof. Dawes Hicks stresses the point that Nature is strikingly adapted to human thought and reason, and in its very essence would seem to be intimately related to mind or intelligence. He alludes also to the work of the American biologist, Prof. L. J. Henderson, on the fitness of our material environment to support life. Countless other distributions of those three indispensable elements, carbon, hydrogen and oxygen, would have been no less antecedently possible, and yet we find "just *that* distribution, just *that* conjunction of properties, which is *fittest* for the maintenance of life".

Nor is the ontological argument overlooked by Prof. Dawes Hicks, and he does not admit that it was disposed of by Kant when he stressed the difference between 300 thalers in his mind and 300 thalers in his purse. For, after all, God is something very different from thalers, and as Anselm (who invented the argument) expressly affirmed, it was *only* in reference to the idea of the infinite that his argument had any significance. "This is an idea the content of which is wholly inexplicable by reference to finite, and therefore limited facts; and, accordingly, its mere presence in our consciousness is sufficient to establish the existence of a reality corresponding to it."

J. C. H.

Index to the Palace of Minos

By Dr. Joan Evans. With Special Sections classified in detail and chronologically arranged, by Sir Arthur Evans. Pp. vi+221. (London: Macmillan and Co., Ltd., 1936.) 31s. 6d. net.

PUBLICATION of an index in a volume separate from the main work would not in the ordinary course call for special comment, beyond note of the fact of issue. The index of "The Palace of Knossos" stands in a different category. The fact that the history of the Palace, as reconstructed in Sir Arthur's excavations, covers the whole of the Minoan age, and the scale in range and detail on which the index has been compiled, not only make it an indispensable aid to the use of the book, of which it is an appendage, but also constitute it a guide to the history of the period and its civilization at large.

Even that, however, does not exhaust its claim to be an essential tool of the historian and the archaeologist. The appearance of Sir Arthur's name as joint author is no mere formality; and for certain entire headings, distinguished by his initials, he has been entirely responsible. As these headings are all of first-rate importance in the archaeological and cultural sense, no one will quarrel with the author for having departed from the strict canons of the indexer. He has made each of them a chronological summary and survey of the subject with which it deals. The amount of detail which has thus been included may be judged from the fact that the entry for "pottery" runs to twenty-three pages, and many other heads of importance are treated on a like scale. The author's modest suggestion that the index may serve as a guide for those students who cannot afford the whole work does less than justice to its value and utility.

With a Spade on Stane Street

By S. E. Winbolt. Pp. xi+240+12 plates. (London: Methuen and Co., Ltd., 1936.) 10s. 6d. net.

STANE STREET, the Roman road running from Chichester to London, presents numerous problems, some of which have given rise to much controversy. The literature relating to it, in consequence, is considerable. Mr. Winbolt's contribution, however, cannot be regarded as in any way superfluous. Not only does he trace the road, field by field, in all its stages, but also he has submitted new and doubtful solutions for determining the line to the test of archaeological excavation, where the application of this method has been possible. His verdict, therefore, may be taken as final. It is unfortunate that excavation has been possible at two only of the *mansiones*, or road-side stations. At Ewell, between which town and London the road is usually regarded as non-existent, the author has boldly attempted a reconstruction of the Roman town upon lines which, while purely conjectural, are supported by cogent argument. Mr. Winbolt is a strong supporter of an early date for the road, and maintains that its importance was due not to military exigencies, but to its use for public and commercial purposes.

Organische Synthesen (Organic Syntheses)

Übersetzt und für deutsche Verhältnisse bearbeitet von Dr. Richard Amus. Pp. xii+586. (Braunschweig: Friedr. Vieweg und Sohn, 1937.) 45 gold marks.

IN the collected volume (1932) of the first nine annual volumes of "Organic Syntheses" (1921-31), several improvements were incorporated. New processes for several compounds were included, the descriptions of experimental procedure were enriched with small but important improvements, and indexes to reactions, substances and processes were provided. Such small but highly useful improvements as the statement of amounts of corrosive liquids and solvents in cubic centimetres as well as grams made a considerable difference in the practical utility of the volume. The descriptions are very full and references are given to the literature.

In the German translation the American materials and apparatus have been replaced by those obtainable from German firms and any necessary modifications of procedure introduced. By co-operation with the American editor-in-chief, Prof. Gilman, improved methods and corrections not to be found in the American edition have been introduced. The German edition will therefore be of interest to those who already possess the American volume, and it should prove most valuable to chemists who are more familiar with German than English. The paper and printing are good, and the translation appears to be careful and accurate.

The Future of Woman

By Anthony M. Ludovici. (To-day, To-morrow and After Series.) Pp. viii+152. (London: Kegan Paul and Co., Ltd., 1936.) 3s. 6d. net.

THIS little book forms a supplement to the author's "Lysistrata", which he now regards as too mild an indictment of feminism. As in his previous works, he maintains that one of the first and principal steps in the regeneration of the Western world is a masculine renaissance of man both as animal and as spirit. Feminism he regards as "nothing more than a government of odd people, by odd people, for odd people". In conclusion, he declares that there can be no solution of life's problems for normal women which leads them away from their normal function of nursing and training children.

Essentials of Modern Medical Treatment

By Dr. Vincent Norman. Pp. xvi+200. (London: Hutchinson's Scientific and Technical Publications, 1936.) 10s. 6d.

CONSIDERABLY smaller and less comprehensive than the well-known "Index of Treatment", to which numerous specialists have contributed, this volume, which is the work of a single author, is to be recommended to the practitioner and student for its lucidity, conciseness and up-to-date character, as well as for its considerably lower price. In addition to the eminently practical advice on treatment, a short account is given of the causation and symptoms of the various diseases.

Assam Origins in Relation to Oceania*

By Prof. J. H. Hutton, C.I.E.

IN choosing this subject I am not attempting to offer any definite solution to the problems of Indonesian migrations, but propose rather to examine one aspect of them in the hopes that I may elicit further information which may contribute towards the ultimate solution of what is really a complex of very difficult problems, as I feel that although a clearing up of the main question may be very distant, some analysis of the Assam side of the problem is perhaps possible.

Many parallels are to be found of one sort or another between Assam and Oceania, some of which were pointed out by Sir Henry Yule and by S. E. Peal in articles in the *Journal of the Anthropological Institute* in February 1880 and 1893 respectively, and others of which I myself indicated in an article on "Assam and the Pacific", in *Man in India* in 1924. In 1925 Henry Balfour pointed out cultural connexions between Assam and Indonesia in the matter of certain types of thorn-lined fish traps and, more recently, of fretted horn and shell ear ornaments.

It is fairly clear that identity of culture, in so far as it exists, is not that of a single culture, but rather of a complex of cultures in each case. It is certain that Assam may be able to throw some light on the Indonesian problem, as the stratifications can, at any rate to some extent, still be traced. The last immigrants are undoubtedly people of Kuki and Kachin affinities. There is a strong tradition among the Chins of the Arakan hill tracts pointing to their migration down the Chindwin Valley, no doubt throwing off parties which must have penetrated the Assam hills from the east on the way, after which one portion of the Kukis at any rate seem to have worked up northwards again from the Bay of Bengal, a movement which has barely ceased, if it has ceased, in the present generation. It would seem that the Kayans of Borneo probably formed part of the same movement. A tradition quoted by Hose and McDougall assigned the arrival of the Kayans in Borneo to the earliest years of the fourteenth century A.D., a date which fits well enough with Kuki and Tippera tradition.

Apart from such preceding migrations, of which there may have been many originating in movements in the Chindwin Valley caused by this southward Kuki-Kachin migration, and of which we probably have a memory in the traditions of

the Angami Lhota and Ao movements from Manipur westwards, the two previous cultures in the Assam hills seem to have been definitely matrilineal and to have belonged to two types. One of these—and presumably the later—seems to have been analogous to the present Khasi and Synteng cultures, the other to that of the Garo and of the Kachari of the Assam plains. The Khasi migration clearly came from the east, and the parallel culture in Tonkin to their earliest remains in Assam is dated by Coëdes to about the beginning of our era. The Garo-Kachari peoples seem to have migrated from the north bank of the Brahmaputra, and while the Kachari is now predominantly patrilineal, as the Garo is matrilineal, both may still be said to be in the process of change as the result of contact between two systems.

It is interesting to notice that in Madagascar the Vazimba, who preceded the Hova as immigrants, had a number of features in common with the megalith-using Khasi, not all of which were afterwards adopted by the Hova. The latter, for example, built in wood, whereas the Vazimba used stone. One may also observe that Hocart, writing on the early Fijians, is inclined to think that the more civilized community was swamped by barbarians before the more recent migration of Polynesians from the east. Undoubtedly the Naga tribes at present represented by the Konyak Nagas in the north and to a lesser degree by Kachha Nagas to the south of the Naga hills, are associated with a more civilized culture in some respects than that of the intervening tribes who have come up from Manipur, always excepting the Angamis, who are in many respects *sui generis* and who probably have incorporated a very great deal of the civilization which preceded them on their present sites.

One important feature of the Konyak tribes, shared, it is true, by their neighbours the Aos, and in a ruder fashion by the Sangtam, Chhang and Yimtsungr of the east, is the possession of enormous slit wood gongs to which I give the name 'canoe gong' on account of their shape. S. E. Peal was the first to report on these gongs, which he called 'canoe drums'; Prof. Henry Balfour calls them xylophones, and the only reason that I do not adopt his term is that I prefer to keep that name for the more usual type of xylophone consisting of a number of slats of wood giving different notes when beaten which is found among the Kuki, though not among the Naga tribes. These canoe gongs are the basis of an important cult intimately

* From the presidential address to Section H (Anthropology) of the British Association, delivered at Nottingham on September 3.

associated with head-hunting, and strongly suggestive of much that is associated with canoes in Oceania.

The true canoe gong with carved figure-heads and long hull like that of a dug-out is almost entirely limited to the Konyak, Ao, Chang and Sangtam tribes, and of these four undoubtedly the Chang and the Ao contain a large admixture of Konyak blood. The Sangtam only use a typical canoe gong in those villages which march with the Ao and Chang country. Farther south the shape is much less elaborate, and the Yimtsungr to the east of them used a mere hollow tree-trunk. South of the Sangtam tribe the canoe gong completely disappears except for the following instance: the Tangkul tribe use a remarkable form of gong, hitherto, I believe, unpublished, which might be described as resembling an inverted boat, the two ends of which are skeleton, while the centre part consists of the usual slit gong of more or less cylindrical type. The Angami use an unornamented wooden vessel of similar shape (without the skeleton ends) for the reception of liquor in bulk on ceremonial occasions, and one recalls Ellis's account of the man of Rurutu who came off to meet him "at a distance of two miles" from the island in a wooden food-vessel 6 feet long and 18 inches to 2 feet wide. A smaller slit gong of somewhat similar pattern, but much simpler, is used for scaring the birds from their fields by the Kachha Naga. Farther south again, the Zanniat Chins, who, unlike the other Chins, have a democratic organization, have a small slit gong not more than 6 feet long very like the Angami vat, while the Ngawn Chins use one of the same size not unlike the South American *teponatzli*, and put food in it on the occasion of a ceremonial dance.

It is interesting to observe that in South America the canoe gong appears to have developed independently from a hollow tree. It is, of course, possible that the canoe gong of the Naga hills has similarly developed from a tree trunk, but since we find no example of signalling by hammering on trees, we are perhaps entitled to argue that the process in Assam has been the other way, and that the smaller slit gongs, or the hollow tree trunks, used by some villages, are degenerate forms of the original gong which started as a canoe, and it is possibly significant that in the Kachin story of the great flood the two survivors escape drowning in "a large oval-shaped drum". On the other hand, it must be admitted that a simple form of slit gong occurs in Yunnan, as it does in Malaya and in Borneo, suggesting either marginal degenerations from a developed type in Assam, or possibly simple types from which the Assam one might have been elaborated. The real argument, therefore, for the canoe gong's being a survival from a real canoe

rests on its associations with head-hunting and a typical canoe culture.

Now the Naga canoe gong is closely associated with the men's house, and generally, if not kept in it, it is kept in an annexe. It is in some respects treated almost as an idol, and tremendous effort is expended on carving it and dragging it up to the village. All human heads brought in are first placed on the canoe gong, at any rate by the Ao, suggesting the Marquesan practice of decorating the prows of their war canoes with the skulls of their enemies. When the gong is dragged up to the village over wooden rollers, such as those used in launching a vessel, the blood of the sacrificed animals is poured on to it, and in the old days any stranger, whether friend or foe, who came to the village on the day when a new drum was dragged in, was killed in order that his head might adorn the drum and his soul inhabit it. Indeed, until a head had come in, or had been brought in for the drum, a fence was put round it which could not be removed, nor could the drum be beaten until the young men had been out and fetched a head to remedy the defect. This head was first laid on the new drum.

The parallel with Melanesian canoe practice is here very close. Codrington writes as follows: "In the eastern Solomon Islands, if no victim was met with in the first voyage of a new canoe, the chief to whom the canoe belonged would privately arrange with some neighbouring chief to let him have one of his men, some friendless man probably, or a stranger, who would then be killed, perhaps as he went out to look at the new canoe. . . . Further west also captives were kept with a view to the taking of their heads when new canoes were launched." He goes on to give an example in a footnote: "The chief of Ravu bought his *peko* [war canoe] . . . for a large sum of money. It was brought over secretly and put into a . . . canoe house, where it stood till a head should have been procured. . . . In the morning a single man came by . . . in his canoe . . . they caught and killed him, set up his head at the prow of the [newly bought] canoe and paddled back to Ravu with shouting and blowing conch shells."

Nowadays in the Ao country a mock raid takes the place of a real one, but even this chastened sacrifice leads to a great success in hunting and in agriculture. The Ao gong nowadays wears a necklace of basket balls representing heads. Real heads were never used in this way, although they were laid on the gong when first brought in. These basket-work ornaments perhaps afford a parallel with the carved head which formed part of the figure-head of the Melanesian canoe. The figure-head of an Ao canoe is generally in the form of a buffalo or gayal head, that of the Konyak tribes

an elephant, buffalo or hornbill head, but Peal, writing in 1893, remarks that the Konyak figure-head is (as depicted in his drawing) a crocodile, although "there are no crocodiles in these hills", and he points out that it is a familiar decoration in Indonesia and the Pacific. Although I have covered most of the ground visited by Peal in the last century, I have never seen any figure-head resembling the head of a crocodile, so that this tradition has apparently disappeared in the forty years since he visited the Naga hills.

It has occurred to me that the instruments used for beating the Naga canoe gong may conceivably be degenerate paddles. The ordinary type is more like the dumb-bell than anything, but often one end of the dumb-bell takes an ornamented form such as the hornbill's head, and in any event this 'dumb-bell' is not unlike a paddle in which the blade has degenerated to proportions similar to those of the handle.

F. E. Williams, writing of the Pairama ceremony in the Purari Delta in Papua, tells us that "when a successful hunt returned at evening the corpse of the victim was borne from the canoe to the *ravi* amid great enthusiasm. The men uttered that prolonged shout or roar which has a singularly exciting effect upon the listener, and rattle their paddles upon the sides of the canoes with the rhythm called *raruki raruki*. . . . On the following day the . . . hunter who first brings down the victim . . . is paraded in triumph through the village standing astride the canoe and balancing himself with a spear". It was formerly the custom of Meithei to signal across the Logtak Lake in the Manipur State in Assam by beating with their poles or paddles on the sides of their dug-outs as the Nagas do on a canoe gong, and I am further told by Mr. William Shaw, who served many years in the Manipur State, that some Kabui villages which have no canoe gongs still have the tradition of having used them once, while in Kabui Khulen village a sort of boat, with a high prow, is dragged in every year at the harvest festival "for all who have died in the past year". The best dressed of the young men rides on the boat, while there is a tug-of-war between the two clans of the village, one pulling at each end of the boat by ropes attached to pierced lugs left on when fashioning this dug-out, which is known as the *thingkhutong*—the plank to which a dead body is ordinarily fastened for burial in that village being called *thingkhu*. It must, I think, represent a boat or a boat-shaped coffin and be associated again with the fertility of the crops, so largely bound up both with the spirits of the ancestral dead, and of dead enemies, while the riding of the boat by the young warrior is reminiscent of the Pairama ceremony described by F. E. Williams.

Boat-shaped coffins are found occasionally in several of the Naga tribes, particularly in the Konyak country, where in one village at any rate they are associated with a tabooed chief, and it is worth noticing that a stone is put up by the Fijian 'spirit house' for each corpse brought in, precisely as the Konyak Nagas put up an erect stone outside the men's house for each head; and it is also remarkable that in one case, at any rate, there seems to have been a close association between the Fijian war canoe and the gong known as *lali*, since the chief Rokona named his war canoe Vatutulali, after his large gong.

The Samoans have a similar gong known as *longo*, the sound of which—according to Brown—will carry for twenty miles under favourable conditions. Brown also mentions that the Samoans struck the sides of their canoes with the handles of their paddles to mark time.

One more parallel is worth indicating in connexion with this subject. Writing in the *Journal of the Royal Society of Arts* of February 1937, La Valette illustrates the uptilted roofs of a branch of the Toradja tribe in Celebes, which he says are deliberately got from the prow and stern of a canoe, and are "bound up with the tribal traditions of their ancestors, who originally arrived from a country overseas to which the spirits of the dead must return". The roofs he illustrated are almost identical with forms common in one branch of the Konyak Nagas, east of the frontier of Assam.

I have elsewhere suggested a possible migration from Indonesia, and migrations from Indonesia to Ceylon and South India are placed by Hornell at about the beginning of the Christian era. I cannot help thinking that if, as I am tempted to believe, there was an Indonesian migration which swept upwards northwards into Assam before the Kukis came south, it must have been at an earlier date than that; at any rate there does seem to have been some expansion in many directions from Indonesia at a date which perhaps precedes the dates suggested by Coedes and Colani for the megalithic civilization of south-east Asia. It would be interesting to know how far the stratifications of cultures in Oceania will correspond to the apparent succession in Assam of an Oceanic canoe culture, a matrilineal megalithic culture and that of a more recent patrilineal one associated with the Kayan and Kuki. The principal point which I wish to make, however, is that the hill cultures of Assam correspond to other distant cultures or combinations of cultures, all of which appear to be marginal in distribution from an Indonesian centre, and that there is some ground for supposing that migrations of culture, if not of people, have taken place from some centre in or near the Indian archipelago in various directions, one of which terminated in Assam.

Noise and the Nation*

By Dr. G. W. C. Kaye, O.B.E.

NOISE ON THE ROAD

THREE reports on road transport noise have been issued by a Departmental Committee set up by the Minister of Transport, and the position is that for the first time in Great Britain a comprehensive attack has been made on the problem of road traffic noise. To this end, loudness measurements, many thousands in number, have been conducted under widely different working conditions, on the over-all noise of some 800 motor vehicles, both new and old, representing all the main types on the roads to-day. The results (at a distance of 18 feet sideways or 25 feet to the rear) mostly ranged between about 70 and 105 phons (the latter value corresponding to a noisy road drill). The Committee was led to propose simple running and racing engine tests which are associated under specified conditions with an 'over-all' noise limit of 95 phons (roughly equivalent to the noise in a tube train) for all vehicles in use on the road, and of 90 phons for new vehicles leaving the manufacturer's works.

The adoption of these noise limits, while making very moderate demands on most types of vehicles would, by ruling out the arch offenders, constitute a substantial contribution to the amenities of the road. In the meantime, the industry, which has already discovered that 'silence is saleable', has the matter well in hand, and indeed it is not unlikely that future developments will not only enable manufacturers to meet the proposed requirements with comparative ease, but may indeed enable the limits to be lowered as time goes on.

To assist the motor industry in this laudable object, the Ministry recently set up four noise-testing stations in different parts of the country. At each of these stations an N.P.L. noise meter is installed, and manufacturers are enabled to submit types of their products and so ascertain for themselves how the noise levels compare with the limits proposed.

The whole question will be further facilitated when the simplified objective noise meter, which has recently been developed by the National Physical Laboratory for the Ministry, is put on the market. Such meters, which will be checked against the Laboratory standard meter, should, when available in quantity, be of great assistance at such time as it may be decided to bring into force regulations for dealing with noise on the road.

(Continued from p. 449.)

THE ABATEMENT OF NOISE

There are two guiding principles when the question of noise abatement is being considered. One is that the degree of abatement of a noise in a particular locality need be no more than will conform to the background of noise which obtains in that locality. The other is that in a medley of noises, the loudest must be tackled first to achieve any appreciable benefit, after that the next loudest, and so on. This is illustrated by the fact that if there are two similar components and one is 10 decibels less intense than the other, the weaker one will contribute only half a phon to the over-all loudness.

The first line of attack on noise abatement, and in general much the most effective and economical, is to tackle an objectionable noise at the source, and find the best means of reducing the output as much as possible. The next step, possibly as a confession of failure, is to find a feasible method of confining or 'smothering' the noise in the place where it is generated. In either case we turn to the engineer for help, and we may anticipate that he is likely to be the more interested if he can see a potential demand from the public.

The path of a noise in its journey from source to hearer may be either *via* the intervening air or *via* a sequence of solid materials or structures. Experience has shown that the two effects require very different remedies for abatement. The study of the general problem of noise transmission is more complex than might be imagined, and some of the major difficulties are not as yet completely resolved. For the practical elucidation of the various factors involved, specially designed 'sound-proof' laboratories, such as those at the National Physical Laboratory, have proved to be necessary. Parenthetically, it may be mentioned that the N.P.L. acoustics laboratory, since its erection four years ago, has been so fully engaged in transmission and absorption work, mainly for the architectural profession and the building industry, that extensions are now in hand and should be available for use by the end of the year. Much research work on building acoustics is also being carried out for the Ministry of Health in connexion with slum clearance, and for the Architectural Acoustics Committee of the National Physical Laboratory and the Building Research Station.

To revert to the case of a non-suppressible noise, if most of the noise is transmitted by air, the best

remedy, should circumstances render it practicable, is some sort of sound-proof enclosure, the design of which may need careful attention both as regards weight and discontinuity of structure. There is, of course, no such thing as a sound-proof material, and success in sound insulation is largely a matter of design.

Certain large-scale operations may require 'sound-proof' buildings to mask them, the doors and windows of which should be heavy and close-fitting and preferably situated on the side remote from that where the noise is liable to be regarded as a nuisance. Doors and windows, particularly high windows and skylights, may require to be doubled and, in extreme cases, it may be necessary to employ double walls mounted on independent foundations. Buildings in which noisy operations are carried on should, if possible, be put under the lee of larger buildings, which may afford advantageous shielding to the locality. In the interior of noisy buildings, it is usually beneficial to the workers to divide groups of noisy machinery, so far as may be possible, into smaller units, each in its own enclosure. Appreciable benefit may also result from lining walls and ceilings with acoustical absorbent, so preventing the noise level from building up unduly.

In the case of structure-borne noises, the remedy is discontinuity somewhere in the structure either in the form of an air gap or as resilient material, for example, under the foundations of noisy or vibrating machinery.

Modern building design and materials do not provide protection from noises, whether from inside or outside, like the more solid houses of a generation ago. The noise problem is accentuated

in the case of the large blocks of flats which are being erected in all quarters, and which apparently are mainly adapted for quiet tenants who are prepared to conform in this respect to a landlord's reasonable requirements. The situation lies largely with local authorities, who should lay down building by-laws, setting forth minimum standards of acoustic insulation. The architect and builder have of necessity been driven from traditional methods of construction to meet the economic requirements and closer scientific designing of to-day. Discontinuity of structure and the use of massive and poorly conducting materials formerly provided defence against sound, but instead we now have monolithic structures which are not only thinner and lighter than the old, but also are composed of good conducting materials. The steel-framed and ferro-concrete building, cement mortar, hard bricks and plaster, to say nothing of a general ramification of central-heating, running water and other piping, have replaced the softer brickwork, lime mortar and plaster, wooden beams, joists and studding, and the localized piping of the older houses. No one pretends, of course, that we can go back to the old methods, but if we are to mitigate the noise nuisance in modern buildings, we must adopt measures which are best incorporated during the designing stage.

There is, too, another aspect which should be clearly appreciated, and that is, if sound insulation in buildings is desired, it has to be paid for. The public, at present enticed with a plethora of labour-saving devices by landlords of flats, has yet to learn that reasonable acoustic privacy is obtainable provided it is prepared to face a small proportionate increase in the rent.

Structure of Protein

THERE can be few problems of predominantly chemical interest which are being attacked by such a variety of methods of investigation as that of protein structure. This was well illustrated by the symposium on protein chemistry held on September 3 in Section B (Chemistry) of the British Association, in which the contributions ranged in subject from biochemistry to mathematics, each justifying its inclusion either by the addition of some significant fact to the total sum of knowledge or by the formulation of a stimulating hypothesis to account for facts which still await complete explanation.

The foundation of protein chemistry as we know it to-day has been laid by organic chemistry, which, chiefly in the hands of Emil Fischer and

his pupils, has provided not only detailed information concerning the composition of proteins, but above all the unquestionable demonstration of the peptide linkage as the predominant feature of their intramolecular structure. Moreover, through the development of improvements in peptide synthesis, particularly the carbobenzoxy method, organic chemistry has provided a wealth of material which has illuminated the mode of action of proteolytic enzymes and which now promises to throw light on the physico-chemical behaviour of proteins and even perhaps on their immunological specificity. These points were brought out by Prof. C. R. Harington (London) in opening the symposium, but he was at the same time at pains to emphasize that the peptide theory in its simplest form is

unable to account for all the properties of proteins, which can only be explained by the assumption of subsidiary linkages within the molecule.

The importance of the peptide linkage was further emphasized by Dr. K. Linderström-Lang (Copenhagen), who pointed out that this linkage is the only one known with certainty to be attacked by proteolytic enzymes. These enzymes, as is well known, may be roughly classified into the proteinases which attack complete protein molecules or their higher degradation products, and the various peptidases which attack peptides at points adjacent to free amino or carboxyl groups or both. Dr. Linderström-Lang directed attention to the interesting evidence which has recently accumulated that the true proteinases owe their peculiar specificity to the fact that they can only attack peptide linkages remote from free dissociating groups.

One of the greatest advances in the understanding of the physico-chemical behaviour of amino-acids and proteins is due to the zwitterion theory introduced by Bjerrum in 1923. The development of this theory and the evidence for its applicability to amino-acids was discussed by Dr. A. Neuberger (London), who laid particular emphasis on the good agreement to be observed between the experimentally determined dissociation constants of amino-acids and those calculated on the basis of the theory; evidence derived from dissociation constants of amino-acids other than α -amino-acids shows that such molecules exist in solution in a relatively unbent condition with the charged groups far apart, thus accounting for the high electrical moment required by the zwitterion theory. Dr. Neuberger proceeded further to demonstrate the fact that it is now possible to interpret the electrometric titration curve of a protein with reasonable accuracy in terms of the polyvalent amino-acids which it contains, the additional dissociating groups of these amino-acids being the factors which determine the electrochemical behaviour of the protein molecule as a whole.

The determination of the very large molecular weights of proteins is a matter of considerable difficulty, and no method has afforded more valuable information on this point than the ultracentrifugal method evolved by Svedberg. This procedure was described by Mr. J. St. L. Philpot (Oxford), and was illustrated by a very beautiful application in which the molecular weight of the enzyme xanthine oxidase was observed by its rate of sedimentation from a solution containing the enzyme system, methylene blue and iodate; the solution, at first colourless throughout, becomes coloured from the top downwards in the ultracentrifuge owing to re-oxidation of the leuco-methylene blue by the iodate as the enzyme is removed.

The remaining two contributions to the symposium were chiefly concerned with the nature of the subsidiary linkage in the protein molecule, which was referred to by the opener. The evidence to be derived from X-ray measurements was discussed by Dr. W. T. Astbury (Leeds), who recalled his well-known earlier work on the structure of the keratins, showing these proteins to be made up of bundles of peptide chains joined by subsidiary linkages which might be either the disulphide linkage of cystine or so-called hydrogen bonds or covalent linkages of unknown nature. It was pointed out by Dr. Astbury that X-ray measurements indicate a transition in structure from the stretched keratin or myosin molecule, through the partly folded molecule of unstretched keratin as it occurs in hair, to the completely folded molecule of the 'globular' proteins such as insulin. The evidence provided by X-ray measurements regarding the mechanism of denaturation of proteins was also discussed; it appears that this process certainly involves rearrangement and unfolding of peptide chains, but it seems to the present writer at least that the real nature of the phenomenon remains as obscure to physicists as it is to chemists.

Of the various theories of protein structure which have been proposed from time to time, few are of greater interest than the 'cyclol' hypothesis advanced on geometrical reasoning by Dr. D. M. Wrinch (Oxford). This theory, which has already been presented in a series of communications to NATURE, was briefly outlined by Dr. Wrinch, who claimed with justice that it is in fact a logical development of the peptide hypothesis built up within the framework of existing knowledge. The criticism of Dr. Linderström-Lang that the cyclol molecule contains linkages of a type not known to be attacked by enzymes was met by Dr. Wrinch with the admission of the possibility of spontaneous breakdown of the structure following initial enzymic rupture of the normal peptide linkages, which it does in fact contain.

The symposium was closed by two brief but interesting contributions, from Dr. Irving Langmuir on the possibilities offered by the study of protein films, and from Dr. D. Jordan Lloyd concerning the important physico-chemical work of Cohn and his collaborators at Harvard.

The general impression left by the symposium was that the problem of protein structure can only be solved by a combination of all applicable methods of attack. The listener was left in no doubt as to the magnitude of the problem, but nevertheless with the feeling that improvements and new developments of technique are now forthcoming at a rate which affords justifiable hope of its solution in the not very distant future.

Health and the Community

ON September 2, the physiologists of the British Association for the nonce forsook their frogs, covies, rabbits and almost, but not quite, their rats. They left the cloistered calm of controlled experiments *in camera* and the discussion of intricate problems of nerve conduction or surface films, interesting, no doubt, to those who have at least mastered the terminology but deadly dull to those who have not, and descended to the world of men, and to a consideration of the criteria of the healthy life both of man as an individual and as an integer in a community. They could not, however, quite part with the rat. The important part this rodent has played and is still playing in the progress of civilization would need a whole article to describe, but we only heard of its value in assaying food for certain vitamins, and were warned of the dangers of accepting results obtained from experiments on rats as applicable without reserve to man. For example, the anti-vitamin D influence of cereals—so clearly demonstrable on rats and puppies, due to the absence from their alimentary tracts of an enzyme capable of freeing phosphate from *phytin*—leads to low-phosphorus rickets, a condition unknown in man. The breakfast cereal, whether provided dry or as Scots porridge, thus leaves the physiological court of appeal without a stain on its character, or, to be more cautious, with the Scots verdict "not proven".

Experiments on animals have given valuable information, and they are still necessary, especially for purposes of assay, but before far-reaching conclusions of value to the community can be drawn, they must be shown to be valid for man by long-term experiments on man. Before these can be attempted, some measure of agreement must be reached as to standards of performance. What is a healthy man? How can his health be measured? It is all very well to talk of the bloom of health, the clear eyes, silky sheen of hair, easy upright carriage and the pleasant facial expression of those physiologically fit, but these qualities are immeasurable. They have no yard-stick. As standards are necessary, such items capable of measurement as height-weight ratio, chest expansion and absence of demonstrable fatigue after moderate work have to be used for want of better. A person may be called normal if he does not depart more than ± 5 per cent from the average.

This led to a discussion on sub-nutrition—a vague lack of efficiency demonstrably due to inadequate intake of the so-called protective foods.

The threshold for these foods varies from individual to individual, some requiring more and some less to enable vital processes to be carried on at full efficiency; so, to play for safety in planning diets for large groups, maximum amounts should be given (not necessarily taken). Laboratory animals have been shown to suffer from excess of these foods. In fact, many diseases common to man may have symptoms similar to those produced by overfeeding rats with certain dietary constituents, but the overfeeding has to be gross. So far, no ill effects have followed *luxus consumption* by a healthy man of any article of diet taken in the ordinary course.

Health and industrial efficiency are not quite synonymous terms, but there is no doubt that ill health causes large industrial losses. The Section had, as guest speaker, Dr. E. Atzler of Dortmund, who told, in fluent English, of his attempts, which met with a large measure of success, to raise the industrial efficiency of the workers in Westphalia. He stressed the value of slow adaptation to working conditions. The operative starting work under new conditions has to become acclimatized, and unless this is done carefully his efficiency and his general health may be impaired. He directed special attention to mineral metabolism—the need for phosphates being noticeable in those about to undergo heavy muscular work, and for chlorides when the work was to be done under semitropical conditions. These mineral needs are less after the worker has become 'hardened' to his job.

The Section turned its attention to more general problems. It was told of a steadily decreasing birth-rate, especially in those classes more financially comfortable. It has been computed that for every hundred women aged twenty-five years in England and Wales to-day, there would be only 83 in 1942, 70 in 1952 and 60 in 1962. Whatever we do now, these figures cannot be increased. Further, there is a tendency to postpone marriage in the better-off classes. Thirty-six per cent of the women of the professional classes who marry do not arrive at the altar until they have passed thirty years of age. The corresponding figure for miners is 10 per cent (Reg. Gen. Report for England and Wales, 1921). Even those who marry younger tend to postpone childbirth. To determine the safest age for reproduction, that is, the age with the lowest death-rate for mother and child, necessitates the close study of a large area with a fairly stable population. Figures were given of 30,000 mothers, 98 per cent of whom came from

the classes covered by State insurance. It was made clear that the safest rate of reproduction for both mother and offspring was the *modal* rate, that is, when the first pregnancy occurred when the mother was round about twenty-five years of age, the second, third and fourth between the ages of twenty-five and thirty and not more than three pregnancies in the next five years. *On the whole*, this rate was observed only by the lower paid members of the community. As income (or security of tenure) improves, there is a tendency to postpone the first pregnancy, with obviously a shortening of the reproductive period and, statistics

showed, with a consequent increase both in maternal mortality and in the number of still-births. The increase in still-births is almost offset by the decrease in child mortality. The result of this is that those who are least able to obtain the necessary food for full health are the very people who are contributing most to the maintenance of the population. To improve the condition of the child-bearers and incidentally of the children born, education in food values and other physiological truths is not of much use unless the necessary food and service are available at a price to suit their incomes and conditions of life. D. B

Obituary Notices

Mr. A. Sharples

MR. ARNOLD SHARPLES, formerly mycologist in the Department of Agriculture, Federated Malay States and head of the Pathological Division of the Rubber Research Institute of Malaya, died at St. Anne's-on-Sea on August 6, after a long illness.

Mr. Sharples was born at Great Harwood, Lancashire, on November 25, 1887. He received his elementary education at Stoneyholm School, Burnley. He left school early, but later, overcoming great difficulties, he became a student at the Burnley Technical College, where in 1908 he won a scholarship to the Royal College of Science, London, and at the same time was awarded King's prizes in both geology and mineralogy. At the Royal College of Science he was especially interested in botany and came under the notice of Sir John Farmer as a particularly promising student. He became an associate of the Royal College of Science and was awarded the diploma of the Imperial College of Science in 1912. His interest in mycology had already been stimulated by his association with north-country naturalists, especially the late Mr. James Needham of Hebden Bridge. On leaving the Royal College of Science he was appointed assistant mycologist in the Department of Agriculture, Federated Malay States, but before going to the East he spent some time at Kew to extend his knowledge of mycology under the direction of the late Mr. G. Massee and Miss Wakefield. All his professional life was spent in Malaya. In 1916 he was appointed chief mycologist in the Department of Agriculture, and in 1930 he was seconded from Government service to be head of the Pathological Division of the Rubber Research Institute of Malaya, situated at Kuala Lumpur. He retired in 1934 and settled at St. Anne's-on-Sea.

During the Great War he served in Mesopotamia (1917-19) as a lieutenant in the Royal Engineers. In this capacity he was concerned with the purification of water supplies for the troops.

From the time of his arrival in Malaya until his retirement, Sharples was a most energetic and able investigator of the diseases of tropical crops, especially rubber. From 1914 onwards there was a constant stream of papers from his pen, published by the Department of Agriculture or the Rubber Research Institute, or appearing at home in the *Annals of Botany* and the *Annals of Applied Biology*. At one time or another he covered the whole range of rubber tree pathology. He treated exhaustively, sometimes in association with colleagues, such diverse topics as the spotting of plantation rubber by mould fungi, pink disease, the root and branch disease of rubber trees caused by *Ustilina zonata*, mouldy rot and brown bast of the tapped bark, lightning damage to coco-nut and rubber trees, and callus formation in tropical plants. These and other investigations were marked by thoroughness and insight. Sharples was not content merely to investigate a disease sufficiently to give advice to planters, but being interested in the fundamental aspects of plant pathology, he examined in great detail the relations of plant and parasite or other disease-producing agency in connexion with environmental conditions. His account (with H. Gunnery) of callus formation in *Hibiscus* and the rubber tree (*Annals of Botany*, 1933) is probably the best description available of the development of this tissue. His wide botanical interests prevented him from becoming a narrow specialist. Sharples was an example of the best type of officer in the tropical departments of agriculture, who realizes both the practical and the fundamental issues involved in problems of crop cultivation.

Sharples had a profound knowledge of all matters concerning rubber cultivation in Malaya, and his advice was constantly sought by the planters, with whom he was always on the best of terms. They had complete confidence in him. He will long be remembered with gratitude by the planting community of Malaya. During his service with the Rubber Research Institute he acted as director for a period.

After retirement, Sharples devoted his leisure to writing an up-to-date book on the "Diseases and Pests of the Rubber Tree" (Macmillan and Co., Ltd., London, 1936). This was a most notable addition to books on the diseases of tropical crop plants; it is, in fact, a treatise on the principles of plant pathology with particular reference to rubber cultivation, and is eloquent testimony to the enlightened outlook which Sharples had on the problems of disease in plants. Unfortunately his health began to fail shortly before the publication of this book, and he died at the early age of forty-nine years. It is sad to think that after such a strenuous life in the East he did not live to enjoy the leisure he had so richly earned.

Personally, Sharples was something of a 'rough diamond', albeit his outspokenness became mellowed with age. He was entirely sincere and courageous in his opinions, and no one was ever a more loyal and kindly friend than he. His high achievement in spite of early handicaps is striking testimony to his sterling character. In an enervating climate he maintained his energy in an astonishing manner: tropical ennui never affected him. In any joint investigation he always pulled his weight, and generously shared credit with his colleagues. As a young man, he was keen on association football and in later life he was fond of tennis and golf. He married Edith Thornton in 1917, who survives him. There were two sons of the marriage, one of whom died a few years ago.

Prof. J. G. Thomson

PROF. JOHN GORDON THOMSON, director of the Department of Medical Protozoology at the London School of Hygiene and Tropical Medicine, whose death took place in London on August 13, was one of the few outstanding medical protozoologists in Great Britain. In addition he was, and continued to be until shortly before his death, a well-known investigator of tropical disease in the field.

Prof. Thomson commenced his career at the University of Edinburgh, where he graduated M.A. in 1903 and where he qualified in medicine with honours in 1908. Two years after qualifying he was appointed Durning-Lawrence research fellow in tropical medicine at Liverpool and later, 1912-13, pathological research fellow at the Liverpool School of Tropical Medicine. During his time at Liverpool, where he worked under Sir Ronald Ross, he carried out many researches on trypanosomiasis and on cultivation of the malaria parasites. His work in this last connexion, which was done largely in collaboration with his brother, Dr. D. Thomson, was perhaps that for which his name was best known.

In 1914 Prof. Thomson was appointed lecturer in protozoology at the London School of Tropical Medicine, but on the outbreak of the Great War he joined the Forces and proceeded in 1915 to Egypt, first as member of a commission to study bilharzia in that country and later as protozoologist to the Central Military Laboratory at Alexandria. On his

return to England he was appointed officer in charge of the Malaria Research Laboratory at the War Office, where again he was associated with Sir Ronald Ross. Whilst in Egypt and later, he published many papers on amoebic dysentery and other intestinal protozoal conditions, as well as studies directed to the finding of satisfactory serological tests for malaria.

In 1918 Prof. Thomson took up the duties of the appointment at the London School of Hygiene and Tropical Medicine which he held at the time of his death; there he worked in post-graduate teaching and in the carrying out of many researches. In 1921 and again in 1922 he went on an expedition to study blackwater fever in Rhodesia. The results of these investigations were presented in a memoir, published by the School, which is now one of the best-known standard accounts of this disease. In 1924 he visited the West Indies, Honduras, Guatemala, Costa Rica and Panama. In 1934 he visited and carried out investigations in Nyasaland, studying more especially the indigenous malaria, and at various times he visited other tropical countries. In the intervals of travelling and demands made on his time by teaching, he published many papers on protozoological subjects and was joint author in Thomson and Robertson's "Text Book of Protozoology", a very useful and condensed source of information on the subjects dealt with.

Though Prof. Thomson worked at many different problems, the malaria parasites were always his favourite study, and even up to shortly before his death the nature of malarial immunity and drug treatment in malaria were much engaging his attention. Prof. Thomson's name is one familiar to research workers in tropical medicine both of British and of other nationalities, and his death will be a loss not only to his colleagues and many friends but also to a very wide circle where his work was known and appreciated.

Prof. Luigi Pernier

WE regret to record the death of Prof. Luigi Pernier, professor of archaeology and the history of ancient art in the University of Florence, which took place in Rhodes at the age of sixty-two years in August last, while he was attending the Dante Alighieri course of "Alta Culture". His death is a great loss to archaeological studies in Italy, more especially in connexion with the investigation of the sites of the early civilizations of the Mediterranean area.

Luigi Pernier was born in Rome on November 23, 1874. On completing his education, he was appointed to the Administration of Antiquities, and took part in the Italian archaeological mission to Crete in 1900, acting as director of the excavations at Festos. In 1909 he was appointed director of the Royal Italian School of Archaeology at Athens and of the "Missioni Italiani in Oriente". While he was head of the School, archaeological explorations were carried out in Crete, Delos, the Sporades and Euboea under his direction. In 1916 he was appointed director of the

Archaeological Museum of Florence and of the Musei Etruschi di Arezzo, when he was responsible for the excavation of Vetulonia, Arezzo, Cortona and Orvieto, investigations of the first importance for our knowledge of the Etruscan civilization. After his appointment as professor of archaeology in the University of Florence in 1922, he also became head of the archaeological mission to Cyrene, where important excavations were carried out under his charge.

We regret to announce the following deaths:

Prof. A. J. Ewart, F.R.S., professor of botany and plant physiology in the University of Melbourne, aged sixty-five years.

Miss A. Lorrain Smith, O.B.E., formerly of the British Museum (Natural History), known for her mycological studies, on September 7, aged eighty-three years.

News and Views

Heavy Nitrogen

At a recent meeting of the American Chemical Society Prof. H. C. Urey reported that he had prepared heavy nitrogen in considerable quantities (see also p. 512). Ordinary nitrogen has long been known to consist of two isotopes of mass numbers 14 and 15, the heavier one being present, however, to only four parts in a thousand. Isotopes of several elements have been already separated in a fairly pure state; of these hydrogen and deuterium are the best known, but other examples are lithium 6 and 7, and neon 20 and 22. The difficulty of the problem solved by Prof. Urey can be appreciated by comparing it with that presented by the neons, where the percentage difference in mass is greater and also the heavier isotope is naturally present to the extent of nearly 10 per cent, instead of the half per cent in the case of nitrogen. It is stated that the heavy isotope is being separated at the rate of a quarter of a litre a day. The separation of pure heavy nitrogen will undoubtedly lead to a great deal of important work in nuclear physics. Nitrogen 15 differs from nitrogen 14 simply in the structure of its nucleus, there being one more neutron present in the heavier type. Ordinary nitrogen has already proved most interesting, since it can be disintegrated in a variety of ways by bombardment with α -particles, neutrons, protons and deuterons. The investigation of the behaviour of heavy nitrogen under the same conditions should lead to valuable conclusions about the effect of the extra neutron in the nucleus. It has also been suggested that heavy nitrogen will be of great service for research in physiological chemistry, since various substances which are important in the body can be made containing some heavy nitrogen instead of ordinary nitrogen, and while their behaviour will be unaltered, these particular molecules can always be identified later by means of the heavy nitrogen atoms.

Mentality of Fish

DR. J. GRAY's evening discourse to the British Association delivered on September 6 at Nottingham shows how closely the reactions of fishes resemble those of man. In the behaviour of man the involuntary machine-like reflex plays a very important part, and in a fish that is swimming freely the movement involves a high degree of co-ordination between a

large number of muscles; the whole of this highly co-ordinated mechanism being completely independent of that part of the fish's brain which corresponds to our cerebral hemisphere and therefore to that part of the brain which is associated with consciousness in ourselves. It is well known, however, that a fish may be trained to make mental associations, and in the last few years the problem has been subjected to rigid scientific investigation. By experiment it is found that a fish is sensitive to a great variety of gentle stimuli such as a very slight change in temperature and the shape and colour of objects in its vicinity. Fish are also capable of carrying out highly complicated migratory excursions. In these types of behaviour Dr. Gray asks us if we do not see most if not all the activities of the human race. Almost certainly the association powers of a fish are on a much lower level than those of man, but the power is there, and it is difficult if not impossible to put our finger on any one of our mental powers and say, "Herein are we a race apart, elevated above the rest of the world". Dealing with the migratory experiments with the Pacific salmon, in which that fish is proved always to return to its own native waters, he says, "I venture to think that if we were to have carried out comparable experiments on a race of human beings, and got similar results, we would have said 'They do it, as you or I would do it, consciously noting the landmarks, memorising them, and so retracing their steps'—in fact they are performing a conscious act, a premeditated, thoughtful, and purposive act. Are we to apply the same conclusions to the fish—if not, why not?"

Rivers and their Formation

IN connexion with the recent British Association meeting at Nottingham, a public lecture on "Rivers", which was abundantly illustrated, was delivered by Mr. R. Kay Gresswell in Lincoln on September 3. Mr. Gresswell pointed out that when a river has once been formed, by virtue of its motion the water is able to carry a load consisting of rock actually dissolved in the water and also of finely powdered rock and pebbles of all sizes, which serve as eroding agents. When it has acquired a load, the river can use it as a kind of file or battering-ram with which to erode its banks and bed and so add to the quantity

it is transporting until it becomes fully laden. The main features of a river are the direct result of the water constantly trying to adjust its bed to suit its load. If the river enters a reach fully laden and the slope is such that the water continues to flow at its original speed, then just as much material will leave that reach as enters it and so no erosion takes place. Should, however, a fully laden river enter a reach the slope of which is less steep than it has been upstream, the rate of flow of the water will be decreased and a proportion of the load is then deposited. This mostly occurs at the beginning of the reach and thus the river gradually steepens the slope until it becomes sufficient for the entering load to be carried through.

In the lower part of its course, a river normally enters upon a plain. Here the rate of flow is greatly diminished and the fully laden river proceeds slowly towards the sea. In turning a corner, the speed on the outside of the curve is always much greater than that on the inside. This results in the water on the outside being able to take on an additional load and thus erode the bank. Conversely, the water on the inside is unable to carry the whole of the load it already possesses and deposits sediment on the inside of the curve. The bend thus becomes steeper and steeper, and it is owing to this action that rivers always meander in the plain tract. Quite commonly the river still does a little actual erosion and in consequence by the continual change of position of the various loops of the meanders, the general level of a strip of land, about one or two miles wide in the case of rivers the size of those found in England, is gradually lowered, the edges of this band, which mark the extreme limit of past meanders, often forming steep cliff-like slopes. If, as the result of earth-movements, the general slope of a river-valley be increased, the river flows more quickly and is thus able to increase its erosion. It sometimes happens that a meandering river is thus rejuvenated, and in that case the river deepens its bed in the shape the meanders then happen to possess. The land between the individual loops are then in time left standing high above the new low river-level. This has happened in the case of the River Wye in Monmouthshire, and has resulted in very beautiful scenery.

Fauna and Climate in Early Palestine

IN view of the interest of the various geographical and distributional problems in the prehistory of Palestine, to which a notable contribution has been made by the preliminary examination of the finds in the bone-bearing beds of Bethlehem (see NATURE, Sept. 4, p. 431) attention may be directed to a communication from Prof. L. Picard, of the Hebrew University, Jerusalem, which appears in the recent issue of the *Proceedings of the Prehistoric Society* (Jan.-June). Prof. Picard there examines in detail the data of palaeontology, geology, archaeology and stratigraphy in their bearing, first on the climate of Palestine in prehistoric times, and secondly on the origin and geographical relations of the fauna of that period.

Writing before the publication of the evidence from Bethlehem, he concurs with Miss Bate's previously published conclusion as to the complete absence from Palestine of a boreal (cold period) fauna, though its existence has been asserted; but he is unable to accept her interpretation of the palaeontological evidence as pointing to a change from a forested landscape with humid conditions to a drier climate and more open country. He finds that while there were a number of forms, now extinct, contemporary with the old Acheulean—the earliest evidence of man's handiwork then available to him—some of these, such as probably the hippopotamus, survived even so late as Biblical times.

As a whole, the various classes of evidence (in palaeontology, trees and plants, as well as land and aquatic fauna) are interpreted by Prof. Picard as concurrently pointing to the fact that no important change in climate takes place down to recent times. In fact, the present climatic conditions, the aridity of the eastern section and the Mediterranean or 'eolian' climate of the western, existed in the Pliocene, and date back to the Upper Miocene. Further, the geographical conditions in the south were such as to preclude migration to, or from, Africa in the Pleistocene. The fauna which has been designated as African-Asiatic has been domiciled in Palestine since the end of the Miocene and can be regarded as endemic during the Plio-Pleistocene. The problem, it will be seen, is of considerable general interest, but to palaeontologist and archaeologist more especially in relation to recent discovery in East Africa. Further evidence from Bethlehem will be awaited eagerly.

Human Skeletal Remains in London

EXCAVATION work in Farringdon Street, London, E.C.4, for the foundations of an extension of the offices of the *Evening Standard* has brought to light a large number of human skeletal remains. About three hundred skulls and two thousand other bones have been found. It is suggested that the excavation may have opened one of the pits in which victims of the great plague of 1665 were buried indiscriminately. There were a number of these pits situated in various parts of London. One of the largest was in Tothill Fields, Westminster, near where Carlton Hall now stands; another near Newgate was adjacent to the site of Christ's Hospital, the Bluecoat School, demolished for the extension of the Post Office, and still another was in Whitechapel. Dr. A. J. E. Cave, of the Royal College of Surgeons, who has inspected the recent finds, is of opinion, according to a statement published in the *Evening Standard* of September 10, that, judging from their condition, they are probably the skeletons of men, women and children who died in the seventeenth century and may well have been victims of the plague. They are all of the same type, and differ but very slightly from typical skulls of to-day. Though they have not yet been submitted to an exact examination, Dr. Cave is stated to have said that the skulls appear to have a

vault a little more pointed than the modern skull. It will be remembered that Prof. F. G. Parsons some years ago examined a large number of seventeenth and eighteenth century skulls of Londoners, when a graveyard, presumably of the adjacent St. Clement Danes, was discovered on the demolition of King's College Hospital in Portugal Street. He then concluded that little change had taken place in the physical characters of the Londoner during the last two or three hundred years, except that the skull showed a slight tendency to broaden.

Recent Excavation at Meare, Somerset

A FORTNIGHT'S work of excavation at Meare Lake Village by Mr. H. St. George Gray and Dr. A. H. Bulleid has brought to light an interesting variant in the method of constructing their dwellings employed by the inhabitants. The season's work, as already indicated (see *NATURE*, Aug. 28, p. 352), is directed to the investigation of the central portion of the eastern half of the village. Excavation of the area surrounding Dwelling Mounds Nos. 16, 17 and 19, which, it is reported in *The Times* of September 13, has now reached the southern half of the floors of the circular dwellings, has shown that there are at least two floors, or layers of clay, separated by a quantity of ash, black earth and refuse deposited during the occupation. The peat in this part of the village is so firm that the usual timber foundations for the support of the clay floors appear to have been unnecessary. In the area surrounding the dwellings the refuse from the huts is found to contain a considerable amount of ornamented pottery (Iron Age "B") and evidence of weaving in the form of loom weights, spindle whorls and bobbins. Portions of bone needles also have been found. In the occupational refuse between the clay floors, the proportion of bones and pottery sherds found to the area at present examined is unusually high. The bones are mostly of lamb and young oxen, but there are also the remains of a small horse, pig and dog, a few bones of red and roe deer and also of birds. Here there is further evidence of weaving—spindle whorls of baked clay, stone and tin, bobbins, etc., as well as a highly polished bone needle and two bone pins with mouldings and long slots of a type unusual in western Britain. Objects of iron are not plentiful, but include a butcher's knife with convex edge. In bronze are a couple of fibulae, an openwork harness ornament, and a hinge-plate with rivet holes. The ornaments include shale bracelets, and among the beads is one of blue, strung on a bronze wire.

Recent Earthquake in Sussex

SHORTLY after 1 a.m. on September 8, an earthquake of intensity 5 or more (according to the Rossi-Forel scale) was felt in the west of Sussex, especially at Horsham and the neighbouring village of Warnham. The earthquake is of some interest owing to its connexion with the series of shocks that have occurred for nearly three centuries in the district around Chichester, the first known to us being that of the year 1553. A little more than a

century ago, between September 1833 and August 1835, there was a series of eight earthquakes in the district, which were studied by a small committee, the first ever instituted for the study of British earthquakes. One of the most important of these earthquakes was that of January 23, 1834. It was of about the same intensity as the recent shock. Its centre lay 4 miles west-north-west of Chichester, and the longer axis of its disturbed area of 780 sq. miles, if produced, passes through Horsham. Readers who are willing to aid in the investigation of the new earthquake should send their accounts to Dr. A. T. Dollar, Emmanuel College, Cambridge.

Mechanization in the Modern World

AMONG the matters handled at the meeting of the International Committee on Intellectual Co-operation at Paris on July 12-17 was the inquiry into mechanization in the modern world. The plan of this inquiry has been approved by the Committee and preparations are now in hand by the Institute. National lists of organizations concerned with social sciences are also being collected by the Institute, and lists have already been received from the United States, France, Japan, Italy, Czechoslovakia, Belgium and Norway. The inquiries on unemployment among intellectual workers are being pursued and the establishment of an advisory committee including representatives of the national bureaux and international organizations concerned has been authorized. The Institute has also collected most of the bilateral intellectual agreements in a volume which will shortly be published. The International Committee on Intellectual Rights has been concerned with preparations for the revision of the Berne Convention and for the Universal Conference on authors' rights, and a meeting of experts is being held to formulate final proposals for two conferences at Brussels on these subjects. The Advisory Committee of Intellectual Workers of the International Labour Office, however, pronounced in favour of keeping the question of the moral rights of salaried artists in the applied arts on its agenda.

The S.S. *Orcades*; the Latest Orient Liner

LAST month the Orient liner *Orcades* started on her maiden voyage. According to an article in the *Electrical Review* of August 27, it is claimed that she is the first British ship on the Suez route to have a public sitting-room supplied with conditioned air. Conditioned air is supplied to the public rooms and to several of the cabins. It is not sufficient for comfort to have only ventilation and correct temperature; the humidity must also be controlled within fairly narrow limits. In the tropics, the atmosphere is frequently uncomfortably damp. To reduce the temperature without extracting moisture from the air raises the relative humidity and may make the conditions more uncomfortable. When the climate is colder, air after warming sometimes becomes unpleasantly dry. Hence although air conditioning as it is managed at present is expensive, it may add greatly to the comfort and well-being of the passengers. The new vessel—an eight decker—has been built by

Vickers Armstrong for cruises and for service on routes between England and Australia. Its gross tonnage is 23,445 and it will accommodate 463 first-class and 605 tourist passengers and a crew of 466. Steam is provided by six oil-fired Babcock and Wilcox boilers. Pipes conduct it to two sets of 1,715 revs. per min. Parsons turbines. These drive the propellers at 112 r.p.m. by means of mechanical gearing. Two systems of intercommunication telephones are installed. The Marconi International Communication Co. has installed an all-wave radio installation, including a direction finder, and an 'echometer' depth sounder, together with a broadcast system of loud speakers throughout the vessel. Time is given by means of 82 synchronous clocks. A portable sound picture equipment by the Western Electric Co. is one of the many forms of entertainment provided.

The Problem of Dates of Publication

THE study of natural history has branched into many side-lines; but it is strange to think how far off the direct line of acquisition of nature knowledge the need for accuracy has led. For the convenience of naturalists the world over, animals and plants bear specific names, and the proper name where several have been given is determined conventionally by priority of christening. But so difficult is it in some cases to determine priority that an extensive literature has developed around these knotty problems, and so insistent is the demand for accuracy that a Society for the Bibliography of Natural History has been formed. The first part of its *Journal* is a catalogue of papers concerning the dates of publication of natural history books, arranged in alphabetical order of the authors of the books, and this ought to be of great service to systematists. Sometimes it is difficult to see exactly how the alphabetical order has been determined; "Ent. Soc. Lond." appears under "London", "Ent. Soc. N. S. Wales" under "Ent."; "Royal Phys. Soc. Edinburgh" appears under "Proc.", while the Wernerian Society of the same city appears under "Edinburgh". Doubtless there are sound reasons for this grouping, but they are not obvious, and they are not set out in the very brief introductory notes. The Society maintains a card index of papers concerned with the dates of publication of natural history books, and copies of such papers will be welcomed by the Secretary at 41 Queen's Gate, London, S.W.7.

Empire Grants Committee for Museums

THE final report to the Carnegie Corporation of New York on the activities of the Empire Grants Committee appears in the *Museum Journal* of May. It is a stimulating document. On April 1, 1934, the Committee was set up to administer a fund of 54,000 dollars granted by the Carnegie Corporation of New York for Colonial Museums, with an addition of 9,000 dollars for expenses, £12,560 in all. All museums in the British Colonies, and in Newfoundland and Southern Rhodesia were invited to submit applica-

tions for grants; forty applications were received and twenty-five grants were made. They ranged from £80 to Kandy Museum and Bermuda Historical Museum to £1,000 for Nairobi, Cyprus, Barbados, Singapore, Zanzibar, Jamaica. Various strict regulations had to be made as to the conditions upon which grants could be made; but the Committee is satisfied that the effect of grants has been in nearly every instance most stimulating to the local museum movement. At Bulawayo and Salisbury, the museums have been elevated to the dignity of national museums; in Cyprus, Barbados and Antigua more attractive premises and added Government recognition have been gained; but in most cases grants have been given for cases and equipment, so that museum interiors have been brightened and organized on modern lines. The success of the experiment leads the Committee to suggest that there are good reasons for continuing so promising a first effort.

Time Measurement

THE history and development of time measurement have already been described in a Science Museum Handbook ("Time Measurement", Part 1). The second part of the handbook which has recently been issued (London: H.M. Stationery Office. 2s. net) contains a detailed description of the objects in "The Time Measurement Collection at the Science Museum, South Kensington". The exhibits, ranging from the ancient Egyptian shadow clocks and water clocks to modern electric time-keepers, include sundials, mechanical clocks, watches and chronometers, escapement models and chronographs, as well as various auxiliary devices such as striking mechanisms, time recorders and time switches. Introductory remarks to each chapter explain the system of classification adopted, and outline the general principles involved in the respective groups of instruments. Many of the exhibits at the Science Museum are shown in continuous operation, while others can be operated by visitors—a facility that appears to receive perpetual appreciation. In addition, several of the more delicate watch mechanisms are illustrated by large-scale models. It may be noted that Harrison's four marine timekeepers (the fourth, completed in 1759, being the chronometer which won for Harrison the British Government prize of £20,000) are now represented in the Museum only by photographs, the originals themselves, long associated with the Royal Observatory, Greenwich, having been transferred to the National Maritime Museum at Greenwich. This handbook with its numerous illustrations provides an admirable introduction to a study of the Time Measurement Collection, and it will also serve as a useful handbook of reference for other occasions.

Meteorology in India

THE Meteorological Department of the Government of India has for several years had to contend with serious financial obstacles in the shape of reduced grants, when the increasing requirements of aviation have demanded increased departmental activity. The

report on the Administration of the Meteorological Department of the Government of India in 1935-36 (Delhi: Manager of Publications, 1936) describes how various economies have been devised in order that the demands of aviation and other interests may be met so far as is possible. By taking full advantage of aeronautical wireless stations for the exchange of weather telegrams between aerodromes, and aided by cheaper telegrams, a saving of more than half a lakh of rupees annually has resulted. Economy was not made any easier by the disastrous earthquake of May 31, 1935, at Quetta, which demolished the Meteorological Office there, as well as the observers' quarters. This led to the pilot balloon station at Quetta being moved to Dera Ismail Khan for a time, and to the setting up of a temporary surface observatory at Quetta when the situation there was well enough in hand again. Research work did not slacken. Dr. T. Royds, director of the Kodaikanal Observatory, joined the expedition organised by the Royal Society and the Royal Astronomical Society to observe the solar eclipse of June 19, 1936. He took with him what is described as "perhaps the most powerful spectrograph ever used at an eclipse". The discovery of oxygen in the sun's chromosphere was announced from Kodaikanal in 1936 (see NATURE of April 11, 1936). Several pieces of research were carried out in the office at Poona with the voluntary aid of students guided by the official meteorologists. These included the development of a spectrograph for the study of ozone in the earth's atmosphere.

Activities of the Rockefeller Foundation

A REVIEW by its president, Mr. Raymond Fosdick, surveys the work of the Rockefeller Foundation during 1936. The expenditure totalled 11,300,000 dollars in connexion with its programme "to promote the well-being of mankind throughout the world". The agencies assisted included institutions, research work in medicine, biology and other sciences, and the humanities. Investigations on the jungle form of yellow fever and other health problems have been promoted, displaced German scholars have been helped, and appropriations have been made for trial work in the development of radio-programmes of cultural and educational value. A grant was given to the Orthological Institute in China for the preparation of a series of books for Chinese readers in 'basic' English.

Encke's Comet

A TELEGRAM from Copenhagen announces that Dr. Jeffers, Lick Observatory, has observed Encke's Comet. The position on Sept. 3-38542^d U.T. was R.A. 2^h 19^m 4.9^s, N. Decl. 27° 10' 20". The magnitude is given as 18. In the "Handbook of the British Astronomical Association" for 1937, Dr. A. C. D. Crommelin gives an ephemeris based on an orbit in which perturbations of Jupiter and Saturn are taken into account. The observed position corresponds closely with that predicted by Dr. Crommelin.

Discovery of a Super-Nova in *Canes Venatici*

PROF. H. SHAPLEY has announced the discovery of a super-nova by Zwicky, and Humason found that it had a typical super-nova spectrum. Stobbe, at Kiel, gives its position as R.A. 13^h 2^m 57.56^s, N. Decl. 37° 57' 19.2", equinox 1937.0, and magnitude 8.7.

Announcements

A DEPARTMENT for psychology under the direction of Prof. E. R. Jaensch, director of the Institute of Psychological Anthropology at Marburg, has recently been added to the Imperial Leopoldine Caroline German Academy of Natural Science.

THE following awards have been announced by the North East Coast Institution of Engineers and Shipbuilders: The Institution Engineering Gold Medal to Harry Hunter, vice-president of the Institution, for a paper on "Singing Propellers"; M. C. James Medal to Mr. H. E. Lance Martin, head of the Civil Engineering Department at King's College (formerly Armstrong College), Newcastle-upon-Tyne, for a paper on "The Determination of the Residual Strains and Stresses in Arc-Welded Plates"; The Institution Scholarship, value £100, to R. A. Lyall, an apprentice of the Central Marine Engine Works, West Hartlepool.

THE board of Rolls-Royce, Ltd., has decided to found, in memory of Sir Henry Royce, a travelling research fellowship to be known as the Henry Royce fellowship. The Fellowship will not exceed £450 a year and will be tenable for one year, by a graduate of a British university or holder of the higher national certificate or other equivalent qualification. Research is to be concerned with the construction, design, materials, or methods of production of automobile transport, including applications to aircraft and modern engineering.

AN International Conference on Physics, Chemistry and Biology will be held in connexion with the Paris International Exhibition in the Palace of Discovery on September 30-October 9. The president will be Prof. Jean Perrin. Further information can be obtained from the General Secretary, L. W. Tomarkin, 11 Rue Pierre Curie, Paris, 5^e.

THE ninth Annual Conference of the National Smoke Abatement Society will be held at the Philosophical Hall, Leeds, on September 30-October 2. The programme includes discussions on town planning and smoke abatement, and education and smoke abatement. Further information can be obtained from the Secretary, Chandos House, 64 Buckingham Gate, London, S.W.1.

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of Rothamsted Experimental Station, Harpenden, Herts, and other members of the staff are available for giving lectures to interested institutions on the Rothamsted experiments. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 509.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Observations of the Solar Eclipse of June 8, 1937

A SCIENTIFIC expedition was organized early in the present year to observe the total solar eclipse of June 8 from somewhere on the coast of Peru, and the party of three sailed from Yokohama in the beginning of April. I was in charge, and arrived at Lima on May 10; after consultations with the Eclipse Committee of the University Mayor of San Marcos, I decided to have the observing station at Hnanchao, some 14 kilometres north-west of Trujillo. Two other members of the party, together with the instruments, landed at the port of Salaverry on May 20, and immediately proceeded to the station.

A large house of Sr. Victor Larco Herrera was kindly put at our disposal, where a large party of Peruvian scientific workers under Dr. G. Garcia was staying for the same purpose. Early in June, Dr. Clyde Fisher's American party also came to the same spot.

The main object of our party was to take large photographs of the inner corona with a ten-metre camera in conjunction with the 30-cm. ocularstat. Further, I had an independent set of cinematographic arrangements to get a rapid succession of photographs of three visible contacts, spectra of the flash and the corona, the extensions and the brightness of the corona. As the sun was about $9\frac{1}{2}^\circ$ in altitude at the time of the eclipse, all instruments were set conveniently inside the rooms of the house and the sun could be observed through the available windows. A separate room was used for meridian observations of longitude and latitude made by me with a 38 mm. astronomical theodolite, the roof being taken away temporarily.

The weather was generally good during the interval of our stay at the camp, except for a few days in the very beginning of June when the skies were continuously overcast. The rehearsals and other preparatory work were well carried out.

On the day of the eclipse, the sky was overcast in the morning, but later it became clear and by 3 o'clock we had a perfect sky. The three visible contacts were observed as follows:

	1st Contact	2nd Contact	3rd Contact
Observed standard time	16 ^h 15 ^m 20 ^s	17 ^h 18 ^m 20 ^s	17 ^h 20 ^m 57 ^s
Corrections to computed time	+6	+3	+5
Observer	M. Horii	I. Yamamoto	I. Yamamoto

With the ten-metre camera, four plates were exposed for the partial phase and eight for the totality, with the exposures ranging from one tenth to 30 seconds. Upon developing, these plates have revealed splendid structures of the inner corona. My own cinematographic arrangements were partially successful, revealing good images only of the inner corona and the flash spectra.

According to these photographs, the coronal streamers are well developed around the sun. Especially in the north-east portion of the sun's limb there is a group of strong streamers and arches over

a wide area, where daily observations of the sun's surface during previous weeks suggest an activity area of large sunspots. Characteristic rays from both the north and the south poles of the sun are completely hidden by strong coronal streamers. Hence the present corona is of the 'sunspot maximum' type.

There are about a dozen prominences visible around the sun. Two of them are magnificent, one in position angle 35° and the other in 290° .

I observed the longitude and latitude of our station on three nights. The preliminary result for the latitude is $-8^\circ 4' 46.6''$, but that of the longitude has not yet been reduced.

ISSEI YAMAMOTO.

(Director, Kwassan Observatory,
Kyoto Imperial University.)

Lima.

June 20.

Photo-conductivity and Phosphorescence of Zinc-blende

FROM early experiments on the photo-conductivity of zinc-blende, Gudden and Pohl¹ deduced that the current must be transported by two kinds of carrier, and according to present-day theory these must be electrons and 'positive holes'—vacant places left in a normally full electron energy band when an electron is ejected. While electrons are liberated by blue light, positive holes do not become mobile until a subsequent illumination by light of longer wavelength, for example red or infra-red, but the reason for this need not be discussed here.

The photo-induced conductivity is proportional to the intensity of illumination, which shows that electrons travel a finite distance (*Schubweg*) and are then 'trapped', the trapping *not* being in general due to recombination; for if it were, the current would be proportional to the square root of the illumination. The mechanism of this trapping need not concern us here; but either under infra-red illumination or thermal agitation the trapped electrons can be set free again. Trapping and re-liberation occur a number of times in succession, but the electrons finally come to rest by combining with a positive hole. The crystal is then said to be quenched.

That this is the case is shown by the way in which the conductivity dies away during quenching. If n is the number of electrons (a constant proportion of which will be in the conducting state), and also the number of holes, then if they are recombining their number will decrease according to

$$\frac{dn}{dt} = -c_1 n^2,$$

whence, integrating, we obtain

$$\frac{1}{n} = c_2 t + c_3,$$

c_1 and c_2 being constants. Thus we shall expect the

resistance of the crystal to be a linear function of the time. This is confirmed by experiment. For example, Fig. 1 shows the resistance-time relation found during the quenching of a specimen by infra-red light at -196°C . It is seen that within the limits of experimental uncertainty the relation is linear.

It is interesting to note that phosphorescence decay data for zinc-blende obtained recently by Antonow-

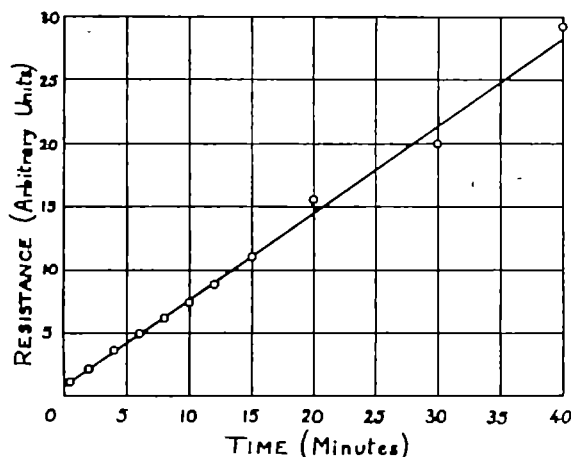


Fig. 1.

Romanowsky² are in full accord with these results, in that they show that the phosphorescence is due to a bimolecular reaction. It is easily seen that on the assumption that the intensity of phosphorescence, p , is proportional to the rate of recombination of electrons with holes, $p^{-1/2}$ should vary linearly with time. Plots of $p^{-1/2}$ against t , obtained from Antonow-Romanowsky's data, show that this is,

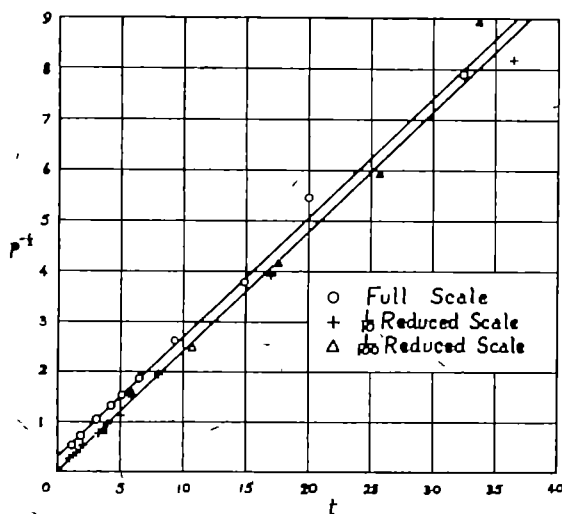


Fig. 2.

indeed, the case. An example of such a plot is given in Fig. 2, in which the lower line is to be regarded as a continuation of the upper one, representing the points on the two reduced scales.

A. L. REIMANN.

Royal Society Mond Laboratory,
Cambridge.
August 18.

Phosphine and Arsenic Derivatives of the Group I(b) Metals: Volatile Derivatives of Gold

WE have shown that the trialkyl phosphine and arsenic derivatives of cuprous iodide, previously considered to be $R_3P(As) \cdot CuI$, have a fourfold macro-molecule¹, $[R_3P(As) \rightarrow CuI]_4$, and are therefore tetra-kis-[iodo-trialkylphosphine (or arsenic)-copper]. A complete X-ray examination of the triethyl-arsine member, $[Et_3As \rightarrow CuI]_4$, showed that the four copper atoms occupy the apices of a regular tetrahedron; the iodine atoms are situated each above the central point of one face of this tetrahedron, so that they also form a tetrahedron external to that of the copper atoms. Beyond each copper atom is an arsenic atom lying on the elongation of the axis joining the centre of the inner tetrahedron to the copper atom. The iodine atoms are thus 3-covalent, each being joined to the three neighbouring copper atoms apparently by one covalent and two co-ordinate links: if this is so, the stereochemistry of the 3-covalent iodine atom must be similar to that of 3-covalent sulphur, and the iodine atom can be regarded as occupying one apex of a tetrahedron with its valencies directed towards the other three apices.

The corresponding silver compounds have now been examined, and prove also to have the fourfold molecule, $[R_3P(As) \rightarrow AgI]_4$. These silver compounds have, moreover, the same constitution as the cuprous compounds, since $[nPr_3As \rightarrow AgI]_4$ is strictly isomorphous with $[Et_3As \rightarrow CuI]_4$. This is a remarkable example of isomorphism, the effect of the replacement of the copper by silver atoms being compensated by the replacement of the ethyl by the *n*-propyl groups. It follows that both the 4-covalent cuprous and argentous atoms have a tetrahedral configuration, in confirmation of the results obtained by Cox, Wardlaw and Webster².

The aurous compounds, $[R_3P(As) \rightarrow AuX]_4$, where X is a chloride, iodide or thiocyanate radical, prove, however, to be monomolecular, and the gold thus shows a true co-ordination number of 2. The phosphine compounds, $[R_3P \rightarrow AuX]_2$, where X is Cl or I, possess remarkable stability, and can be freely distilled under reduced pressure. The compound $[nBu_3P \rightarrow AuCl]_2$ can be volatilized even at atmospheric pressure, and the vapour, if passed through a heated tube, deposits a fine film of gold. There are thus two distinct chemical methods of producing gold films, the first having been recently described by Prof. O. S. Gibson in NATURE of August 14 (p. 279).

It is noteworthy that, whilst the copper and silver atoms both acquire 7 electrons in the above compounds and thus attain the electronic structure of the next inert gas, the gold atoms acquire only 3 electrons and thus remain 4 short of the radon structure. The gold in these compounds, however, falls in line with mercury, which acquires 2 electrons in compounds such as HgR_2 and $Hg(SR)_2$, and with thallium, which acquires 1 electron in compounds such as $[TlR_2]X$, a group of 4 shared electrons in the sixth quantum group allowing considerable stability in all three cases.

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¹ Mann, Purdie and Wells, *J. Chem. Soc.*, 1503 (1936).

² Cox, Wardlaw and Webster, *J. Chem. Soc.*, 775 (1936).

³ Mann and Purdie, *J. Chem. Soc.*, 1549 (1936); Wells & Krist. 96, 435 (1937).

¹ Gudden, B., "Lichtelektrische Berechnungen" (Springer, 1928).

² Antonow-Romanowsky, W. W., *Sov. Phys.*, 7, 386 (1935).

Behaviour of Cylinders of Inflammable Gas in a Fire : Extinguishing Flames by Coal Gas

On the night of October 5, 1936, a fire occurred in Pearse Street, Dublin, in a shop which housed two full cylinders of compressed gas, one containing 150 cu. ft. of oxygen, the other 100 cu. ft. of coal gas. In each case the internal pressure was 120 atm. During the fire explosions took place, and a large portion of the building collapsed. It was found afterwards that three firemen had lost their lives. A Tribunal of Inquiry, appointed by the Minister for Local Government and Public Health of Saorstát Éireann, has recently issued its report (Stationery Office, Dublin). "The Tribunal is satisfied that the explosions must be attributed to the two full cylinders of coal gas and oxygen," and includes among the results of the explosions "the trapping of three firemen who were then within the building thereby causing their deaths".

The fire, and the inquiry which followed, raise a point of general interest. If a fire occurs in premises in which cylinders of compressed gas are stored, will that fire be likely to be much more disastrous than if cylinders are absent?

In the present instance, there is no doubt that the cylinders burst in the course of the fire, for they were found ruptured in the ruins. There was general agreement, however, that the result of the physical bursting of a cylinder of compressed coal gas, followed by the burning of its contents, was likely to be much less disastrous than if the contents of the cylinder became mixed with air and suffered chemical explosion.

The men of science who attended the inquiry as expert witnesses found themselves faced with the following problem. Suppose the back of the shop (where the coal gas cylinder was placed) in flames, and suppose the front of the shop not yet on fire. The coal gas cylinder bursts, presumably in the midst of the flames. Could the gas (if the burst took place on the suitable side of the cylinder) make its way through the flames into the air in the front part of the shop, form an explosive mixture, and explode if a flame reached the mixture before it had become too dilute?

There is no doubt that the emerging coal gas could extinguish the flames in immediate contact with the cylinder. Intense cooling (in this instance 500°–600° C.) would result from an almost adiabatic expansion. Further, the concentration of combustible material would far exceed the upper critical explosion limit, which is about 28 per cent of combustible in the case of Dublin coal gas. I expressed the opinion that the jet of coal gas, shot with high velocity from the ruptured cylinder, might thus extinguish the flames in its path, and blast its way through the surrounding fire to the air in the front of the shop, where chemical explosion would probably follow. The alternative picture submitted was that of the coal gas swelling out of the ruptured cylinder as a 'balloon' which would necessarily be kindled at its periphery. It would then make its way to the nearest outlet as a gigantic flame, prevented by a mantle of burnt gases from mingling with air so as to form an explosive mixture.

The essential problem is therefore: Can a jet of coal gas extinguish flame *without itself being ignited*? If the answer is in the affirmative, there exists a possibility of chemical explosion in a case such as the present. Whether explosion actually occurs will depend on a variety of factors, such as the volume

and pressure of the escaping combustible gas, and the extent of the fire by which the container is surrounded.

I have carried out experiments, which I believe to be new, showing that coal gas *can* extinguish flame without itself being ignited.

A coal gas flame, five or six inches high, was established in the open air. A small cylinder of compressed coal gas (20 cu. ft.), fitted with the usual nozzle to control the rate of discharge, was used. The nozzle was opened full and the stream directed, from a distance of 3–4 ft., on to the flame. After a little practice, one was able to extinguish the flame without igniting the stream of gas from the cylinder.

A less striking experiment was carried out as follows. A five-litre flask was filled with coal gas, and the mouth covered with thin paper to form a temporary barrier to the gas. The flask was adjusted, mouth downward. A small gas flame was prepared. The tube from which this gas issued was surrounded at the mouth by a short piece of wider glass tubing with irregular edges, to puncture the paper before the flame reached it. The edge of the wider tubing was only just above the level of the top of the flame. When the flame was pushed up into the flask of gas, it was of course extinguished. The gas which issued from the flask sometimes took fire, but on numerous occasions the flame was extinguished without igniting the gas.

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Formation and Breakdown of Amino-acids by Inter- molecular Transfer of the Amino Group

We have previously reported¹ the discovery in muscle of a highly active metabolic mechanism, by the action of which the amino group and two hydrogen atoms of glutamic acid are transferred to pyruvic acid (added or of metabolic origin) with the formation of alanine (and ketoglutaric acid). This is the key to the puzzling fact that glutamic acid is transformed into succinic acid by muscle tissue without the formation of either ammonia or amide nitrogen (D. Moyle-Needham).

Further work, to be published in detail elsewhere, showed this reaction to be a reversible one. From alanine and α -ketoglutaric acid muscle tissue rapidly forms glutamic and pyruvic acids, equilibrium mixtures of similar composition resulting in both the direct and the reversed reaction.

The presence of the enzyme system responsible for this process of *Umaminierung* can be readily demonstrated not only in muscle, but likewise in other organs (heart, brain, liver, kidney), irrespective of their capacity or inability to metabolize amino-acids by oxidative deamination or reductive amination respectively. In organs containing Krebs's aminodehydrogenase the intermolecular transfer of the amino group competes with oxidative deamination and, owing to its greater velocity, completely inhibits the latter process in the presence of an excess of pyruvic acid. Only with nucleated erythrocytes and malignant tissues no evidence of *Umaminierung* has been obtained up to the present.

α -Ketoacids other than pyruvic, for example, α -keto-butyric, α -ketocaproic, oxaloacetic or phenylpyruvic acid, may equally serve as acceptors for the amino group of glutamic acid. On the other hand, all

α -amino acids readily give up their amino groups to α -ketoglutaric acid in the presence of muscle tissue; the formation of glutamic acid has been demonstrated with sixteen different natural and racemic amino-acids including such as glycine or histidine, known to be difficultly accessible to oxidative deamination by surviving tissues. The rate of *Uminierung* is astonishingly high; thus, no less than 6.5 mgm. glutamic acid is formed in two minutes from glycine and ketoglutaric acid by one gram of muscle tissue. This would correspond to a value of $Q_{Uminierung} = 152$. In our opinion, the mechanism of this biocatalytic reaction is the same as that discussed by Herbst¹ in recent studies on a somewhat similar model reaction, occurring when amino-acids are heated with ketoacids in aqueous solution.

Aspartic acid behaves in the same way as glutamic acid (Kariagina, this laboratory), and oxaloacetic acid—as ketoglutaric acid, in the function of amino nitrogen donors or acceptors respectively. The 'trapping' of oxaloacetic acid by the acceptance of amino groups, interfering with the action of Szent-Györgyi's "fumarate system", offers an adequate explanation for the inhibitory effect of amino-acids on the respiration of muscle and other non-deaminizing tissues, repeatedly observed by different authors. An attractive hypothesis on the origin of diabetic ketosis was recently put forward by Koranyi and Szent-Györgyi², who consider this condition as a result of damage to the fumarate system, possibly brought about by *Uminierung* or a similar mechanism.

It deserves special attention that no transfer of the amino group occurs unless either the amino-acid or the ketoacid is a dicarboxylic one. No instance of a direct amino nitrogen transfer between two monocarboxylic acids has yet been observed, but some evidence has been obtained showing that the reaction can be brought about by the catalytic action of dicarboxylic amino- or ketoacids, added in small amounts and functioning as intermediary amino nitrogen carriers. The above data indicate that the dicarboxylic amino- and ketoacids probably play an important and specific part in the intermediary nitrogenous metabolism, bearing some analogy to the catalytic function of the C_4 -dicarboxylic acids in tissue respiration.

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Moscow. July 25.

¹ *Bull. Biol. et Med. Exper., Moscow*, 2, 230 (1937). *Biochimica*, 2, 242 (1937).

² Herbst and Engel, *J. Biol. Chem.*, 197, 505 (1934). Herbst, *J. Amer. Chem. Soc.*, 58, 2130 (1936).

³ Koranyi and Szent-Györgyi, *Deutsch. Med. Wochenschr.*, No. 27 (1937).

Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures"

(1) IN NATURE of July 17, Dr. Stenz¹ expresses the opinion that not more than 3000 stones fell near Pultusk in the famous meteorite shower of January 30, 1868, and that only a curious misreading of a chemical analysis led to the usually quoted number of 100,000 stones.

The Pultusk fall is of special interest, being one of the very few—six or seven—cases in which the orbit of a meteorite could be calculated; according

to the astronomer Galle², for the Pultusk stones a hyperbolic velocity, hence an extrasolar origin, is proved. Furthermore, from the acoustic and optical phenomena of the fall he concluded that the stones were not fragments produced by an "explosion" in the atmosphere, but had already entered the solar system as a shower. The question as to their approximate number is, therefore, of some importance, and it may be permissible to quote a few statements from the literature which seem clearly to contradict Dr. Stenz's drastic reduction of the figure.

The well-known Bonn mineral dealer, Dr. A. Krantz, procured 34 kgm. of the stones³. He ascertained that 1 kgm. contained some 210 stones with a perfect crust⁴, this being proof that all the stones he counted had fallen as separate units, although some did not weigh more than a gram. It follows that this one dealer possessed more than 7000 stones, that is, more than twice the number Dr. Stenz ascribes to the whole fall. Altogether 200 kgm. were secured⁵, representing—on the basis of Dr. Krantz's statistics—some 42,000 stones. In the shower the smaller stones were obviously more numerous than one would infer from some collections, for which the bigger ones were preferred; but, for example, Dr. Melion's description of the 125 Pultusk stones in his possession⁶, of a total weight of 1150 gm., shows still the marked preponderance of the small type (86 stones of less than 7 gm.).

Now, considering that in the shower the majority only weighed a few grams—the so-called "Pultusk peas"—and that the fall covered an area⁷ of 17 km. $\times$ 6 km. of rough and partially flooded land⁸, the assumption that the total number was two or three times the number of stones recovered is very conservative. Vom Rath⁴ even thinks it possible that several hundred thousand stones fell. There is certainly no reason to change the usually quoted round figure of a hundred thousand for the 3000 of Dr. Stenz.

One gram was apparently the smallest mass anyone in the Pultusk area called a "stone" and thought worth picking up, but Galle² may be right in assuming in the original shower the presence of "innumerable" smaller particles.

(2) For more than a century the well-known etching-patterns on iron meteorites have been called "Widmanstätten figures", after their discoverer, Alois von Widmanstätten (1754–1849). He, however, personally published nothing on the subject, but left this duty to his friends. Four years ago, Dr. Spencer⁹, in a very thorough survey of meteorite literature, showed that the spelling of the name Widmanstätten was not constant, the "tt" sometimes being replaced by "dt", the "a" by "e", and so on, and stated that all the various forms hitherto used are wrong, the correct spelling of the family name being Widmanstetter. Following Dr. Spencer, writers on meteorites in Great Britain and abroad¹⁰ begin to speak of "Widmanstetter figures".

It is certainly no use trying to decide whether "tt" or "dt", "d" or "e" is the more correct spelling of an Austrian name of a hundred years ago; as these differences are not audible in pronunciation, both ways of writing were then considered as equivalent. The "t" instead of "n" at the end of the name is a somewhat more serious difference. A study of the history of this particular family shows that for decades both forms occurred; but Cohen, who was already aware of this discrepancy, on the authority

of Wurbach's dictionary¹⁰, declares in his "Meteoritenkunde"¹¹ that the discoverer of the etching-figures himself usually wrote "Widmanstätten" and therefore this form ought to be chosen. In view of Dr. Spencer's publication, I asked friends in Vienna and Graz to inquire anew about the form of the name personally used by the scientist. They went rather fully into the question and completely confirmed Wurbach's and Cohen's statement. Official documents are still preserved which mention Alois von Widmanstätten as the owner of a house in Graz, as the inventor of a balance, etc.

Keepers of meteorite collections may be glad to learn that there is, therefore, no reason to alter the hundreds of labels bearing the name Widmanstätten.

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August 5.

¹ Stenz, E., *NATURE*, 140, 118 (1937).

² Galle, J. G., *Abhandl. d. Schlesischen Gesell. naturhist. Cultur*, p. 79 (Breslau, 1868).

³ Wülfing, E. A., "Die Meteoriten in Sammlungen", p. 287 (Tübingen, 1897).

⁴ von Rath, G., "Ueber die Meteoriten von Pultusk im Königreich Polen", *Festschrift Gesell. fur Naturkunde*, p. 135 (Bonn, 1868).

⁵ "Die Meteoriten des Dr. Jos. Melion", p. 7 (Brünn, 1880).

⁶ Bratina, A., "Die Meteoriten vor und nach ihrer Ankunft auf die Erde", p. 22 (Wien, 1893).

⁷ "Notice sur la météorite tombée le 30 Janvier 1868 aux environs de la ville de Pultusk, publiée par la Haute Ecole de Varsovie (1868)"; Meunier, St., "Météorites", p. 491 (Paris, 1884).

⁸ Spencer, L. J., *Meteorol. Mag.*, 23, 329 (1933).

⁹ For example, Heide, F., "Kleine Meteoritenkunde", *passim* (Berlin, 1934).

¹⁰ von Wurbach, O., "Biograph. Lexikon d. Kaiserthums Österreich", p. 258 (Wien, 1897).

¹¹ Cohen, E., "Meteoritenkunde", I, p. 40 (Stuttgart, 1894).

Response of the Pigeon Crop Gland to Prolactin: Inhibition by Oestradiol Monobenzoate

Riddle and Braucher¹ showed that injections of the hypophyseal lactogenic hormone, prolactin, discovered by Stricker and Grueter², will cause growth of the crop glands of the pigeon. In view of the fact that established lactation is inhibited by administration of oestrogenic hormones^{3,4,5}, it is of considerable interest to determine whether or not simultaneous administration of oestrogens will affect the response of the pigeon crop to prolactin injections.

Two groups of 24 young pigeons of 'homer' type were used. Each bird was given six daily subcutaneous injections of 1 ml. of a solution containing 5 mgm. of prolactin. For the gift of this material, which was prepared by the method of Bates and Riddle⁶, omitting the final purification, we are indebted to Dr. F. G. Young. In addition, on the fifth day before the commencement of the prolactin injections one group was given injections of 1 ml. progynon B oleosum forte (kindly supplied by Dr. H. Neumann of Messrs. Schering, Ltd.) containing the equivalent of 5 mgm. oestradiol monobenzoate in sesame oil, followed by similar injections on the day of commencement of prolactin treatment. The other (control) group received equivalent injections of sesame oil alone. Twenty-four hours after the last injection the birds were killed and weighed. The sex of each was determined and the crop glands dissected out, fixed in Bouin's fluid and weighed from 70 per cent alcohol after pressing in muslin. The mean weights of the crops in mgm. per 100 gm. of body weight at killing are given in the accompanying table, the results for the two sexes being given separately. The crop gland region in the normal

pigeon usually weighs about 300 mgm. per 100 gm. body weight.

	Male		Female	
	No. of birds	Mean crop weight in mgm. per 100 gm. body weight	No. of birds	Mean crop weight in mgm. per 100 gm. body weight
Oestradiol monobenzoate	9	680 (±67)	15	830 (±50)
Sesame oil	7	1490 (±103)	17	1080 (±47)

The figures given in parentheses are probable errors of the means against which they are entered.

In both sexes administration of oestradiol monobenzoate caused a marked inhibition of the crop gland response, the mean inhibition amounting to about 54 per cent in the males ($P = 1:2,500$)* and about 23 per cent in the females ($P =$ about $1:40$).

This difference between the sexes in the degree of inhibition (sex-difference statistically significant at $P = 1:140$) is for the most part accounted for by the fact that in this experiment the reaction of the control birds to prolactin + sesame oil was significantly greater in males than in females ($P = 1:180$), while in the group receiving oestradiol monobenzoate the difference between the responses of the two sexes was negligible.

It is noteworthy that the group receiving oestradiol monobenzoate lost on the average 7.7 per cent of body weight in the course of the experiment ($P = 1:90$), although the control group gained on the average 6.7 per cent ($P = 1:210$). In both groups the mean change in body weight was somewhat greater in the females than in the males.

Since the prolactin response of hypophysectomized pigeons appears to be either nil⁷ or considerably less than that of intact birds⁸ it is possible that oestradiol monobenzoate inhibits the response by way of the pituitary.

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* P -Probability that an effect at least as great as the observed effect should have arisen purely as an accident of random sampling. See Fisher, R. A., "Statistical Methods for Research Workers" (1934), Edinburgh and London, chap. v, *passim*.

¹ Riddle, O., and Braucher, P. F., *Amer. J. Physiol.*, 87, 617 (1931).

² Stricker, P., and Grueter, E., *C.R. Soc. Biol. Paris*, 90, 1978 (1923).

³ Jough, S. H. de, *Acta brev. neerl. Physiol.*, 8, 52 (1933).

⁴ Robson, J. M., *Quart. J. Exp. Physiol.*, 24, 337 (1936).

⁵ Folley, S. J., *Biochem. J.*, 30, 2262 (1936).

⁶ Bates, B. W., and Riddle, O., *J. Pharm. and Exp. Therap.*, 55, 365 (1935).

⁷ Gomez, E. T., and Turner, C. W., *Proc. Soc. Exp. Biol. N.Y.*, 25, 59 (1936).

⁸ Schooley, J. P., Riddle, O., and Bates, B. W., *Proc. Soc. Exp. Biol. N.Y.*, 33, 406 (1937).

Some Interrelations between Bivalve Spatfalls, Hydrography and Fisheries

IN a study of the intensity and distribution of spatfalls of *Cardium edule* on the Cork sands in Morecambe Bay, it was found that the heaviest falls occur (a) where tidal streams meet—such localities being described locally as 'meetings'—and (b) where banks shelter a stretch of ground from prevailing winds. The heaviest falls occur at about the half-tide level.

The fall of spat is contemporaneous with considerable depositions of fine sand intermingled with some

detritus, and larvæ and post-larvæ of various other organisms such as *Polydora*, *Macoma*, other bivalves and worms. Such settlements form a densely populated mud or slutch. The same phenomenon occurs in the Dee estuary. In winter the slutch disappears.

It is clear that the *Cardium* and other organisms become concentrated and precipitate out of the plankton in localities where slack and eddy waters occur. As many as 100,000 young *Cardium* per square metre may occur in the centre of such areas¹, with diminishing concentrations towards the periphery of the meetings and low values outside them.

Recognition of these conditions at once suggested comparison with those found by Davies² on and near the Dogger Bank. Here concentrations of the fish-food, *Spisula truncata*, up to 8,250 per square metre occurred in the centre of elongated or ovoid areas, with diminishing numbers to the periphery in each case. This distribution resembles that of *Cardium* and other organisms in Morecambe Bay, and it was suspected might be brought about in a similar way, namely, by the concentration of the planktonic forms in eddying waters over and around the Dogger Bank. Recently Tait³, in investigating the surface drift of water in the North Sea, finds stream currents giving rise to eddies or swirls in several localities, including one on the north-east of the Dogger Bank. This eddy practically overlies the part of the Dogger Bank where Davies found the great spatfalls of *Spisula*.

There can be little doubt that immense quantities of larval fish foods in the form of bivalves and worms become concentrated in these swirls or eddies. Where sub-surface conditions are suitable as over the Dogger Bank, in the Moray Firth, in the mid-east Scottish coast and other areas, the larvæ settle out of the plankton to form rich feeding grounds for fish. We have therefore now a rational explanation of how such grounds are formed, and a clear indication of where to find them. On natural oyster beds oyster larvæ also tend to settle most frequently (a) where eddies form, as at the junction of a side stream with the main one, as well as in eddies formed along the shores of the main channel, and (b) in other regions of relatively still water⁴.

In the recent planktonic studies in the south-western North Sea by Savage and Hardy⁵ and Savage and Wimpenny⁶, only the area of the drift west and south-west of the Dogger Bank was investigated, and it is a reasonably safe prediction that an immensely rich planktonic area remains to be discovered in the eddy over the north-eastern region of the Dogger Bank. This eddy is not stationary, so that spatfalls may settle out in different but adjacent places, as is apparent from Davies's justifiably painstaking research. These spatfalls indicate, moreover, that the eddy over the Dogger Bank may extend sometimes from the surface into deeper water—probably during certain sets of tides when bivalve larvæ are ready to settle—or may enclose a body of relatively still water at all depths.

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¹ Orton, J. H., "James Johnstone Memorial Volume" (1934).

² Davies, F. M., *Fish Insect., Min. Agric. and Fish.*, II, 8, 2 (London, 1923).

³ Tait, J. B., *Fish. Scotland, Sci. Insect.*, No. 1 (1937).

⁴ Orton, J. H., "Oyster Biology and Oyster Culture", p. 135 (1937).

⁵ Savage, B. H., and Hardy, A. C., *Fish Insect., Min. Agric. and Fish.*, II, 14, 2 (1934).

⁶ Savage B. H., and Wimpenny, R. S., *Fish Insect., Min. Agric. and Fish.*, II, 15, 1 (1935).

Consumption of Oxygen in Sea Water under Controlled Laboratory Conditions*

DURING a recent hydrographical cruise of the *Atlantis*, the oxygen consumption in samples of water taken from eighteen levels between surface and 4,600 metres depth at Station 2886 (32° 19' N., 65° 59' W.; June 19, 1937) was determined under controlled laboratory conditions. Two glass bottles (with ground-glass stoppers) were filled from each of the Nansen water bottles as soon as they were brought on deck; one set of eighteen samples was stored at a temperature of 11° in an electric refrigerator and the other set at a temperature of 24° in the laboratory. After ten days of storage in darkness, oxygen contents of the two sets of samples were determined and subtractions of these values from initial oxygen contents of the samples gave results we have termed oxygen consumption.

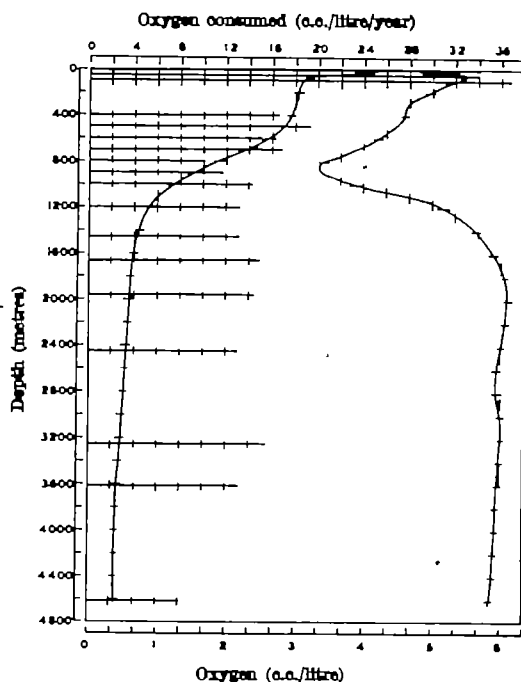


Fig. 1.

OXYGEN CONSUMPTION IN C.C. PER LITRE PER YEAR (OBTAINED BY MULTIPLYING MEAN DAILY VALUES BY 365) FOR VARIOUS DEPTHS SHOWN BY HORIZONTAL LINES REFERRED TO TOP SCALE; VERTICAL DISTRIBUTION OF OXYGEN, RIGHT CURVE REFERRED TO BOTTOM SCALE; VERTICAL DISTRIBUTION OF TEMPERATURE, LEFT CURVE, REFERRED TO TOP SCALE. DATA FROM *Atlantis* STATION 2886

The oxygen consumption at 24° ranged from 0.058 to 0.165 c.c. per litre per day, and at 11° it ranged 0.020 to 0.069 c.c. per litre per day; higher values characterized water from levels below 1000 metres depth. The average oxygen consumption of all eighteen samples incubated at 24° was 0.1224 c.c. per litre per day, and for those at 11° it was 0.0487 c.c. per litre per day.

In an attempt to estimate what the oxygen consumption would have been if the samples of water had been incubated at their respective observed temperatures *in situ* (Fig. 1), it was assumed that the

* Contribution No. 151 from the Woods Hole Oceanographic Institution.

variation in oxygen consumption with temperature (between 25° and 2°) was of the form :

$$(1) \quad \ln k = c - \frac{A}{T};$$

which equation after being differentiated and then integrated between the limits k_1 , T_1 , and k_2 , T_2 , results in a form of the Arrhenius equation :

$$(2) \quad \ln \frac{k_2}{k_1} = \frac{Q}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right),$$

which frequently represents in a satisfactory manner the effect of temperature on biological reactions over limited temperature ranges.

Upon determination of the constant Q (R is the gas constant) from the average consumption values at 24° and 11°, each of the 18 pairs of values obtained at these temperatures were reduced by means of the Arrhenius equation to values corresponding to observed temperatures (range 25°-2°) at the depths from which the samples were taken, and the means of each pair of values (after multiplying by 365) are plotted against depth in Fig. 1. It is realized that this method of extrapolation may not hold for this particular phenomenon over the entire temperature range of 25° to 2°, but it does furnish an approximation.

The results (Fig. 1) after reduction are too high, particularly in the deeper levels, to be used in estimating oxygen consumption *in situ* in the water column itself. For example, at Station 2886, water from the minimum oxygen layer (less than 60 per cent saturated, occurring approximately between depths of 700 and 1000 metres) had an average daily adjusted oxygen consumption of 0.0363 c.c. per litre, which is about 32 times greater than the value of 0.42 c.c. per litre per year previously estimated for this layer; and water from between 1000 and 2000 metres had an adjusted daily consumption in the laboratory of 0.0385 c.c. per litre, which is more than 100 times greater than the more reasonable previously estimated value of 0.103 c.c. per litre per year for this part of the water column.

Thus, it appears that conditions in the sea, other than temperature, restrict the rate of oxygen consumption, and the above results are of interest since they indicate the potential rates of oxygen consumption throughout a water column of the sea when its equilibrium is disturbed by laboratory conditions.

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Role of Heteroauxones in Legume Nodule Formation, Beneficial Host Effects of Nodules, and Soil Fertility

FOLLOWING identification of β -indolacetic acid¹ as a constituent of ether extracts of cultures of *Rhizobium phaseoli* in dextrose-bacto-tryptophane and in dextrose-bacto-tryptophane-peptone broths, these crude extracts were tested for auxones by applications to coleoptiles of *Avena*, and to hypocotyls and internodes of *Phaseolus vulgaris*, var. Red Kidney. The tests were strongly positive. Thus far we have been unable to determine whether β -indolacetic acid is the only heteroauxone in the preparations because of the scarcity of material.

Further, extraction of nodules of spontaneously infected Red Kidney bean plants first with acidulated 95 per cent alcohol (in which the nodules were ground

with pumice) and then with peroxide-free ether has yielded preparations which feebly affect growth of coleoptiles of *Avena* and of hypocotyls and internodes of the Red Kidney bean. Thimann's² method of extraction with acidulated chloroform probably will reveal a higher auxone content. Possibly the lot of nodules extracted was too old on the average to give a maximum auxone yield and possibly the sample used (50 gm.) was too small. Work is under way with larger and younger samples and with other methods of extraction. Tests with ferric chloride, hydrochloric acid and amyl alcohol indicate β -indolacetic acid as a nodular constituent. Unfortunately, the test is made with difficulty and uncertainty because of the dark colour of the crude extracts. Until more material and better tests are available, it will be impossible to identify β -indolacetic acid more positively or to determine whether the extracts contain growth substances other than β -indolacetic acid.

In conjunction with our findings¹ that pure β -indolacetic acid, applied in different concentrations and amounts in lanolin paste to primary roots of Red Kidney bean induces: (1) positive bending; (2) coiling; (3) retardation or suppression of root elongation; (4) premature and excessive lateral root initiation; (5) local diameter increase and nodulation, and with Thimann's³ findings that pea nodules are hyperauxonic in relation to normal healthy pea roots and that β -indolacetic acid incites nodulation in roots of *Pisum sativum*, our new findings indicate that β -indolacetic acid is one of the chemical agents, if not the agent, responsible for incitation of nodulation in susceptible hosts by *Rhizobium phaseoli* and other nodule-forming organisms.

The relative yields of total crude extracts from equal weights of nodules and of healthy roots as well as the greater growth-affecting capacity of the former, indicate hyperauxony for the nodules. These observations, together with Thimann's³ report that nodules of pea have a greater auxone content than non-infected root tips of the pea, seem to support the hypothesis¹ that tumours (including callus and galls) are brought about by local hyperauxony. This may be due to autoauxones, to heteroauxones, or to both added to the normal autoauxone content.

Coupled with our earlier findings¹ that β -indolacetic acid applied experimentally to the bean may augment or be in part a substitute for its autoauxones, the results reported here suggested the hypothesis that the beneficial effects of suitable concentrations of β -indolacetic acid and other auxones acting as heteroauxones may account in part for the characteristically beneficial effects of: (1) nodules for some host plants; (2) green manuring with nodule-bearing plants; (3) fertilizing with manures rich in dung and urine, or with compost; (4) humus soils; and (5) mycorrhizal fungi for some host plants.

This research was supported in part by a grant from the Rockefeller Foundation to the University of Chicago. Miss Virginia Eggers executed the growth tests. Prof. F. C. Koch kindly permitted use of space and equipment of his biochemical laboratory for execution of the extractions.

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July 29.

¹ Link, G. K. K., Wilcox, H. W., and Link, A. DeS., *Bot. Gaz.*, 59, 816-837 (1937).

² Thimann, K. V., *J. Gen. Physiol.*, 18, 23-34 (1934).

³ Thimann, K. V., *Proc. Nat. Acad. Sci.*, 22, 511-514 (1936).

Structure of a New System of CO Bands

IN a previous note¹ the discovery of a new system of red-degraded CO bands, placed just before the heads of the violet-degraded Third Positive system, was reported. Inspection and measurement of high-dispersion spectrograms now show that the new bands have a structure appropriate to a $^3\Sigma \rightarrow ^3\Pi$ band-system, the lower state being the $a^3\Pi$ state, which is the usual final state of the CO triplet systems. The upper $^3\Sigma$ levels of the new bands lie about 88705 cm^{-1} and 85885 cm^{-1} above the CO ground state; they have observable spin-splittings and rotational constants $B' = 0.7$ to 0.8 cm^{-1} . The system may tentatively be designated as $f^3\Sigma \rightarrow a^3\Pi$. It may be considered, however, as probably due to transitions from the higher vibrational levels of $a^3\Sigma$ to the lower vibrational levels of $a^3\Pi$. For, within the heights of the initial levels $f^3\Sigma$ of the new bands occur also the initial levels $b^3\Sigma$ of the Third Positive bands, and the latter are strongly perturbed, as has already been established², by vibrational levels of the $a^3\Sigma$ state, for which we have predicted term values and rotational constants of the magnitude now observed for the new bands.

Rotational analysis and details will be published shortly elsewhere.

R. SCHMID.
L. GERÖ.

Physical Institute,
Royal Hungarian University,
Budapest. July 31.

¹ Schmid, R., and Gerö, L., *Naturewiss.*, **26**, 90 (1937).

² Schmid, R., and Gerö, L., *Z. Phys.*, **106**, 36 (1937) 106, 206 (1937).

L-Emission Bands of Zinc, Copper, Nickel and Cobalt

I HAVE studied the intensity of the L-emission bands of metals from Co (27) to Zn (30). The apparatus used was a vacuum spectrograph using a bent crystal of mica, and the source of the radiation was an X-ray tube.

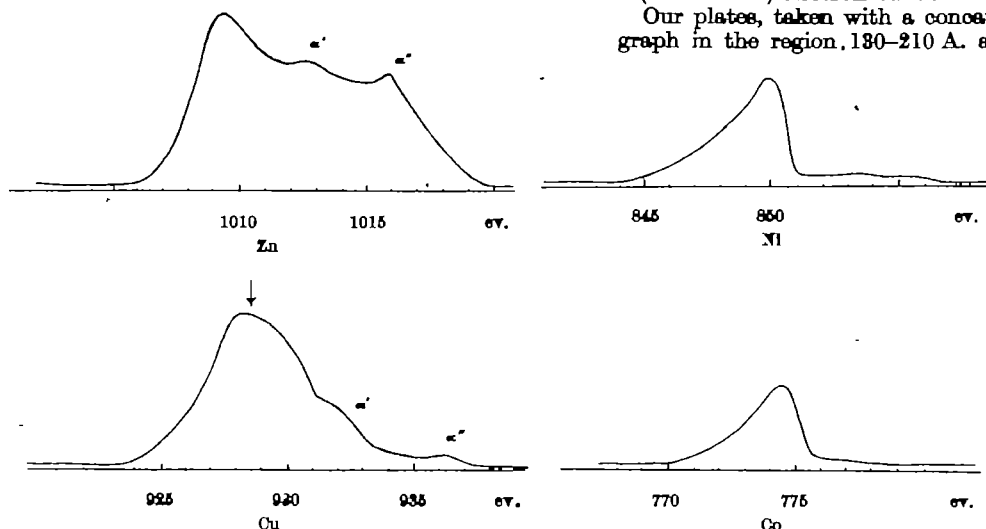


Fig. 1

To obtain the actual intensity distribution of the emitted radiation, the plate was calibrated by a method already described¹. The curves giving the intensity of the L_α bands against energy (in electron-volts) are shown in Fig. 1.

It is well known that the L-emission bands are emitted when M_{IV} , γ -electrons make transitions into the L_{II} , m -levels ($L_{\alpha_{1,2}}$ and L_{β_1}). There are also transitions of N_I -electrons into the L_{II} , m -levels. For these metals the N_I - or $4s$ -electrons are the conduction electrons, and occupy levels which overlap in energy those of the M_{IV} , γ - or $3d$ -electrons.² Thus the observed bands represent transitions of both $3d$ - and $4s$ -electrons. But for copper and zinc, unfortunately, the short wave-length ends of the bands, which are probably due to the $4s$ -electrons, are completely masked by satellites, which are strongly enhanced by the reorganization of the atom on account of the Auger effect³, L_I-L_{III} .

The position of the short wave-length edge of the L_α -bands may be estimated from the L-absorption spectra, and is given by the wave-length of the slope of the absorption curve near the minimum absorption. For copper, we can deduce from the absorption curve of Sandström⁴ that the edge of the L_α -emission band is given by the arrow marked on Fig. 1. From the comparison of the L-emission and L-absorption bands it is obvious that the width of the L_α -band is about 5 eV.

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Aug. 3.

¹ *Comptes rendus*, **204**, 1212.

² See Mott and Jones, "The Theory of the Properties of Metals and Alloys" (Oxford, 1936), p. 191.

³ See Oster and Kronig, *Physics*, **2**, 13 (1935).

⁴ Sandström, A., Thesis, Uppsala (1935).

M-Emission Bands of Zinc, Copper and Nickel

WE have had the opportunity of seeing Dr. Farineau's letter before it was sent to press. We have recently observed the M-emission bands of nickel, copper and zinc metals, and it seems worth while to add a note, since the two sets of results, especially taken together, allow one to draw certain conclusions about the structure of the $3d$ - and $4s$ (conduction)-electron bands in these metals.

Our plates, taken with a concave grating spectrograph in the region 180–210 Å. and with an X-ray tube run at 3,000 v. as source, give results which, on a scale of energy, are almost identical with Farineau's L-emission bands. This is good evidence that, apart from transition probability factors, the curves represent features of the density-functions of the combined $3d$ -conduction-levels of the

metals. We also obtain for zinc and copper the peaks marked α' and α'' by him. But, contrary to his conclusion, when we compare the wave-lengths of points on the M-emission bands with the wave-lengths of the M-absorption edges which we have determined¹, we

arrive at the definite result that for both copper and zinc the peaks marked α' are part of the main emission band, only the α' peaks being satellites. Also it would, in the present case, be difficult to understand how the Auger mechanism could account for more than one satellite. A wave-length error, either in the L -absorption or the L -emission band of copper, seems the most likely explanation of the discrepancy.

If the α' peaks are to be included in the main bands, the shapes of the L - (or M -) emission bands, free from satellites, can be fairly accurately gauged from Farineau's Fig. 1, except in the case of zinc. Two points of interest stand out. (1) The curves show the shifting of the main peak (certainly due to $3d$ -electrons, which form a shell, incomplete for cobalt and nickel but complete for copper and zinc) towards the low energy end of the band as we pass from nickel to zinc. It is true that the resolving power of the method is not very good, being limited by the Auger broadening of the excited state. The unsharpness of the high-energy edge of the main bands gives a measure of this broadening. (2) The total breadths of the bands obviously represent the energy-spread

of the conduction ($4s$) electrons. For copper, it may be taken as $8\frac{1}{2}$ volts, including the α' peak, but correcting for the unsharpness of the edge. It is found that this is only a little greater than the breadth of 7 volts calculated, assuming one conduction electron per atom, on the elementary Sommerfeld theory (this correspondence is fairly general¹).

Now nickel and copper have the same crystal structure and almost the same lattice constant. So, from the present point of view, they differ only in the number N of conduction electrons per atom. Since the band-width is proportional to $N^{2/3}$, the energy-spread (6 volts) for the nickel band allows us to determine N for nickel as 0.59. This agrees excellently with the value postulated to explain the magnetic properties².

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Aug. 18.

¹ Skinner and Johnston, *Proc. Roy. Soc., A*, **18**, 420 (1937).

² See O'Bryan and Skinner, *Phys. Rev.*, **44**, 370 (1934).

³ See Motz and Jones, "The Theory of the Properties of Metals and Alloys", chap. vi.

Points from Foregoing Letters

AN account of the Kyoto University expedition to Peru to observe the total solar eclipse of June 8, 1937, is given by Prof. Issei Yamamoto, who states that excellent photographs showing the structure of the inner corona were obtained by means of a ten-metre camera.

A graph showing that the resistance of zinc-blende, after excitation by blue light and 'quenching' by heat or infra-red light, decreases linearly with time is submitted by Dr. A. L. Reimann. The author infers that the electrons experience increasing difficulty in finding 'positive holes' to combine with as quenching proceeds. The linear rate of decay of the phosphorescence of zinc-blende, the author states, also agrees with this view. An outline of a mechanism of conduction is sketched, which seems necessarily to follow from the decay data, together with the results of early work on other photo-conductivity phenomena by Gudden and Pohl.

Drs. F. G. Mann and A. F. Wells show that aliphatic trialkyl phosphines and arsines unite with cuprous and argentous iodides to give fourfold molecules, $[R_3P(As) \rightarrow CuI]_4$ and $[R_3P(As) \rightarrow AgI]_4$, the structure of which has been determined in detail. Aurous halides give, however, the simple compounds of type $[R_3P(As) \rightarrow AuX]$, the phosphine members of which can be distilled without decomposition.

Prof. K. C. Bailey states that a gas flame 5-6 inches high can be extinguished by a jet of coal gas from a cylinder, without the jet being ignited. He infers that coal gas from a cylinder, bursting during a fire, may extinguish the fire locally, and thus make an opportunity of mingling with the air, and forming an explosive mixture, possibly with disastrous results.

Further work by Prof. A. E. Braunstein and M. G. Kritsmann on the transference of an amino group and two hydrogens from glutamic to pyruvic acid (with the formation of alanine and ketoglutaric acid), shows that the reaction is a reversible one. The enzyme responsible for the process occurs in various organs (muscle, brain, liver, etc.). The exchange of

amino group and hydrogen atoms takes place between other similar molecular couples, provided either the amino- or the ketoacid has two carboxylic groups.

Prof. F. A. Paneth brings evidence to prove that the number of stones, of one gram weight and heavier, in the Pultusk meteorite shower was of the order of 100,000. He also discusses the correct spelling of "Widmanstätten figures" (etching-patterns on iron meteorites).

It has been found that prolactin, a hormone stimulating milk production, will cause growth of the crop glands of the pigeon. Drs. S. J. Folley and P. White now find that if the pigeons are previously given injections of one of the female sex hormones, oestradiol monobenzoate, a marked inhibition of the crop gland response to prolactin is observed.

Prof. J. H. Orton states that the spatfall of the cockle is observed in localities where slack and eddy waters occur, that is, where tidal streams meet or where banks shelter a stretch of ground from prevailing winds. As many as 100,000 young cockles per square metre may occur in the centre of such areas.

The consumption of oxygen in sea water (that is, the amount of oxygen disappearing after ten days from samples of sea water obtained from various depths and kept under controlled laboratory conditions) has been determined by H. R. Seiwel. It appears that conditions in the sea, other than temperature, restrict the rate of oxygen consumption as found in the laboratory, since some of the results obtained, particularly for the deeper levels, are much too high as compared with previous estimates.

Prof. George K. K. Link reports that *Rhizobium phaseoli*, the bacterial incitant of nodulation of bean roots, produces the heteroauxone β -indolacetic acid when grown in pure culture in tryptophane-containing broths. He finds also that nodule extracts contain β -indolacetic acid, which may account for nodule production and for the beneficial effects of green manuring with nodule-bearing plants, and of humus soils, manures and mycorrhizal fungi.

Research Items

Canoes of Oceania

DR. A. C. HADDON and MR. JAMES HORNELL have made a detailed study of the canoes of Oceania, of which the first volume by Mr. James Hornell, dealing with the canoes of Polynesia, Fiji and Micronesia (Bernice P. Bishop Museum, Honolulu, *Special Publications* 27) is based in part on personal investigations in certain of the islands in 1924-25, in part on an exhaustive and critical examination of references in early travel literature with its illustrations, as well as of the models which are preserved in museums. References in early literature are usually inadequate, while the illustrations and the models are often inaccurate. Problems of distribution and dispersal will be considered by Dr. Haddon in a third volume. From the present collection of facts certain general conclusions as to population movements in Polynesia emerge. Two classes of vessel have to be taken into account, the outrigger and the double canoe. In outrigger canoes, in addition to rig and form of hull, the number of outrigger booms and the method of attachment to the float must be considered; in the double canoe the form and relative proportion of the hulls. The fundamental canoe types are reducible to three: (1) Proto-Polynesian, in which the hull has pointed ends, inclined upwards, but little emphasized, is strengthened by inserted ribs, and the canoe is rigged with a primitive sprit-sail; (2) Melanesoid-Polynesian, with head low and stern curved up high, profusely ornamented with carving, the sail a primitive sprit-sail, triangular or sub-triangular; (3) Tangaroan, plank-built hull with ribs tied to ridges, the planks sewn together through holes, rigged with a primitive lateen sail. This third type was probably introduced by an Indonesian people who worshipped Tangaroa. From the evidence of the canoes it may be argued that the Proto-Polynesians reached Polynesia direct from Indonesia by way of Micronesia; and not after coasting along the shores of the Melanesian Islands as is held in the generally accepted view.

Fishes of Paraguay

A REMARKABLE similarity exists between the fish fauna of the La Plata and that of the Amazon basin, and two explanations have been offered: that the two faunas represent the same initial stock, which by migration over the marshy uplands between the Tapajós and the Paraguay or across the low divide between the latter and the Guaporé peopled the two river basins; or that the two faunas illustrate the parallel evolution of two distinct stocks. A contribution to a solution of the problem is made by Prof. Nathan E. Pearson, who has listed the fishes of the Paraguayan basins, and considers that it is unnecessary to assume parallel evolution to explain their Amazonian resemblances (*Pub. Calif. Acad. Sci.*, 23, 99; 1937). Migration is a sufficient explanation. The fishes entered South America some time during the Tertiary Period and crossed the low Amazon valley and a highland divide to enter Paraguay. The Rio Guaporé and other tributaries of the Amazon seem to have

afforded the migratory paths. At the present time, the possibility of such migration has been cut off, since the fall in the volume of the streams flowing from the highlands of Matto has given rise to an effective barrier, but the nature of the fishes on the two slopes of that barrier indicate that it is of recent origin.

Life-History of *Apophallus venustus*

FOLLOWING a previous account of its morphology and taxonomy, T. W. M. Cameron has published an account of the life-history and bionomics of the trematode, *Apophallus venustus* (*Canadian J. Res.*, 15, No. 2; 1937). This trematode is endemic in the Lower Ottawa Valley, and has been found in cats, dogs and racoons. It has also been found in the great blue heron, though not in several other species of fish-eating birds examined. The first host is an operculate snail, and the only species discovered naturally infected was *Goniobasis lioscoens*, in which the percentage of infection may reach 31.6. The metacercaria stage lives in the second host, a fish, and eleven out of twelve species of freshwater fish when eaten by cats under controlled conditions were found to be capable of carrying infection. The metacercariae are present in the subcutaneous tissue or the muscles. The adult in the cat lives principally in the ileum, and in the laboratory all infected cats lost their infection during the winter, so that the reservoir would appear to be the fish.

Lac in Malaya

ATTEMPTS to cultivate the lac insect (*Laccifer lacca*) outside India have been made from time to time. The most recent effort has been tried out in Malaya and an account of the experiment is given by Mr. N. C. E. Miller in Scientific Series No. 19 (1937) of the Department of Agriculture, Straits Settlements and Federated Malay States. Consignments of brood lac for the work were obtained from the Lac Research Institute, Nankun, India, in which country the insect has been propagated for several hundred years. It may be added that about 25,000 tons of shellac products are exported annually from India to all parts of the world. The consignments received in Malaya were used to inoculate rain trees (*Enterolobium saman*), *Cajanus indicus*, *Zizyphus jujuba* and plantation rubber trees. The outcome of the experiments was disappointing. It was decided that the climatic conditions in Malaya, especially the high degree of humidity, and other circumstances are wholly unsuitable. The very young insects, or swarming larvae, showed a prominent tendency to colonize the host trees towards or on the main stems and to neglect the young growing shoots. Owing to this erratic behaviour and the rapid suberization of the branches, they failed to survive. Another contributing cause of the failure was the prevalence of a chalcid parasite of destructive propensities. These causes, and the inroads made by synthetic substitutes for resins, are stated to have led to the abandonment of any further trials.

Endosperm and Embryo in Reciprocal Cereal Crosses

IN reciprocal crosses of plants with different chromosome multiples, the more successful cross is usually the one in which the high chromosome number comes from the female parent. Messrs. J. W. Boyes and W. P. Thompson (*J. Genet.*, 34, No. 2) discuss this subject in relation to cereals, recording a series of observations on embryo and endosperm development in reciprocal hybrids between *Triticum vulgare* and *T. durum*, *T. vulgare* and *T. dicoccum*, *T. spelta* and *T. monococcum*, as well as back-crosses and crosses between wheat and rye. Chinese wheat, unlike other varieties, can be readily crossed with rye pollen. In the crosses low-chromosome female $\times$ high-chromosome male, although there is a higher rate of endosperm growth, abnormalities in the endosperm are frequent. These include nuclei of unusual sizes, abnormal structure and irregular shapes, weakly staining cytoplasm and persistent non-cellular regions. The reciprocal crosses do not show these abnormalities, except in the widest crosses. The embryo, on the contrary, is healthy in development in all except the widest crosses, and the reciprocals show very little difference. In rye (7 chromosomes) $\times$ wheat (21), fertilization rarely occurs although the pollen germinates well on the rye stigma. In the back-crosses F_1 female $\times$ *vulgare* male, the endosperm varies widely from normal to conspicuously abnormal. This is attributed to a variable amount of chromosome unbalance, which is believed to be one of the causes of the differences in the endosperm of reciprocal crosses.

Diseases of Ornamental Plants

THE *Gardeners' Chronicle* of July 10 announces the appearance of two fungus diseases upon ornamental plants. Mr. D. E. Green directs attention to a downy mildew of snapdragons caused by *Peronospora Anthrini*. The disease has been known in southern Ireland, and has now appeared in England. It checks the growth of young shoots, has a tendency to curl the leaves downwards, and often causes the plant to send out many small shoots from the base. Messrs. A. Beaumont and P. H. Gregory describe a leaf-spot disease of *Gerbera Jamesoni*, a plant which can be grown outside for market in Devon and Cornwall. The fungus *Ascochyta Geberae* attacks the leaves, and produces brown spots with margins of purple. Pycnidia of the fungus are embedded within the tissue of the spots. The disease appeared in Italy in 1913, and has not since been described until its occurrence in Cornwall in 1936.

Protective Spray Deposits

THE efficiency of protective insecticides and fungicides depends largely on the amount of spray material which remains on the foliage immediately after spraying, and the degree to which this resists the various agencies which tend to remove it. Fajans and Martin (*J. Pom. and Hort. Sci.*, 15, 1, 1-24; 1937) denote these two properties by the terms 'initial retention' and 'tenacity' respectively. They describe laboratory experiments from which are evaluated the effects of a number of spray supplements, particularly wetting agents, on initial retention and tenacity, the supplements being added to spray materials used in the form of suspensions. In the majority of the systems examined, the initial retention of a suspension was found to be the same as that of the aqueous phase,

but in some cases the latter was reduced by the presence of the solid particles. This reduction seems to be related to an effect on the wetting and spreading properties of the spray, but is not independent of the nature of the surface sprayed. The tenacity of the spray deposit is dependent upon the characters of the spray supplement, the solid particles and the surface sprayed. It is comparatively higher on surfaces wetted with difficulty and is enhanced by oils, both hydrocarbon and glyceride. Highly surface-active supplements, especially at high concentrations, reduce tenacity, whilst those like gelatine and lime casein, which yield residues insoluble in cold water, have a favourable effect. These conclusions were tested in the field by treating a crop of potatoes against blight (*Phytophthora infestans*) with cuprous oxide sprays to which ten different spray supplements were added. A high degree of correlation was obtained between the amounts of spray residue and the control of blight.

Meteorology of American Floods

THE unprecedented floods on the Ohio and lower Mississippi Rivers last winter, coming so soon after the exceptional floods of March-April 1936 in the middle and north Atlantic States, have led C. F. Brooks and A. H. Tieszen to a study of the meteorology of such floods. An account of their work has appeared under the heading "The Meteorology of Great Floods in the Eastern United States" (*Geographical Rev.*, 27, No. 2, April 1937) and has recently been reprinted as a separate paper. The flood of 1937, with its monetary loss of at least six hundred million dollars, is, according to these writers, the greatest American flood on record. They find that two meteorological features are common to all great floods such as those of 1882, 1889, 1903, 1913, 1922 and 1927, and those of the last two years, namely, "a rapid and continuing flow of moist tropical air into the country and a frequent and persistent elevation of this tropical current by a colder air mass over the same region". This arises from a persistent anticyclone over the western part of the North Atlantic and another over the central or northern interior of the United States, or a little farther to the west. The one drives tropical air northwards, the other polar air southwards, and ascent of the warm air is continuous and sometimes violent along the front between the two. The importance of the weather before the heavy rains that are the immediate cause of the flood is pointed out; a rapid run-off is favoured both by wet weather which saturates the ground and by severe frost that makes it impermeable; on the other hand, dense vegetation and a dry soil or a deep cover of snow over unfrozen ground may entirely absorb five inches or more of rainfall. The fact that great floods are confined to the winter and spring is to be attributed to the vegetation that protects the summer and autumn by hindering run-off and rapidly using ground water.

Young's Modulus Apparatus

THE August issue of the *Journal of Scientific Instruments* contains a description of an interferometer apparatus for the accurate determination of Young's modulus over a wide range of temperature, devised by Mr. J. W. Cuthbertson of the University of Manchester. A bar of the material about 9 cm. $\times$ 0.8 cm. $\times$ 0.3 cm. is supported symmetrically on parallel horizontal knife edges about 4 cm. apart; the

load is applied by needle points, near the ends of the bar, which support a bar to whose centre the load is applied by weights or by a lever. The rise of the centre of the test bar is transmitted by an invar wire to a tripod the other two legs of which are supported by hole and groove in a fixed plate. The tripod carries the lower plate of an interferometer the upper plate of which is fixed. The interference bands in reflected light are observed in a microscope and the number which pass a fixed line, as either load or temperature is gradually changed, is counted to get the rise of the centre of the bar. The bar and its supports are suspended in an oil bath by rods of invar bolted to horizontal iron beams which carry the interference apparatus. A few typical results are given.

Detection of Destructive Larvæ in Timber

In the National Physical Laboratory Report for 1936 (London: H.M. Stationary Office. 2s. 6d.) Dr. R. L. Smith-Rose, the head of the radio department, describes an acoustic-electrical equipment for detecting destructive larvæ in timber. At the request of the Forest Products Research Laboratory, he explored the possibilities of applying microphone and amplifier technique to the detection of larvæ in specimens of timber. The first experiments showed that there was little likelihood of the successful application of a method of this kind to the detection of larvæ in buildings or growing timber, owing to the faintness of the sounds concerned relatively to the associated background noises. Further experiments carried out when the specimens were housed in a sound-proof container were promising. A suitable equipment was designed and constructed. The specimen of timber to be examined was placed in a sound-proof container with a suitable control specimen and a microphone was laid on each. When the specimen contained larvæ, the noises made by these could in general be readily distinguished from the more uniform background noise of the amplifier itself. In some instances different larvæ could be distinguished by the differences in the sounds they made. A description of the equipment used has been prepared for publication.

Reflection of Radio Waves in the Atmosphere

THE well-established reflection of radio waves in the upper atmosphere takes place at apparent heights of 100–200 km. and it is generally believed that the damping effect of atomic collisions on ionic motion prevents reflection from ionized layers much lower than this. R. A. Watson-Watt, A. F. Wilkins and E. G. Bowen (*Proc. Roy. Soc., A*, 161, 181) have now observed reflection from much lower levels. They used the pulse technique, refined so that a very short pulse was transmitted upwards and echoes of very short delay could be observed on a cathode ray tube. Continuous records and 'snap' observations were both used. The observers were able to detect a series of reflections which they interpret as arising from a few layers at height about 10 km., possessing reflection coefficients of the order 0.7 (for 50 m. waves and vertical incidence). The layers are fairly persistent in time and occur both by night and by day. The records also reveal reflections from the Appleton D region (50–90 km.) and from stratospheric layers at about 30 km. A feature of D region reflection is the occurrence of sporadic bursts of reflection lasting a few seconds. The appearance of

a 30 km. reflecting layer has on several occasions been correlated with thunderstorms, and an appendix to the paper shows that the 'runaway electrons' predicted by C. T. R. Wilson should be bent round by the earth's magnetic field and might produce ionization of the type required. The occurrence of these low reflecting layers may have some practical bearing on short-wave transmission and in particular on television phenomena.

Concentration of Nitrogen Isotope

By using the exchange reaction between ammonium sulphate and ammonia gas, H. C. Urey, M. Fox, J. R. Huffman and H. G. Thode (*J. Amer. Chem. Soc.*, 59, 1407; 1937) have been able to concentrate the heavy isotope of nitrogen, ^{15}N , for use in biochemical and chemical investigations. A solution of ammonium sulphate was pumped into the top of a fractionating column under low pressure, ammonia was liberated from the salt at the bottom by addition of caustic soda, and the ammonia gas stripped by a packed column. This ammonia was fed back to the bottom of the column and escaped at the top. As a result of a 13-day run, nitrogen containing 2.54 per cent of ^{15}N was obtained, an increase of concentration of 6½-fold. The samples were analysed by the Bleakney mass spectrometer, giving an accuracy of 0.02 per cent ^{15}N .

Structure of Water

THE open tridymite-like structure of ice as regards the distribution of the oxygen atoms appears to have been definitely established by Barnes, and Pauling's explanation of the discrepancy between the entropies of ice calculated by Nernst's theorem and statistical methods indicates that the hydrogens are unequally spaced between the oxygens. Present theory, as developed by Bernal and Fowler and modified by Katsoff and others, considers liquid water at ordinary temperatures as having essentially a broken-down ice structure, permitting closer packing with a considerable amount of co-ordination persisting through hydrogen bonds. This co-ordination decreases with rising temperature or addition of electrolytes. According to Pauling, two of the four hydrogens which surround a four-co-ordinated oxygen atom tetrahedrally are bonded to it in much the same manner as in an isolated water molecule, while the other two hydrogens are at a greater distance (1.77 Å. instead of 0.99 Å.) from the oxygen and essentially bonded to other oxygen atoms. The oxygen nucleus in ice has four oxygens tetrahedrally bonded at 2.76 Å., with a proton along each O—O axis. An examination of the Raman spectra of ice at 0°, of water over a wide range of temperatures, and of deuterium oxide, has been made by P. O. Cross, J. Burnham and P. A. Leighton (*J. Amer. Chem. Soc.*, 59, 1134; 1937). The results are interpreted on the basis of a model consisting of O—H oscillators perturbed by various types of co-ordination. A semi-empirical treatment indicates that in ice at 0°, the four-co-ordinated structure predominates, but appreciable amounts of three- and two-co-ordinated molecules are present. Water is rather more than two-co-ordinated at 25°–90°, and is slightly less co-ordinated than deuterium oxide, two-co-ordinated structures predominating in both liquids. Little significance is attached to the existence of definite polymolecular structures such as $(\text{H}_2\text{O})_n$, $(\text{H}_2\text{O})_2$, frequently postulated as existing in liquid water.

Egyptian University Scientific Expedition to South-West Arabia

By Dr. S. A. Huzayyin

BETWEEN April and October 1936 the Egyptian University of Cairo sent out a scientific expedition to Yaman and Hadhramaut. It consisted of four members, and was intended to carry out researches in the fields of geology, physiography, archaeology, anthropology and entomology. The expedition covered a distance of some 2,500 kilometres and was able to carry out intensive researches at various localities both on the High Plateau of Yaman and in the interior of Hadhramaut. The material brought back has not been studied in detail as yet; but a preliminary note can be given here.

GEOLOGY

One of the expedition's main aims was to work out certain problems connected with the geological history of the southern borders of the Red Sea. We worked at a number of points along the lines of rifting both south and west of the Yaman Plateau, where the old crystalline rocks (schists and granites) of the base were exposed under later (secondary and tertiary) sediments and lavas. The successive horizons of the tertiary traps of the High Plateau were carefully examined and specimens collected. In north-east Yaman we worked chiefly on Jurassic limestones and Nubian sandstones, and a large collection of fossils was made from the successive zones of the former. The interior of Hadhramaut was found to have a relatively simple structure and to consist mostly of Eocene limestones on earlier unfossiliferous sandstones. We hope that new evidence from the lower part of the Eocene may throw useful light on the date of the trap volcanic series of tertiaries in south-west Arabia.

PHYSIOGRAPHY

Pleistocene geology proved to be quite interesting. We worked chiefly on the middle parts of the valleys, which were relatively independent of changes in base (sea) level. Two physiographic cycles were established, the first being by far the more pronounced. Valleys with sloping sides were first cut and then filled with coarse gravels which now rise (usually in two or more terraces) to some 30 m. above the beds of the streams. During this stage there was a good deal of lateral wash and erosion in the middle parts of the valleys, and this erosion was probably responsible for the sloping sides of the V-shaped valleys. The gravels were examined at a large number of exposures, but unfortunately they produced only one or two specimens of pre-Challeian appearance.

The second physiographic cycle was associated first with the cutting of new steep-sided valleys *emboites* in the older gravels, and then with the filling in of these new valleys with soft sediments of silt. Deposition was much more regular and there was very little lateral wash in the middle parts of the new valley-beds. The discharge during the depositional phase of the second cycle was much less than that during the depositional phase of the first cycle, as only

soft silt could be carried to the middle courses of the streams. The two cycles were separated by a phase which was marked by extensive volcanic activity, especially in north-east Yaman, where the lava spreads always cover the old gravels and underlie the silts. The second cycle was followed by erosion, during which new torrential beds were cut into the silts (sometimes producing a series of erosional terraces). There has also been a still more recent (historical) outburst of volcanic activity (on a much more limited scale), the accompanying features of which are still noticeable in hot springs, etc.

We were able to associate the two physiographic cycles (or at least their depositional phases) with pluvial episodes. During Quaternary times this corner of Arabia seems to have had two major Pluvials separated by an Interpluvial. It was not possible to work out the stages of the first Pluvial, which was a prolonged one, and which must have had more than one sub-maximum (as shown by terraces); but there is presumptive evidence from one or two places that the second Pluvial may have had two sub-maxima separated by an Intrapluvial. In recent times there was a new wet phase (shown by archaeological and other evidence), which we believe to have continued well into the Christian era (perhaps to the fifth century A.D.).

ARCHAEOLOGY

The south-west plateau of Arabia proved to be singularly poor in prehistoric remains. Perhaps the great height (mainly above 1,500 m.) and the unfavourable climatic conditions during pluvial episodes contributed to this. It is to be recalled that very few remains have thus far been found at the high altitudes (above 8,000 ft.) of the opposite coasts of East Africa. We have carefully examined gravel exposures and have carried out experimental excavations at no fewer than fifteen caves and rock shelters in Yaman and Hadhramaut, but the results were largely negative. Surface specimens were looked for all along the route, but they were found only in very limited numbers and in particularly favourable localities; they belong typologically to Lower and Middle Palaeolithic and rarely to the Upper Palaeolithic. Whatever may have been the reasons, the scarcity of even surface finds shows that even if remains of prehistoric man may some day be forthcoming from this region, they will never be comparable in quantity with those from the African side. This reflects rather unfavourably on recent views put forward with regard to East Africa as a centre of cultural diffusion in Lower Palaeolithic times.

Remains relating to the early historic phase of the area were, on the other hand, particularly abundant. Work and excavations at a number of places in Yaman and Hadhramaut have yielded fairly illuminating results. New light is thrown on relations between south-west Arabia on one hand and the Hellenistic East and Graeco-Roman Egypt on the other, during the early centuries of the Christian era.

More than a hundred new Sabaitic inscriptions were copied and photographed. At three sites in the Aden and Hadhramaut protectorate, particularly the ruins of Reiboun (near Mash-had) there is, on the other hand, contacts with East Africa. Here we found an industry of obsidian (with some flint) in definite association with pottery and with Sabaito-Himyaritic inscriptions, all found in shallow kitchen midden-like remains and amongst ruins of ancient buildings and habitations. Some of the characters were actually inscribed on the pottery both before and after baking. The obsidian industry includes practically all the types and sub-types of the so-called final Palaeolithic and Neolithic cultures of East Africa—Wilton, Elmenteitan and Gumban. There are small nuclei, simple and retouched blades, truncated and notched ones, small backed knives, trapezoidal forms (in abundance), true lunates (less abundant), chisel-ended tools or *pièces écailées* ('sinew-frayers' of Dr. L. S. B. Leakey), borers, medium-size and small burins (but not the micro-burin proper) and scrapers of various descriptions (nucleiform, round, at end of blade, etc.). Yet there can be no doubt about the Sabaito-Himyarite date of this industry in south-west Arabia (the few centuries centring round the beginning of the Christian era).

Apart from inscriptions (on stone and on pottery) there are metal elements and beads of dating value. The pottery here is much more developed and varied than in East Africa, but this is to be expected in a country with more progressive civilization. One cannot argue from the evidence we have for the separation of the obsidian industry from the rest of the datable remains which must all have belonged at least to one and the same culture phase*. If this be so, the dates assigned by Dr. Leakey and others to the so-called final Palaeolithic and Neolithic industries of East Africa will have to be revised. It would be unreasonable to argue for a 'survival' into historic times of an obsidian and flint technique in south-west Arabia after it had been introduced from the African side at a final Palaeolithic date. It would be rather in this latter region (East Africa), which produced no such highly progressive civilizations as we know from south-west Arabia, that we should expect such 'persistence'. Perhaps many of the Microlithic elements of industries in East Africa may ultimately prove to be of comparatively recent historic date (Christian era).

We have also discovered, at a number of rock shelters in the Middle Wadi Hadhramaut, rock drawings (both animals and men) of both naturalistic and schematic styles. The former were associated with Himyaritic inscriptions (mostly names and cartouches), while the latter were of much more recent appearance. At the base of some of the rock shelters we found a flake and blade industry of flint which we have reason to associate with the first series of drawings.

ANTHROPOLOGY

Anthropometrical measurements were made of 1,350 male individuals, of whom 800 were studied in Yaman and 550 in Hadhramaut. More than 400 individuals were photographed full face and profile. The individuals are representative of the great majority of the tribes inhabiting the area, and useful light may be expected to be shed both on local distribution of anthropological features and types and on similarities and connexions with neighbouring areas in Asia and

Africa. Already interesting links are being worked out with Iran and the west Deccan. Local differences have also been worked out within both Yaman and Hadhramaut. The population of the northern part of the Yaman plateau is essentially mesocephalic, though it also shows certain features due to mixture. South Yaman, on the other hand, has broader heads. There is also a number of Jewish colonies in Yaman from whom representative groups were measured. In Hadhramaut we have a markedly brachycephalic type (very dominant, especially in the interior) and a mesocephalic one (especially on the coast). The broad heads of Hadhramaut show interesting anthropometrical features, and the roundness of their heads is primarily due to shortness (flattening of the back) rather than to width. Armenoid affinities among the broad heads of south Arabia are already known from previous observation and measurements (Bertram Thomas, etc.). The High Plateau of Yaman is practically free from prognathism, which becomes more and more marked as we go eastwards into Hadhramaut. We have reason to believe that this feature was not the result of crossing with Negroids from Africa, but represents an element brought from farther East. Special attention, however, has been paid to cases and areas of metisisation between Negroid and Arab types, especially in coastal regions. Some peoples of the coastal plains of west Yaman have been shown to have marked affinities with the Negroids of Africa, who, however, do not seem to have affected the High Plateau to any appreciable extent. Certain parts of the Hadhramaut coast are equally mixed, and even in the interior there are colonies of imported elements (for example, Negro soldier-slaves, Indo-Chinese and Chinese elements as slaves and wives brought back by enterprising merchants of Hadhramaut, etc.).

ENTOMOLOGY

Between five and six thousand specimens have been collected, and a large number of these were actually set in the field. They represent fauna from all the altitudes we have passed through (from sea-level to 3,500 m.). The identification of our specimens will inevitably be a long process, but it is hoped that fresh light may be thrown on the question of migration between adjacent parts of Africa and Asia in these regions. One of the chief topics we worked upon was the question of locust breeding-grounds and migrations, and already some useful results have been achieved in this direction.

In addition to these topics, members of the expedition carried out side-line investigations, such as the taking of a meteorological record during the journey (with as few breaks as possible), the collection of plants and small animals in localities which have not been visited before and of fishes and aquatic fauna from all streams and springs along the way, as well as the recording of observations on the general geography and ethnography of the lands and peoples in the areas visited.

*Should there be any chance of such a separation, however, the only possibility would be that at a posterior date poorer tribes took shelter among the Sabaito-Himyarite ruins and left their obsidian industry thoroughly mixed with earlier remains. In that case the lithic industry would be still more recent than the Sabaitic phase. There can be no possibility of the Sabaito-Himyarites having chosen for sites of their cities places where earlier obsidian and flint-using tribes left their kitchen midden and rubbish heaps.

The Location of Industry

THE attention which is now being given to the location of industry was reflected not only in Prof. P. Sargant Florence's presidential address to Section F (Economic Science and Statistics) of the British Association on September 3, but also in the discussion by the same Section on September 2 of problems of labour transference. Mr. H. C. Emmerson, assistant secretary to the Ministry of Labour, who opened the discussion in place of Mr. Humbert Wolfe, described the work which the Ministry of Labour has been carrying out since 1928 to assist the unemployed. Men and women from the depressed areas are given the first opportunity of vacancies in other areas and are assisted if necessary by free travel, special allowances and a lodging allowance. In 1936, no fewer than 20,000 men and 8,000 women were placed through the exchanges. A juvenile employment scheme was started in 1928, and Mr. Emmerson also described a household removal scheme by which a man is assisted to take his family to the place of his new employment, and a family removal scheme which sends members of one family to work in one place. 10,000 removals have taken place under the two schemes.

The Ministry of Labour's present policy is largely directed to the movement of workers to specific vacancies, and this was severely criticized by Mr. S. R. Dennison, of the University of Manchester, who argued that in spite of the success achieved the basic policy is sometimes wrong. Employers expect a higher standard of work from men supplied by the exchanges than from those recruited directly. Mr. Dennison believes that transference should be accelerated not during boom years but when there is a slump, and urged that the Ministry should be filling 80 per cent of the vacancies instead of the present 25 per cent. In Lancashire, the existence of a family income is a strong deterrent, and Mr. Dennison also considers that with the present policy a depressed area is left heavily weighted with unemployed in the lower and higher age groups, and in consequence with more dependants, a falling income and increased depression. In that direction complete evacuation is the only logical policy.

The social consequences of industrial transference were discussed in a paper by Mr. A. D. K. Owen. For communities from which transference has taken place on an appreciable scale, the most obvious consequence is either a diminution in population growth or an actual fall in population. Up to the present, the high rate of natural increase (due to relatively low death-rate and high birth-rate) in the areas from which most transference has taken place has compensated to some extent for the loss of population by migration. More important, however, are the modifications in the age-structure of the population resulting from migration. Industrial transferees are mostly young people; there has in consequence been a marked ageing of the population in the depressed areas, and this tendency will increase in the next few years. Moreover, as the transference is voluntary, it acts as a selective process which tends to lower the average quality of the population left behind. With some important exceptions, it is the more active and adventurous elements in the community which tend to migrate. The immediate effect

of transference is to reduce unemployment in the depressed areas from which it takes place, but the ultimate effect may well be different, especially if skilled or potentially skilled workers are transferred. Denudation of skilled workers or of the most promising young workers may actually increase unemployment by impeding the development of new industries and in time depressing existing industries still further. The development of new industries in the depressed areas has already involved the return of some skilled transferees.

Where transference has resulted in an appreciable fall in population, it has considerably eased the problem of overcrowding as well as reduced the pressure on local social services, but there are losses in institutional life as well as in rate income. For communities to which transference has taken place there is a valuable gain in population, which provides a basis for industrial expansion but also raises many difficult problems for local government authorities in the expanding areas. Overcrowding is very serious, as well as transport problems and the provision of a sufficient number of new schools. In spite of difficulties of assimilation and social friction, the introduction of large numbers of new workers and their families into fresh areas is socially invigorating, and the redistribution of the labour supply in relation to economic opportunities represents a considerable economic gain. On the other hand, there is some reason to believe that subsidized transference is artificially distorting the industrial structure of the country. For the community as a whole the greatest gain from industrial transference has been the salvaging of young workers from the deteriorating effect of long-continued unemployment, and this must be set against the waste of social capital in the areas from which transference takes place and the devitalization of provincial or even national culture. Mr. Owen considered industrial transference should continue along different lines related to a broad plan of national development which takes account of both economic and social factors.

Dr. O. A. Oesser, in a paper on psychological and sociological aspects of labour transference, first reviewed the problems involved in relation to the condition of the material available for transfer. Highly skilled workers are more easily transferred, provided jobs are available for which their training is adequate, not only because transfer from a more skilled to a less skilled job is easier than the reverse, but also because of their frequent tradition of emigration and their higher intelligence level, wider knowledge, training and flexibility. The type of educational system may also be a factor. The social and economic conditions of the areas between which transfer is to be made must next be considered. People can be moved from areas of lower to areas of higher standards of living, but local patriotism and reluctance to move may be obstacles, as well as traditions and a subjective social status of occupation. Finally, Dr. Oesser suggested that the condition and state of industries in the area must be considered in relation to those of Great Britain as a whole, and he used the jute industry as an example to illustrate the growth of new social patterns among the unemployed and the mobility of labour between occupations.

International Society of Leather Trades' Chemists

CONFERENCE AT COPENHAGEN

THE biennial conference of the International Society of Leather Trades' Chemists took place at Copenhagen on August 29-September 2, the meetings being held in the Technological Institute there. The president for the years 1938-39 is Mr. W. R. Atkin (England). It was announced that the Procter Memorial Research Fellowship Fund had reached a total of £3,400, and it was hoped to appoint the first research scholar in October 1938. It was also decided to institute a Procter Memorial Lecture to be delivered at all future conferences, and the first will be delivered in London in 1939. Dr. E. Scheil (France) was made an honorary member of the Society.

Several combined sessions were held with the German Internationalen Vereins der Leder Industrie Chemiker, before which many interesting communications were made.

Dr. K. Linderstrom-Lang gave the opening lecture on the constitution of proteins as elucidated by enzyme studies. Dr. Dorothy Jordan Lloyd followed with a paper on the swelling of structured proteins with special reference to the influence of the reticular tissue on the swelling of collagen in alkaline solutions.

Mr. W. R. Atkin discussed the titration curves of gelatin and collagen, pointing out that, by the application of the Procter-Wilson theory to the titration curve of gelatin, it was possible to construct a replica of the swelling curve of gelatin in hydrochloric acid. It was also demonstrated that the second isoelectric point of gelatin postulated by Wilson could not exist. Dr. F. Schneider gave a paper on the hide proteins, emphasizing that various hide proteins could be distinguished by determining their sugar and amino-

acid contents. Dr. F. Stather dealt with the technical problems of fat-liquoring and stuffing of leathers, while several aspects of the chemical testing of vegetable tanned leather were dealt with by Dr. V. Kubelka.

Mr. G. Parsy discussed the pH values of sulphonated oils, and a new electrode for pH determinations was demonstrated by J. Hangaard. Dr. D. Burton described a method for determining the amount of neutralizing agent required by a chrome leather, and Dr. K. H. Gustavson discussed the concept of the chrome-collagen compound as an internal complex salt. The tanning effect of polytungstic acid was described by Dr. C. Riess, and Dr. E. Elöd pointed out in his paper the use of polyvinyl alcohol as a substitute for proteins in tanning research experiments. Dr. G. Otto compared the titration curves of synthetic tannins with those of natural tannins, and Dr. W. Grassmann described a nephelometric micro-method for the identification and estimation of tannins.

Mr. A. Dohogne discussed the relative water permeabilities of sole leathers tanned by slow and rapid methods, and Dr. A. Miekerey described some work on the combination of lignin sulphonie acids with hide substance. The fractional extraction of pine bark was the subject of a paper by Dr. V. Nemes, while Dr. L. Pollak explained methods for the chemical control of hide soak liquors.

During the official banquet which followed the conference, Dr. E. Stiasny was presented with the first copy of a special "Festschrift" volume published to commemorate his sixty-fifth birthday, to which contributions have been made by well-known leather chemists throughout the world.

Metallurgy and the Aero Engine

THE sixteenth Autumn Lecture of the Institute of Metals was delivered by Dr. D. R. Pye, director of scientific research to the Air Ministry, on "Metallurgy and the Aero Engine", at the Sheffield meeting on September 6.

During recent years, there has been a remarkable increase in the power output from aero engines. A comparison of two engines of the same general type and cylinder capacity shows an increase in the last seven years of more than a hundred per cent. This increase has been achieved by improvements in the quality of the fuel, which allows the combustible mixture to be supplied by a supercharger at a higher pressure and temperature. A parallel improvement in the materials of construction to meet the severe conditions of temperature and mechanical loading has taken place, and there is scarcely one major component of the two engines of which either the material or its treatment has not been modified. The problems so far as they concern the metallurgist are both thermal and mechanical. It is fundamentally impossible greatly to increase the proportion of the heat generated which is turned into mechanical work.

The marked increase of power has, therefore, involved a corresponding increase in the waste heat which is to be removed. The piston, which must be receiving about forty per cent more heat, is a critical factor and the temperature attained on the piston is, from examination of the recrystallization of aluminium alloy pistons after use, of the order of 450° C.

The discovery of a new material of about the same specific gravity and thermal conductivity, but better able to maintain its strength at temperatures of 300° C. and above, would be one of major importance.

The increase of waste heat, combined with the chemical problems introduced by the use of lead tetra-ethyl in the fuel, has profoundly affected the metallurgy of the exhaust valve. In spite of great improvements in the steel, it is now necessary not only to transfer heat away from the valve head by means of hollow valves containing liquid, but also to coat the valve with special alloys to resist oxidation at the high temperatures involved. Improvements of sparking plugs involve interesting problems in which the engineer needs the help of the physicist.

On the mechanical side, the chief metallurgical problem of the aero engine is that of maintaining two surfaces rubbing together at high temperatures without seizure. This is essentially a problem of lubrication, but as the temperatures of the working surfaces increase, the viscosity of the oil gives less and less protection, and the nature of the metal surfaces themselves will play a more important part.

Working surfaces are never flat when considered in terms of molecular dimensions, and it becomes, therefore, of great importance to examine the possibility of the treatment of the surfaces in such a way as to render them less liable to seizure. The line taken by the engineer at present is to use one of the recognized methods of producing a hardened surface, but much further knowledge in this direction is still required. Beilby showed thirty-five years ago that during the polishing process the normal structure of metal is destroyed and the surface becomes amorphous. This conclusion has been confirmed by the recent work of Finch and Bowden. It has been shown that during the 'running-in' process a very thick Beilby layer of amorphous material is produced on the surface of a steel cylinder. Apart from the fact that observations have shown that a metal in the amorphous condition is harder and tougher than the crystalline variety, it is, in Dr. Pye's opinion, reasonable to suppose that an amorphous surface could be more easily protected from seizure by a thin oil film than could one of a crystalline character.

Such problems can only be successfully surmounted by the engineer with the advice of the physicist, and they are bound to assume a steadily greater importance where rubbing surfaces have to survive without seizure under high temperature conditions.

Science News a Century Ago

Faraday and Schönbein

ON September 21, 1837, Faraday wrote to Schönbein, from the Royal Institution, "Your very pleasant and acceptable letter of the 9th of July with the accompanying books I received only last week, while at Liverpool, at the very meeting you refer to and I heartily wish that you had been there yourself. It is now five years since I have been able to attend any of these meetings but I was very pleased with the one to which I now refer. . . . As the Association forms no collection of books or apparatus I gave the said copy of your work to Professor Henry of Philadelphia in the United States with a view of extending what you have done as far and as fast as possible and wherever the English language is found. He was exceedingly obliged to me for it and I only wish that you and he had met at Liverpool. . . ."

"With regard to Mr. Croese's insects, etc., I do not think anybody believes in them here except perhaps himself and the mass of wonder-lovers.—I was said in the English papers to have proved the truth of his statement, but I immediately contradicted the matter publicly. . . . It is but just of me to say that in conversation with Mr. Croese I was very much pleased with him and with the readiness with which he received my critical remarks. As regards the crystallization supposed as real, he was lugged into view and must not be charged with having pressed himself forward. He is in fact a very modest man but has been dragged into an unkind situation. . . ."

David Uwins (1780–1837)

DR. DAVID UWINS, one of the first English converts to homœopathy, was born in London in 1780, the son of Thomas Uwins, a clerk in the Bank of England and brother of Thomas Uwins, the artist. He received his medical training in London and then went to Edinburgh, where he graduated M.D. in 1803. He then returned to London, where he was made L.R.C.P. in 1807. In 1815 he was appointed physician to the City Dispensary and afterwards to the Finsbury and Central Dispensary. In 1828 he became physician to the lunatic asylum at Peckham, and as the result of his experience in that institution published in 1833 "A Treatise on those Disorders of the Brain and Nervous System called Mental". In later life, owing to the influence of his friend Frederick Hervey Quin, he took up homœopathy, and in 1836 announced his conversion to that doctrine in a pamphlet entitled "Homœopathy and Allopathy, or Large, Small and Atomic Doses". As the result of this step he quarrelled with his former friends and his health broke down owing to the stress of controversy. He died in London on September 22, 1837, and was buried in Kensal Green Cemetery.

Uwins was a prolific writer. In addition to the works already mentioned his chief publications were "Modern Medicine, containing a Brief Exposition of the Principal Discoveries and Doctrines" (1808), "A Compendium of Theoretical and Practical Medicine" (1825) and "A Treatise on those Diseases which are either directly or indirectly connected with Indigestion, and on the Principal Ailments of Children" (1827). He also contributed medical articles to Gregory's "Encyclopædia" and the *Quarterly Review*, and was for some time editor of the *Medical Repository*.

Lyell to Leonard Horner

LYELL had spent the months June to September 1837 on the Continent and thus had not been able to attend the British Association meeting at Liverpool. Just before he returned home he wrote on September 23 from Paris to Leonard Horner (1785–1864), the geologist, "I am glad to receive your report of the meeting at Liverpool, and to hear the Association was so well supported. I must try to be at the next. I saw a very blundering account of my letter in the 'Athenæum'. I am anxious that when printed by the Association, it should be given as I sent it, and this principally because I have carefully avoided bringing prominently forward any collision with Von Buch, whom I like too well not to be sorry that he should fancy, as he has done before now, that I am always seeking to run against him. I only mentioned him as having been the first to announce the posteriority of the granite to the transition beds, which was a grand step at that time, and true; though perhaps he did not come at it by a strictly logical course. I knew how he drew his inferences, which were quite natural twenty-six years ago, before he had adopted the true theory of granite, but had I brought forward his errors, I should also have dwelt on his praises. Chancellor Brougham said of Serjeant Wilde, that it was rather hard to visit on the barrister the sins which he committed in the flesh as an attorney, and I should also think it hard to show up the mistakes which Von Buch the Huttonian fell into, in the youthful days of his Wernerianism."

Societies and Academies

Paris

Academy of Sciences, July 12 (*C.R.*, 205, 97-184).

ANTON E. MAYER: Groups of curves of three lines.

MME. CHRISTIANE PAUC: Further study of a group of infinitesimal transformations.

JACOB: Determination of the jump of a function by development in a Hermitian series.

CHI-TAI CHUANG: The behaviour of a holomorphic function and of its derivatives in a circle.

PIERRE CHEVENEARD and EUGÈNE JOUMER: A mechanical magnifier with enlargement of more than 1,000. Application to recording the viscous deformation of metals at high temperatures.

MAX SERRUYS: Supplements to the nuclear inflammation theory of knocking in petrol motors.

F. J. BOURELIER: The auto-oscillations of real jets in identical media by autofolds.

ALBERT MILHOUD: Concerning the inflammation of dirigible balloons. Discussion of the conditions producing an electric spark when the valve is opened to allow the hydrogen to escape.

ROGER MÉRIGOUX: The influence of a thin layer of oil on the motion of waves.

MARCEL PAUTENBERG, MOSHÉ FELDENEKRAIS and LÉOPOLD VIGNERON: The absolute standardization of an apparatus for the measurement of very high voltages: the electrostatic valve. The indications of the rotating voltmeter standardized up to 50 kilovolts are in agreement with the results given by the electrostatic valve method, up to about 400 kilovolts.

THADÉUSZ PRZYSŁSKI: The production by electrolysis of coloured rings in the mass of a salt.

HENRI LACOSTE-TAYAN: Cycles of recoil in magnet steels.

SERGE NIKITINE: The dichroism of flow in solutions of fluoresceine.

LOUIS CARTAN: The focalization of corpuscular bundles by circular deviation in a transverse magnetic field.

MAURICE COTTE: The Gauss approximation for the general systems of electronic optics.

RAYMOND ROURE, LOUIS QUEVRON and RENÉ GENES: A photo-electric comparator. The instrument reduces the measurement of a variation of length to the measurement of a variation of current. A displacement of 1 micron produces a change of 0.4 milliamperes.

RENÉ AUDUBERT: The ultra-violet emission spectrum of the slow thermal dissociation of silver nitride. The slow decomposition of silver nitride by heat is accompanied by the emission of light, corresponding to three narrow bands between 1950 Å. and 2600 Å.

EMILE RINCK: The diagram of solidification and electrical conductivity of the rubidium-caesium alloys. These two metals form a continuous series of solid solutions, with a minimum solidification point at 9° C. The conductivity measurements proved that no definite compound of caesium and rubidium is formed. These results are not in agreement with the earlier work of Gorla on the same subject.

MAURICE DODÉ: The reversible action of iodine vapour on dry potassium nitrite. The influence of the miscibility of this salt with the corresponding nitrate.

CLÉMENT COURTÉ: The diamagnetism of solutions of iodine and the purity of the alcohol. The law of additivity of coefficients of magnetization applies to a solution of iodine in alcohol only if the latter is pure, and such measurements can be used for detecting the presence of impurities in alcohol.

ANDRÉ DEBIÈRE: A new mode of transformation. When hydrogen is brought into contact with purified carbon at the temperature of liquid nitrogen a large amount of heat is set free, higher than the heat of combustion of the hydrogen with oxygen. Helium shows a heat evolution of the same order of magnitude under the same conditions, but with other gases (oxygen, nitrogen, argon) the effect is small. The source of this heat energy is unknown.

MARCO TIFFENHAU, PAUL WHITE and BIANCA TOHOUBAR: The order of addition of the hydrides to the epoxides and of the hypohalogen acids to the ethylene derivatives, methylene cyclohexane and methylcyclohexene, as well as their epoxides.

RAYMOND QUELET and MARCEL PATY: New methods of preparation of 5-bromo-2-methoxybenzyl alcohol and of 5-bromo-2-methoxybenzaldehyde.

ANDRÉ MEYER and HENRI DEUTEL: The 2,6- and 2,8-dimethyl-4-chloroquinolines. General properties. The reactions with amines.

HENRY GAULT and MATIAS COGAN: Ethylol-formylglutamic ester.

ALEXIS TCHITCHIBABINE and CHARLES HOFFMANN: A new (2,3,6) triaminopyridine.

LOUIS MARTINHAU and CHARLES PRÉVOST: The catalytic dehydrogenation of a tertiary alcohol into a ketone.

LUCIEN DAUTERBANDE, EDMOND DUMOULIN and PIERRE ANGNOT: Study of anti-aerosol esparto pulp filters. The perforation of anti-aerosol filters by the ageing test with steam.

PIERRE LEGOUX: The magnesian series of supracrustal rocks of the west Ivory Coast.

JULIEN DURAND: The structure of the crystalline region of Rouergue and of Albigeois.

PIERRE BERNARD: The relation between the swell on the coast of Morocco and the microseismic agitation in western Europe.

EDMOND ROTHÉ and TH. KOPONWICZ: The comparison of the radioactivity of Alsatian rocks by the method of (Geiger-Müller) counters.

ALBERT BALDIT: The influence of the terrestrial relief on the vertical movements of the air at Bannet-d'Ordanche (Massif of Mont-Dore). Studies of air velocities made in connexion with a school for gliding.

RENÉ SOULES: The embryogeny of the Violaceae. The development of the embryo in *Viola tricolor*.

LUCIEN LEBOUX: The presence of allantoinic acid in the leaves of *Corylus avellana*.

VINCENT, HERVIAUX and COIC: The measurement of the lime capacity of soils, and the liming of acid soils.

JEAN JACQUES BOURHIOL: Premature metamorphosis by the ablation of the *corpora allata* in the young silkworm.

JULES ALQUIER and MME. ANDRÉE MICHAUX: Study of the calcium-phosphorus ratio in various tissues especially in the femurs of the growing rabbit.

JEAN LAVOLLAY and MME. FRANÇOISE LABORY: The action of ascorbic acid (vitamin C) on the pigmentation of the mycelium of *Aspergillus niger* in the presence of magnesium in excess, and on the development of this mould.

RODOLPHE L. MAYER and CHARLES ORCHSLIN: Antistreptococci. Extract from a sealed letter on the activity and toxicity of certain derivatives of benzene sulphamide.

EMILE ROUBAUD, JACQUES COLAS-BELOOUR and GEORGES JEAN STEFANOPOULO: The transmission of yellow fever by a palaeartetic mosquito common in the Paris region.

Moscow

Academy of Sciences (C.R., 15, No. 4, 1937).

V. S. IGNATOVSKIY: The Laplacean transformation (7).

G. V. PREIFFER: Possibility of joining to a complete system of non-linear equations a linear equation or a system of linear equations.

B. LEWITAN: A generalization of inequalities of S. Bernstein and H. Bohr.

G. N. NEUMIN: The elements of the orbit of Comet 'Neujmin II' as computed from the connexion between its appearance in 1916 and 1927.

B. J. SYVINSKOV: Dependence of the rate of photo-chemical reactions in solution on the concentration of reagents.

V. SUKACHEV and S. DOLGAJA: Fossil remains of plants in loess and loess-like clays in connexion with the problem of origin of these deposits.

K. A. VLASOV: The theory of desilification of granitic pegmatites.

E. S. BUKSEER, N. P. KAPUSTIN and V. V. KONDOGUBY: Helium, radium and thorium in beryllium minerals of the U.S.S.R.

D. MICHLIN and P. KOLMENIKOV: Influence of colloids and of electrolytes on the state of equilibrium in maltose.

D. J. VAKOLIN: Some data on the yield of essential oil by a new variety of dragonhead (*Dracocephalum moldavica* L. var. *hexagonum* D. Vakulin) from different seed samples.

E. M. SEMPIL'VA: Morphology of the chromosomes of some species of potato.

B. S. MOŠKOV: Photo-periodism and a hypothesis as to flowering hormones.

M. CH. ČAJLAČAN and L. M. YARKUVAYA: New facts in support of the hormonal theory of plain development (2).

A. R. VERNER and V. F. ALTNRGOT: The phenomenon of mycophagy.

Sydney

Royal Society of New South Wales, July 7.

ADOLPH BOLLIGER: Red compounds formed by picric acid and creatinine in the presence of sodium hydroxide. Four compounds have been isolated. They are characterized by a varying sodium or sodium hydroxide content. Compound I, which is obtained *inter alia* by the addition of one molecule of sodium hydroxide to a mixture of one molecule of creatinine sodium hydroxide and one molecule of picric acid, consists of one molecule of creatinine, one of picric acid and two of sodium hydroxide. Compounds II, III and IV, obtained after the addition of larger amounts of sodium hydroxide, contain two and a half, three and three and a half molecules of sodium hydroxide for each molecule of creatinine picrate. Compound IV represents the maximum degree of saturation with sodium hydroxide and has been considered as the most likely cause of Jeffe's reaction.

Vienna

Academy of Sciences, June 24

E. STEINACH and H. KUN: Conversion of the male sex hormone into a substance with the properties of the female sex hormone. Studies with young and old men. Injection of male sex hormone produces in the urine a substance with oestrogenic properties.

J. SCHINTELMISTEER: Redetermination of the range of α -particles from thorium. The variation of the ionization along the range of the α -particles from a thorium source of exceptional purity has been studied, and the extrapolated and mean ranges in air at 0° C. and 760 mm. pressure have been determined as 2.59 cm. and 2.56 cm. respectively.

R. WEISS: 4', 4''-dihydroxy-3', 5', 3'', 5''-tetrabromonaphthalene-2, 3-dicarboxylic acid anhydride.

O. REDLICH, T. KURZ and W. STRICKS: Spectrum of scattered light of some inorganic compounds.

BELLA BAUMINGER and F. LIEBEN: The sugar-formic acid combination in the oxygen current.

Washington, D.C.

National Academy of Sciences (Proc., 23, 295-349, June 15).

D. L. FOX: Carotenoids and other lipid-soluble pigments in the sea and in deep marine mud. Material filtered from sea water, including microplankton, faecal matter and other organic detritus, and also marine muds from 1,000 fathoms were found by chromatographic analysis to contain carotenoids, assuring a supply of these compounds even to deep-sea animal organisms.

H. D. BARCOCK: Internuclear distance in oxygen molecules. New determination based on measurements of twelve absorption bands of atmospheric oxygen.

J. M. BEAL: Bud development in *Lilium Harrisii* following treatment with indoleacetic acid. In another species, treatment with this substance in lanoline of a stem from which the terminal bud had been removed produced protuberances found to be adventitious roots; in *L. Harrisii* buds appeared in the axils of the upper two or three leaves. These buds closely resemble bulbils (vegetative reproductive organs) normally found near the base of the stem.

S. WRIGHT: The distribution of gene frequencies in populations. A mathematical discussion.

H. FRICKEN and M. DEMEREC: The influence of wave-length on genetic effects of X-rays. Wave-lengths of 0.94 Å. and 2.2 Å. were used. *Drosophila melanogaster* males were treated individually in a chamber in which their abdomens were compressed to a thickness of about 0.15 mm. in order to reduce absorption of this soft radiation. The frequency of lethals per unit dose is found to be the same for both wave-lengths, suggesting that the genetic changes are not due to direct activations within a gene but are probably of the nature of sensitized reactions induced by neighbouring activated molecules.

M. E. REISSNER: Theory of beams resting on a yielding foundation. A mathematical discussion, from which it is claimed that, provided the deflection of the surface of the foundation due to a concentrated loading is known, then the problem of buckling of a beam of infinite length, resting on a yielding foundation and on an infinity of equidistant supports, can be solved completely.

G. A. MILLER: Groups having a maximum number of independent generators.

E. KASNER: Trihornometry: a new chapter of conformal geometry. A trihorn is defined as an ordered triplet of curves which pass through a common point in a common direction. Various relationships between the conformal invariants of this configuration are derived, including the analogues of the laws of sines and cosines of ordinary trigonometry.

J. v. NEUMANN: Continuous rings and their arithmetics.

Forthcoming Events

INSTITUTE OF SOCIOLOGY, September 24-26.—Conference on "Social Stratification and Class Conflict" to be held at King's College of Household and Social Science, Campden Hill Road, W.8.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 24-27.—Annual Conference to be held at Gonville and Caius, Cambridge.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

LABORATORY ATTENDANT in the Science Department, South-East Essex Technical College, Dagenham—Clerk to the Governors (September 25).

LECTURER IN BIOLOGY in the Kingston-upon-Thames Technical College—The Principal (September 25).

HEADMASTER of the Bagdad Technical School—The Secretary (I.P.R./O.A.), Board of Education, Whitehall, S.W.1 (September 30).

TWO INSPECTORS FOR THE DEPARTMENT OF AGRICULTURE FOR SCOTLAND—Secretary (Establishment Branch), Department of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh 2 (September 30).

ASSISTANT EXECUTIVE ENGINEER in the Public Works Department (Irrigation Branch) of the Government of the Punjab—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 1).

ASSISTANT LECTURER IN MUNICIPAL ENGINEERING in the Manchester Municipal College of Technology—Registrar (October 4).

CHIEF LECTURER IN HISTORICAL ENGINEERING in the West Ham Municipal Technical College—The Principal (October 9).

ENGINEER SUB-LIEUTENANT in the Royal Indian Navy—Secretary, Military Department, India Office, London, S.W.1, marked "Engineer Recruitment" (October 18).

ASSISTANT LECTURER IN MATHEMATICS in the University of Manchester—Registrar.

ENGINEER in the Public Works Department of the Government of Sarawak—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M. 5419).

LECTURER IN PHYSICS in the University of Reading—The Registrar.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 57: Mechanical Properties of some White-Bearing Metals and other Tin-Base Alloys at various Temperatures. By Dr. O. B. Homer and H. Plummer. Pp. 20+4 plates. Free. Series A, No. 58: The Tensile Properties of a Series of White-Metal Bearing Alloys at Elevated Temperatures. By H. Greenwood. Pp. 9. Free. (London: International Tin Research and Development Council.) [258]

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 22nd July 1937. Pp. 29. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [268]

Norman Lockyer Observatory. Director's Annual Report, April 1, 1936-March 31, 1937. Pp. 6. Council's Report and Accounts and List of Council, Staff, Members, etc., June 1937. Pp. 12. (Bristol: Norman Lockyer Observatory.) [268]

Readers' Guide to Books on Electrical Engineering. Pp. hi+16. (London: Library Association.) [268]

London Shellac Research Bureau. Technical Paper No. 11: Viscosity of Lac and Hard Lac Resin Solutions. By Dr. Lal C. Verma. Pp. 20. Technical Paper No. 12: Modification of Lac with Higher Fatty Acids and their Mixed Glycerol Esters, Part I. By Dr. R. Bhattacharya. Pp. 16. (London: London Shellac Research Bureau.) [268]

Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on the Plant of the National Coke and Oil Company, Ltd., at Brith, Kent; Tests carried out 26th January to 9th February 1937. Pp. vi+54+2 plates. (London: H.M. Stationery Office.) 1s. net. [29]

Proceedings of the Royal Irish Academy. Vol. 43, Section B, No. 5: Turbellaria of Ireland. By Bowland Southern. Pp. 43-72. 1s. Vol. 43, Section B, No. 11: River Liffey Survey—The Ostronomid Fauna of the Submerged Mosses. By Carmel F. Humphries and Winifred H. Frost. Pp. 161-181. 1s. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [29]

St. John Cass Technical Institute. Calendar, Session 1937-1938. Pp. 141+3 plates. (London: Cass Technical Institute.) [29]

The Prediction and Reduction of Occultations. (Supplement to the Nautical Almanac for 1938.) Pp. v+46. (London: H.M. Stationery Office.) 2s. net. [29]

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 7, No. 1, March 1935. Compiled by Agnes Elizabeth Glemie, assisted by Gwen Davies. Pp. xii+371. (London: H.M. Stationery Office.) 5s. net. [29]

Other Countries

Bermoe P. Bishop Museum. Occasional Papers. Vol. 13, No. 1: A New Species of *Ocicide* from the Solomon Islands (Coleoptera, Cimicididae). By Walther Horn. Pp. 4. Vol. 13, No. 2: Observations on the Teratology of the Genus *Peperomia*. By T. G. Yuncker. Pp. 5-10. Vol. 13, No. 3: Check List of the *Cicadidae* (Coleoptera) of Oceania. By J. B. Corporaal. Pp. 11-28. Vol. 13, No. 4: Nyctaglinidae of South-eastern Polynesia and other Pacific Islands. By Anton Helmerl. Pp. 27-48. Vol. 13, No. 5: Check List of Neuroptera Planipennis of Oceania. By P. Breen-Petersen. Pp. 49-60. Vol. 13, No. 6: Check List of the *Coccidiomyidae* of Oceania. By Dr. H. F. Barnes. Pp. 61-66. Vol. 13, No. 7: On Lea's *Filix Derodontus* (Coleoptera, Curculionidae). By Elwood O. Zimmerman. Pp. 67-74. Vol. 13, No. 8: A New Species of Hawaiian *Brachymeria*. By Leo D. Whitney. Pp. 75-76. Vol. 13, No. 9: A New Species of *Garniola* from Karotonga. By Leo D. Whitney. Pp. 77-78. Vol. 13, No. 11: Rhynchosomus of the Mangrove Expedition. By Edwin O. Van Dyke. Pp. 89-130. Vol. 13, No. 12: Quantitative Studies of *Copepoda* in Hawaii with Brier Surveys in Fiji and Tahiti. By C. H. Edmondson. Pp. 131-146. Vol. 13, No. 13: Check List of the Palpiforms of Oceania (Coleoptera, Polyphaga). By Armand d'Orchymont. Pp. 147-160. Vol. 13, No. 14: Three Additional Species of *Peperomia* in Hawaii. By T. G. Yuncker. Pp. 161-166 (Honolulu: Bermoe P. Bishop Museum.) [268]

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 17, 1935. Pp. 112. (Rochester, N.Y.: Eastman Kodak Co.) [268]

Annuario della Pontificia Accademia della Scienze 1. 1935-1937. Pp. lxxix+809+38+87 plates. (Città del Vaticano: Pontificia Accademia delle Scienze.) [268]

U.S. Department of the Interior: Geological Survey. Bulletin 874-B: Geology and Fuel Resources of the Southern Part of the Oklahoma Coal Field. Part 2. The Lehigh District, Coal, Atoka and Pittsburg Counties. By M. M. Knechtel. Pp. iv+91-149+plate 11. 20 cents. Bulletin 876: Coal Deposits of Pike County, Kentucky. By Charles B. Hunt, Guy H. Briggs, Jr., Arthur O. Munyan and George R. Wesley. Pp. v+92+50 plates. 2.25 dollars. Bulletin 882: Spirit Leveling in Massachusetts, 1932-25. Pp. 156. 15 cents. Professional Paper 180-K: The Stratigraphy of the Upper Cretaceous Rocks north of the Arkansas River in Eastern Colorado. By C. H. Dana, W. G. Pierce and J. B. Reeside, Jr. (Shorter Contributions to General Geology, 1936). Pp. ii+207-232+plates 64-65. 10 cents. Water-Supply Paper 776: Geology and Ground-Water Resources of Duval County, Texas. By Albert Nelson Sayre. Pp. vi+116+8 plates. 25 cents. Water-Supply Paper 788: Surface Water Supply of the United States, 1935. Part 8: Western Gulf of Mexico Basins. Pp. 197. 25 cents. Water-Supply Paper 790: Surface Water Supply of the United States, 1935. Part 10: The Great Basin. Pp. 94. 20 cents. (Washington, D.C.: Government Printing Office.) [29]

Indian Lac Research Institute. Some Analytical Data for Shellac. Pp. 10. Some Information and Advice to Shellac Manufacturers. Pp. 3. Bulletin No. 26: Estimation of Orpiment in Shellac. By M. Rangaswami and H. K. Sen. Pp. 8. 2 annas. (Namkum: Indian Lac Research Institute.) [29]

Kungl. Svenska Vetenskapsakademien Handlingar. Serien 3, Band 16, No. 4: On the Devonian *Ooecanthids* of Germany, with Special Reference to the Dermal Skeleton. By Erik Aron Stenroos. Pp. 56+12 plates. (Stockholm: Almqvist and Wiksells Boktryckeri.) [29]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 169: Manurial Requirements of Sugar Cane in Egypt. 1: Optimum Rate of Nitrogen Experiments. By Arthur H. Rosenfeld. Pp. ii+23+6 plates. P.T. 4. Bulletin No. 181: Water-Table Effects 3: Further Studies on Relative Incidence of Diseases on Stone-fruit Trees. By Dr. Amm Filary. Pp. ii+13+13 plates. P.T. 3. Bulletin No. 187: A Multiple Picking Experiment—The Improvement of Grade. By Dr. W. Lawrence Bails and H. A. Hancock. Pp. 11+5 plates. P.T. 2. Bulletin No. 188: Strength, Grade and Price of Egyptian Cottons. By H. A. Hancock. Pp. 12+5 plates. P.T. 2. (Cairo: Government Press.) [29]

Trinidad and Tobago: Forest Department. Administration Report of the Conservator of Forests for the Year 1936. Pp. 20. (Trinidad: Government Printer.) 2s. 6d. [29]

Southern Rhodesia: Geological Survey. Bulletin No. 31: The Geology of the Country around Hunters Road, Gwelo District. By A. M. Macgregor. Pp. iv+78+8 plates. (Salisbury: Government Stationery Office.) 2s. 3d. [29]

Société de Biogéographie. Contribution à l'étude des Réserves naturelles et des Parcs nationaux. Pp. 181-210+plates 32-38. (Paris: Paul Lechevalier.) [29]

Dominion of Canada. Nineteenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement, 1935-1936. Pp. 166. (Ottawa: National Research Council.) [29]

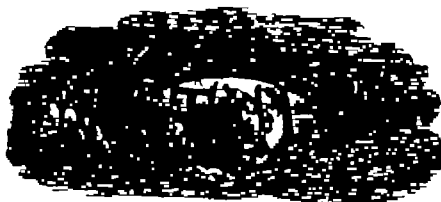
Memoirs of the India Meteorological Department. Vol. 26, Part 7: Latent Instability in the Atmosphere revealed by some Indian Tephigrams. By V. V. Soboni and Miss M. M. Paranjpe. Pp. 131-149+10 plates. (Delhi: Manager of Publications.) 1.8 rupees; 2s. 6d. [29]

Bergens Museums Arkiv, 1936. Hefte 2, Naturvidenskabelig rekke. Pp. 88+11+17+5+15. Bergens Museum. Årberetning, 1935-36. Pp. 106. (Bergen: A/B John Griegs Boktrykkeri.) [29]

Indian Forest Records (New Series). Vol. 1, No. 1: Indian Termites of the Section Pentapleura. By O. B. Parkinson. Pp. iii+47+3 plates. 12 annas; 1s. 3d. Vol. 1, No. 2: Illustrations of Indian Forest Plants. Part 4: *Hopsea beiferi* (Dyer) Brandis, *Hopsea oblongifolia* Dyer, *Shorea floribunda* Wall, *Shorea asamica* Dyer, and *Shorea seneciifolia* Fischer and Hutchinson. By C. B. Parkinson. Pp. h+20-45+5 plates. 1.4 rupees. 2s. Vol. 2, No. 5: Seed Weight, Plant Perennia, etc., for Forest Plants in India. By J. N. Sen Gupta. Pp. iii+176-221. 3 rupees, 5s. 2d. (Delhi: Manager of Publications.) [29]

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The Organization of Social Research

EVERY year the social services of Great Britain tend to attract increased attention and generally to demand increased expenditure of public money. This may be all to the good ; but from time to time it is desirable to attempt to survey the situation and to consider whether in practice these services are being adequately directed by controlled and informed social research. In a field of this kind, where the boundaries are extremely wide and the claims in every direction are most insistent, constant and wise research is particularly necessary if undue waste is to be avoided and if merely sectional interests are to be held in reasonable control.

As things are at present, our problems of public health have been placed upon a sound foundation, mainly through the organization and activities of the Ministry of Health and later of the Medical Research Council. Research in agriculture is now being similarly promoted by the more recently established Agricultural Research Council. The National Physical Laboratory and the Department of Scientific and Industrial Research, likewise subsidized by the State, have brilliantly developed the contributions which can be made by physics and chemistry to a great variety of industrial and even social problems. The Industrial Health Research Board, with far more slender resources and with a less independent status, has made valuable contributions to some of the problems of industrial life. So far as national organization goes, that is all. Other problems—economic, educational, biological, psychological, sociological—are left to advisory or to consultative committees, which can receive 'evidence' and issue reports (but do little else), or to private enterprise and sporadic effort.

It is high time to alter this state of affairs—to establish a new scientific body, with adequate endowment from the State, which will do for human social research what the Medical Research Council does for public health, what the Agricultural Research Council is beginning to do for agriculture, and what the Department of Scientific and Industrial Research does for the applications of physics and chemistry. Such a body must be nationally constituted ; for most of the problems which it would be asked to study are the immediate and practical concern of existing government departments.

Everywhere, and in all directions, the most prodigious efforts are now being made to bring differently organized social groups into peaceful and lasting co-operation. But we have much yet to learn about the nature and extent of these differences ; for example, of class-differences and of class-conflicts. In industry, in education, in politics national and international, in science, and in religion, it is essential that bases of successful co-operation be found—or the world as we know it must disappear in faction, enmity and confusion.

Scientific invention and popular education have combined to bring groups widely different in language, or tradition, or custom, or aim, or, all of these, into close contact ; and every day potentialities of conflict threaten to become actual or even to break into sharp strife producing lasting irritation and lamentable waste. Many of the best minds are set to devise all manner of elaborate machinery for promoting and preserving friendly relations between groups. Yet if but a fraction of the intelligence that has been put to work upon this problem of machinery had been devoted to a study of those human conditions

which will inevitably wreck even the most wisely devised machinery, there would have been great economy and far more to show for the effort. The methods for a controlled study of the bases of group co-operation—and of consequent government by consent—are to hand. They can be made as scientific and as definite as those of the investigation of any other human problem. They require wide application, for which centrally and nationally organized effort is necessary.

It is clear that at the present day the great mass of the work of the world can be performed efficiently with a relatively slender equipment of intelligence, and—what is probably more important still—with only a small basis of acquired knowledge. This is due to the enormous advances of physical science and especially to the modern applications of engineering. The great requirement now, so far as the working-day activity of the masses goes, is for specialized skills, not for extensive knowledge. Moreover, the time during which these specialized skills must be kept continually in operation in order that the basic needs of civilization may be satisfied is all the while decreasing. We may even say, with an approximation to truth, that, apart from the institutions devoted to technical training, modern popular education is now designed mainly for leisure, not for work.

We know, however, extraordinarily little of how, if at all, the majority of workers in any section of a modern community utilize their education for their leisure, and even less about how and how wisely leisure occupations are chosen and how they affect social and workaday behaviour. There can be no doubt that the views, opinions and beliefs which influence public policy in many directions are stimulated and developed chiefly during periods of leisure. Consequently, the most stable community in modern social life appears likely to be the one in which leisure is ample and most ably employed; and as science still further advances its techniques, the truth of this will become even more obvious. It is not, therefore, surprising that serious attention is at length being given to stimulating the study of leisure and of its influence in human affairs; but this study needs adequate control and organization.

Bound up with the increasing importance of leisure is the fact that leisure has itself become possible largely as a result of a great speeding-up in the *tempo* of work and in the specialization of routine processes. There is a general impression

that these two conditions—speeding-up and increase of routine—are exerting profound influences upon human behaviour and consequently upon social policy. They may be responsible for special occupational difficulties or disorders, the study of which overlaps the field of medical research. They may give rise to a degree of dissatisfaction which inevitably results in various forms of group conflict. They may encourage individual maladjustments to an extent which has wide repercussions upon family and social life. Whether or no they do these things, in what directions, how and when, are all matters for speculation at the present time; but they could be made matters of far more certain knowledge.

The general drift of social development for many years past seems to have been for more and more of the functions which were formerly those of small groups to become the direct practical concern of larger ones. Thus the functions of the family—so often in a vague way said to be disastrously breaking down—in regard to education, health, industrial training, and many everyday regulations of behaviour, have passed largely to some wider authority constituted within the nation-group. Similarly, the functions of local religious, industrial and general administrative groups have in many instances been lost or become strictly controlled. Coincidentally, human loyalties, partly by training and propaganda, partly by natural drift, seem to have been diverted from the smaller to the larger groups, or to have changed in character as regards the smaller groups. On one hand, any more forcible and competent social group must be able to perform functions on behalf of its members better than any smaller, less organized group can do; and on the other hand, every large modern society, such as the nation-group, must necessarily contain and maintain in very great variety internal social differentiation. A study, therefore, by experimental and observational methods, of the place and functions of small groups in a large society, would have a close bearing upon many urgent problems of practical social control.

These are a few only of a large number of other general problems (for example, those of population and of crime) upon the solution of which the effectiveness and stability of present and future social organization depend. They are matters of daily debate and speculation; and in that stage they will remain, unless they are conceived, as they properly should be, as problems in higher human biology, to be attacked, not by dialectic

alone, but by experiment when possible and by controlled observation. Methods for such an attack are already being devised and applied. But they will have little chance of success, unless they can attract the attention of, and be refined and sharpened by, the best scientifically trained minds available.

Besides these general problems, there is a mass of more specialized questions which call for immediate and organized research. Much brilliant recent physiological investigation, on 'conditioning', on habituation, on adaptation, on inhibition and on the development of co-ordinated motor activity, has its most significant application to human behaviour. The last ten years have seen the study of the operation of incentives and 'drives' placed upon a much firmer basis in so far as the behaviour of animals is concerned; but virtually nothing is known, except in a speculative sense, about their conditions and mode of operation in human society. Modern civilization depends to a considerable extent upon skills of one kind and another, yet we are only at the outset of ascertaining the principles which determine how different skills can best be acquired and maintained. In region after region, throughout the British Empire, wherever native populations are being rapidly caught up in modern Western ways of life, urgent practical difficulties concerning education, administration, and the swift transformation of manners and customs arise and cannot be postponed. As things are, the administrator is forced to do his best to meet such problems *ad hoc*, and in a hurry. There are principles underlying the correct solution of them

all; but these principles demand organized research for their discovery, and hitherto the State has given no systematic support for such research.

Indeed, at the present time in Great Britain, if a government department, or any outside person or body, is brought up against some research problem underlying the administration of any branch of the social services, there is little that can be done beyond referring it to the Medical Research Council or to an advisory committee. This is scarcely fair. The Medical Research Council is usually sympathetic; but many of the problems thus proffered are remote from its terms of reference, and in any event its resources are insufficient to do much more than meet its own immediate concern with public health in the specifically medical sense of the phrase. Also, though an advisory committee can inquire into whatever research may be in progress and can collect opinions, it cannot initiate original investigations on an adequate scale.

A new, centrally constituted scientific body is urgently needed, to survey the field of social research and to set on foot considered programmes of actual investigation on higher biological lines. The questions demanding study are most of them border-line problems, at the growing points of research in different departments of science, involving organized and many-sided efforts for their solution. There is no government department that could not profit vastly from such an enterprise. Ultimately the public purse would be saved from much wasteful expenditure, and the country's social services set upon a firmer foundation of well-attested knowledge.

Exploration in Iran

Archæological Reconnaissances in North-Western India and South-Eastern Iran

Carried out and recorded with the support of Harvard University and the British Museum by Sir Aurel Stein. Antiques examined and described with the assistance of Fred H. Andrews and analysed in an Appendix by R. L. Hobson. Pp. xx + 267 + 60 plates. (London: Macmillan and Co., Ltd., 1937.) 63s. net.

AFTER forty years of research and exploration in and around Central Asia, Sir Aurel Stein found himself constrained by the intolerable character of the conditions imposed on his activities

by the Chinese Government to cease from further investigation in a field which he had regarded as the major objective of his studies. While he has every sympathy in his personal disappointment and frustration when the expedition in Inner Mongolia was abandoned, the loss to science by the diversion of his experience and knowledge to other regions is felt to be a calamity. Nevertheless, there is compensation of a kind in the fact that by an arrangement with Harvard University and the British Museum, which were his sponsors, he was able to turn to the exploration of regions of the Middle East, which were still archæologically unexplored and geographically imperfectly known.

By October 1931, Sir Aurel's arrangements for the first of his journeys in southern Iran were complete, excepting for the official permit to travel in Persia. Pending its receipt, which was delayed until the end of the year, Sir Aurel revisited the northern Punjab and the Salt Hills, where he began his career as a field archaeologist in 1889. The purpose of this interlude was to round off his studies of the invasion of India by Alexander the Great by examining the scene of the last phase of that adventure at the point where the invading forces turned back, and to determine the exact spot at which the defeat of Poros on the banks of the Hydaspes (Jhēlum) took place, a problem of which, after prolonged examination of previous theory on the ground, he concludes that a final and exact solution is improbable. In the account of his present journey in the Salt Hills, he includes the first full statement to appear, after nearly fifty years, of the detailed topographical and archaeological argument by which he identified the Jain temple mentioned by the early Chinese Buddhist traveller Hsüan-tsang, and the site of the ancient Simhapura.

Early in January 1932, Sir Aurel left India for Makrān; and a few days later he crossed the frontier from the British post at Suntsar, and began under escort his long journey through Persian Makrān and Baluchistan to Kermān, where the advancing season, too hot for further archaeological exploration, brought his first journey to a close. Re-assembling his party after he himself had spent a brief period in England, he set out from Kermān in October 1932, his purpose being to explore the coast of the Persian Gulf in search for early historic and prehistoric sites. He travelled south to Mināb at the mouth of the Persian Gulf and thence proceeded along the inhospitable coast; but before his journey as planned was completed, all further exploration was forbidden by the Persian authorities owing to tribal unrest, and his second journey came to an end at Bushire.

In the two journeys of the period 1931-33, Sir Aurel had covered two thousand four hundred miles of country, almost the whole of which was, for archaeological studies, virgin territory. Of this he had also made a topographical survey, except for an interruption of his observations for a time by the officious, and as it proved, unauthorized veto of the commander of his escort. The course of his journeys was determined by archaeological 'points', the occurrence of burial mounds and occupation sites of prehistoric or early historic age. It is to be noted that though historic sites were found along the actual coast line, there was none here of prehistoric age, a fact of which Sir Aurel discusses the significance and suggests that it may be due to submergence.

A large number of sites, both of prehistoric and early historic age, were examined and recorded. Time was not available for an intensive study of any one site, and there are several on which the author insists upon the urgent necessity for systematic and exhaustive excavation. It was possible, however, by surface finds and trial trenches to collect and determine the sequence of a large quantity of ceramic evidence and other material—stone and bone, copper, bronze, iron and glass (beads and bangles)—in date extending from the chalcolithic age down to the close of the pre-Islamic period, several centuries after the commencement of our era. An idea of the richness of some of the sites in archaeological data may be gathered from the fact that at Damba-kōh, a hillock-site in the alluvial plain of the Bāhū river, about sixteen miles only from the frontier, there were at a rough estimate seventeen hundred cairn burials, or if those scattered nearby are taken into the account, some two thousand. The practice of cairn burial shows a considerable variety in construction, but the skeletal remains are invariably those of bodies which have been exposed previously to burial. In this area, the author infers, it must have persisted for a very considerable period, extending from the close of the pre-Islamic period back to, at least, the Iron Age.

On the prehistoric or chalcolithic sites there is abundant evidence, in the painted pottery in particular, of affinity on one side with the chalcolithic civilization traced by Sir Aurel on his expeditions to Baluchistan in 1926-28, which in turn links up with the civilization of the Indus valley, and on the other, with early western Asia. Finds from the Tal-i-pir (Haraj), for example, especially the painted pottery and the 'button-seals', are compared with those found at Persepolis, Arpachiyah and Fars. Further, the designs in monotone of the yellowish-grey ware from this site provide a link between Persepolis and the chalcolithic site at Fars and Baluchistan, where most of the designs appear, while the bands of horns found here as a form of decoration relate Baluchistan, Iran and Susa.

Sir Aurel has modestly given to this elaborately produced and detailed account of his first two journeys in Iran the title of 'Reconnaissances'; and so these journeys must be regarded, as providing both a strong incentive and guidance for further and more intensive archaeological investigation—this not only for its own sake, but also for the light it will throw on the relations of early civilizations in India and Mesopotamia. At the same time, the topographical and archaeological record, as well as the magnificent series of plates of the pottery and other finds, ensure its permanent standing as an authoritative work of reference.

Men and Mathematicians

Men of Mathematics

By Prof. E. T. Bell. Pp. 653. (London: Victor Gollancz, Ltd., 1937.) 12s. 6d. net.

PROF. E. T. BELL has written a fascinating book. The amount of biographical details and of mathematics that he has compressed into a volume of 650 pages is extraordinary; but he is never dull; his style is lively, at times even 'snappy'; he carries the reader along; he whets the appetite. No doubt the mathematician of a certain age who remembers little more mathematics than what he learnt at school and at the university will wish that the modern theories and developments could be more fully described so that he could get a better general idea of them; and the reader who is mainly interested in the personal and human side, while reading with enjoyment the biographical details, which are not easily accessible elsewhere, will wish for more. This is as it should be; but, if the writer has set himself what is (in such a compass) a wellnigh impossible task, we are not the less grateful to him.

Prof. Bell explains that he has applied two criteria in selecting names for inclusion: first, the importance for modern mathematics of a man's work, and, secondly, the human appeal of the man's life and character. Some, as he says, qualify under both heads, for example, Pascal, Abel and Galois; others, like Gauss and Cayley, chiefly under the first, though both had interesting lives. When the two criteria clash or overlap as between several claimants for inclusion on account of a particular advance, he has given the second the precedence, as his primary interest is here in mathematicians as human beings.

In his first chapter Prof. Bell deals with the Greeks—Zeno, Eudoxus and Archimedes; then, with a bound over eighteen centuries, he passes to Descartes and Fermat, the founders of analytical geometry. This is because, throughout the book, "the emphasis is wholly on modern mathematics, that is to say, those great and simple guiding ideas of mathematical thought that are still of vital importance in living creative science and mathematics". The particular Greeks dealt with are those whose work makes, as it were, a continuous story with that of the moderns. The story properly begins with Zeno of Elea. Zeno did not indeed claim to be a mathematician, and next to nothing is known of his life; but he put forward the four famous paradoxes which have exercised the acutest minds ever since, and even now, notwithstanding the labours of Weierstrass, Dedekind and Georg Cantor, cannot be said to be disposed of finally.

Though some of the great mathematicians were born in the humbler walks of life, they are not in a majority. Monge was the son of a pedlar and knife-grinder, Fourier of a tailor, Fermat of a leather-seller; Gauss's father worked as a gardener, canal-tender and bricklayer. Laplace was the son of a peasant and became a 'complete snob'; he examined Napoleon as a candidate for the Military School, and afterwards, in recognition, Napoleon 'pushed' him in every possible way; he was Minister of the Interior for six weeks; under Louis XVIII he sat as Marquis de Laplace in the chamber of peers. Most of the others were sons of professional men, chiefly in the law, officials, pastors, and so on. Some were miserably poor or became so; Kummer tramping back and forth every day between Sorau and Halle with his food and books in a knapsack on his back reminds us of Eudoxus trudging from the Piræus to Athens and back to hear the lectures of Plato.

Only a few of the subjects of the book seem to have been exceptionally precocious. Though the legends of Pascal's precocity are no doubt overdrawn, he discovered his famous theorem before reaching the age of sixteen years. Lagrange is said to have become professor of mathematics at the Royal Artillery School in Turin at sixteen years of age. Gauss, before he was three years old, spoke up and corrected an error which his father had made in calculating the weekly wages of some labourers; in his tenth year he produced in a few seconds the answer to an addition sum set to his class, in which a hundred numbers beginning with 81,297 and ending with 100,899 were to be added, because he instantly saw that the numbers formed an arithmetical progression with 198 as common difference. Sir William Rowan Hamilton must almost have rivalled John Stuart Mill: he was a good reader and advanced in arithmetic at three years of age; at five he read and translated Latin, Greek and Hebrew; at eight he added Italian and French and wrote an original poem in Latin hexameters. Euler ("analysis incarnate") was, like Gauss, a marvellous calculator. Two of his students summed a complicated convergent series in specific numbers and disagreed only by a unit in the fiftieth place of the result. To decide between them Euler did the whole calculation in his head; his answer was found to be correct.

Prof. Bell has strong likes and dislikes. He cannot forgive Newton for accepting, at the age of fifty-four years, the post of Warden of the Mint, nor Leibniz for spending so much of his life in the trivial service of the Brunswick family.

Citrus Diseases

Citrus Diseases and their Control:

By Prof. Howard S. Fawcett. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Second edition, completely revised, rewritten and enlarged. Pp. xv + 656. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.

A SECOND edition, after ten years, by the senior author of Fawcett and Lee's well-known book must be welcome to a great industry and to citrus pathologists. Lee, being engaged on other investigational work during recent years, generously withdrew from joint authorship of the new edition. The arrangement of the matter is the same as in the first edition, but with fifty-three additional pages of text (apart from the bibliography) and two new chapters. Significant of the notable extension of citrus planting outside of the United States during late years and the attention given by trained pathologists to the diseases and means of control, is the expansion of the chapter on the geographical distribution of citrus diseases from six to thirty pages.

A new chapter has been added on 'diseases due to deficiency or excess of inorganic constituents' in collaboration with Haas of California, and the parts treating of sweet orange and Australian scab and of citrus blight have been written with the help of Miss Jenkins of Washington and Rhoads of Florida respectively. Descriptions are given of about a score of diseases either not mentioned at all or only cursorily dealt with in the first edition; among these *Mal Secco*, a specific disease as understood now (due to *Deuterophoma tracheiphila* Petri), and of serious moment in the lemon plantations of eastern Sicily, is probably the most out-

standing. Of the diseases fully treated in the first edition, Fawcett now records that no cases of canker (caused by *Bacterium citri* (Haase) Doidge) have been detected in Florida since 1927, and that it appears to have been eradicated from all commercial plantings in the other Gulf States. The great campaign aiming at the total eradication of canker, begun in Florida in 1914 and extended to the neighbouring States, seems, therefore, to have been wholly successful: it has cost about two and a half million dollars. A similar campaign of eradication against canker in the Union of South Africa, begun in 1918, has been equally successful. These two effective campaigns against a highly infectious disease (the very susceptible grapefruit was the variety mainly concerned), seem destined to become classical in the history of plant disease control.

The author presents strong evidence, based mainly upon his own investigations, in support of the view that psorosis, a disease of wide distribution, the etiology of which baffled pathologists for many years, is due to a virus.

The bibliography has been enlarged from seventeen to forty-one pages, due in part to the filling of gaps in the references recorded in the first edition and to the very complete list of those of the last ten years (to the end of 1935).

The make-up of the book corresponds with the high standard of the first edition; the plates in colour, remarkable products of the technique of reproduction, are the same as those in the earlier edition. Should the new edition be reprinted, it would seem an added convenience if the plates could be numbered and listed in the table of contents.

Physiology of the Parasitic Nematodes

Nematodes Parasitic in Animals

By Dr. Geoffrey Lapage. (Methuen's Monographs on Biological Subjects.) Pp. x + 172. (London: Methuen and Co., Ltd., 1937.) 4s. 6d. net.

THE scope of this excellent little book is not, as its title might suggest, systematic or faunistic. It is addressed primarily to the experimental biologist, and the author's chief concern is with the physiology of the parasitic Nematodes, upon which, as he points out, their relationships with their hosts depend, and a better knowledge of which might enable us to control their harmful activities in man and domestic animals.

There is an introductory chapter on the structure, life-histories and classification of the group. Here, in so condensed a work, it is perhaps inevitable that a few errors and questionable statements should creep in. It is doubtful whether "most nematodes are parasitic"; while it seems a pity to find the common misspelling of Filarioidea as "Filaroidea" constantly repeated.

The main part of the book, however, is a useful review of the mass of recent literature dealing with the mode of life and metabolism of the Nematodes, their effects on their hosts and the problems of

resistance to infestation. A bibliography of more than 400 references is given. His review leads the author to the conclusion that "in spite of every effort, no efficient control of any nematode parasitic in animals is known. . . . Work, therefore, which seeks to understand the physiology of nematodes is urgently needed. . . . No group of animals presents problems more interesting to the experimental biologist, nor a challenge more exacting to his skill. . . . If every biological laboratory in the world employed one experimental biologist on the study of parasitic nematodes, the reproach that neither biology nor medicine can cope with these parasites would soon be removed."

Our great ignorance of the physiology of these organisms, in spite of the work that has been done on them, is well brought out. The difficulties in the way of exact experiment are great. No one

has yet been able to keep alive a Nematode parasitic in a warm-blooded animal, outside its host, for more than a few days. It is also very difficult to exclude bacteria and other contaminating factors. As Dr. Lapege says, "the products of nematode-metabolism cannot be accurately determined until a completely sterile nematode can be studied".

After discussing the known facts concerning the resistance of animals to infestation with Nematodes, the author says that "the available evidence suggests that . . . the three kinds of resistance are different only in degree and not in kind", and is of the opinion that comparisons between such resistance and bacteriological immunity should be made with caution. Some possible methods of controlling infestation, mainly in grazing stock, are briefly discussed in the last chapter.

H. A. B.

Practical Hints in Horticulture

The Horticultural Note Book :

a Manual of Practical Rules, Data and Tables, for the use of Students, Gardeners, Nurserymen and others interested in Flower, Fruit and Vegetable Culture or in the Laying-out and Management of Gardens. Compiled by J. C. Newsham. Fifth impression. Pp. xx + 418. (London : The Technical Press, Ltd., 1937.) 7s. 6d. net.

THE new edition of this book follows on the lines laid down by its author in the original work. For conciseness and lucidity in pocket-book form, it would be hard to improve upon. Its data and practical details can be fully relied upon and the wealth of information crowded into its 418 pages covers the whole of the operations of any up-to-date garden. In this respect the author has a genius for imparting—in tabloid form—his wide knowledge to others.

A very large number of subjects bearing upon horticulture are ably dealt with. There are chapters on such widely different items as weights and measures, sizes of pots, land measures in detail, valuable information and full descriptions on the formation of kitchen and fruit gardens, lists of plants for each, costs of digging, trenching and drainage. The making of lawns and their upkeep, lists of grasses to use in various soils, buildings, sheds, fruit rooms, greenhouses and heating apparatus, are all dealt with separately in a thorough and practical manner.

Soils and geological formations are given a full chapter, and the chemical contents of various soils and manures are clearly defined.

Propagation by seeds, layers, grafts and cuttings is described in detail. There is a long chapter on fruit culture, which includes a useful list of varieties of all the best fruits grown in the British Isles. The best stocks to use for grafting, planting of various fruits, choice of sites suitable for each kind, picking, storing and even details as to packing and marketing are all fully discussed. No important item or detail has been left out and the whole work is brimful of most valuable information, all collected together under separate headings, and very easy to look up by the aid of a full and complete index.

In the 92 pages devoted to flowers and their culture, full lists of plants for the herbaceous border, greenhouse, stove and house decoration are given, and a feature of this is that all the principal florists' flowers are dealt with separately, with valuable notes on the time of flowering, height and colour of the flowers. A select list of ferns for stove, greenhouse and hardy conditions ; cultural notes on orchids ; lists of trees and shrubs for various soils and conditions ; notes on economic plants ; weeds of various kinds, and notes on the best method of eradication are included ; also, the rotation of crops, and even such out-of-the-way subjects as "The Natural Food of Wild Birds" ; "Points to be Observed in Judging" ; "The Economic Value of Timbers", and a whole chapter on "Insecticides and Fungicides".

For its size and completeness, there is nothing like this book as a valuable aid to both the amateur and professional gardener, and it is one that should be on every garden-lover's bookshelf.

The Nation's Intelligence

By J. L. Gray. (Changing World Library.) Pp. iv+154. (London: Watts and Co., 1936.) 2s. 6d. net.

The Menace of British Depopulation

By Dr. G. F. McCleary. Pp. 148. (London: George Allen and Unwin, Ltd., 1937.) 4s. 6d. net.

THESE two books, both conceived on scientific lines, and both written in the scientific spirit, are concerned with two momentous issues. One of them asks the question: Are we heading for national stupidity? The other asks the still more stirring question: Are we heading for national suicide?

In dealing with the first of these questions, Mr. Gray confronts the school of writers who hold that the offspring of the prosperous classes are on the average abler than the children of the poor in virtue of their superior mental inheritance, and who do not shrink from the inference that our high expenditure on social services, including education, simply encourages the perpetuation of inferior types, and ought, therefore, to be restricted. Arguing, as we have said, on strictly scientific lines, and without any social and political prejudices, Mr. Gray gives reasons for believing that there is no cause for alarm, that there is no ground for supposing that the average intelligence of the community is decreasing, and that, so far from being a blunder, the raising of the physical and intellectual level of the masses is of vital importance.

As to the menace of depopulation, Dr. McCleary sounds the definite note of warning. The population of Great Britain is still increasing, but, at a rate so greatly reduced as to point to the beginning of decrease in the near future. If, says he, our present fertility and mortality rates remain at their present level, we shall enter upon a period of decline which must end in extinction. Most people, by the way, do not realize the position, because they are misled by an unscientific and superficial view of the relevant statistics. As the same process is going on in most of the Overseas Dominions of the British Empire, and as the mother country will soon be able to do nothing to help them, the outlook for the Empire is a black one. The author is in no doubt that the main cause of the decline is voluntary birth-control. He sees little hope of stimulating the growth of population by such artificial expedients as family allowances and marriage loans. Yet he does not close on a note of despair. The effective remedy, he holds, lies in making life better worth living for all classes of the community.

Vakuumspektroskopie

Von Dr. Hans Bomke. Pp. x+248. (Leipzig: Johann Ambrosius Barth, 1937.) 17.70 gold marks.

SINCE the publication of Lyman's monograph "Spectroscopy of the Extreme Ultra Violet", there has been a steady development of technique and accumulation of results in the field of vacuum spectroscopy. Improved glass gratings and the use of grazing incidence have enabled the limit of the spectrum to be pushed to shorter wave-lengths, until now it is well within the long-wave limit of soft

X-rays. Many spectra have already been studied. It has thus become desirable that a new survey should be made of the investigations which have been carried out in this field. In his valuable little book "Vakuumspektroskopie" Dr. Hans Bomke has set himself this task.

Dr. Bomke opens with a brief historical review, then proceeds to describe in considerable detail the design of various types of vacuum spectrographs, their method of use and the construction of light sources suitable for them. About two thirds of the book are devoted to these topics. The remaining third is concerned chiefly with work which has been done on the spectra of atoms, although eight pages at the end briefly summarize results obtained with molecules and solid bodies. The appendix contains useful constants and a very full bibliography.

This book should prove of great assistance to those desirous of becoming acquainted with recent researches in the extreme ultra-violet.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. Vol. 11: Organometallic Compounds. Part 4: Derivatives of Selenium, Tellurium, Chromium and Platinum. By Archibald Edwin Goddard. Pp. xxviii+292. (London: Charles Griffin and Co., Ltd., 1937.) 20s. net.

THE subject-matter of the present volume is concerned with the aliphatic and aromatic derivatives of selenium and tellurium and the organic compounds of chromium and platinum. It is almost entirely of interest from the point of view of organic chemistry, and it may be suggested that vol. 11, dealing with organo-metallic compounds, four parts of which making up a total of 1,632 pages have already been published, is out of proportion with the rest of the work. In the present volume, very minute details of preparation are given and the text will be of interest mainly to the specialist. The literature appears to have been very well covered and there are good indexes. For those who wish to inform themselves of the subject of which it treats the book will be a very useful guide. The preparations are nearly always given in sufficient detail to make reference to the original publications unnecessary.

Practical Stereoscopic Photography

By J. Moir Daltzell. Pp. xv+224. (London: The Technical Press, Ltd., 1936.) 10s. 6d. net.

DR. MOIR DALTZELL's book deals with the minutiae of a single branch of photography. The subject is for the most part clearly treated, but the complete absence of illustrations renders some parts difficult to follow. In the early chapters the author discusses the characteristics of binocular vision, describing the psychological effects of various muscular actions and their relation to our interpretation of what we see. There follows a very complete treatment of apparatus and technique. Much of the part dealing with technique is applicable to general photography, and will be found very valuable to the 'one lens' workers as well as to stereo workers.

The Voyages of the *Discovery**

ABOUT forty years ago, the first *Discovery* lay a-building in Stephen's yard at Dundee, for Captain Scott's Antarctic Expedition. She was built like a Dundee whaler, but of the finest African oak, and finished as a labour of love; her timbers, spars and full barque-rigging were all as

Office built a new ship under her old name, less beautiful, but equipped as no other ship had ever been for the naturalist and the hydrographer. A much smaller vessel was added later on, bearing the name of that great scientific navigator and whale-fisher William Scoresby. She was built as

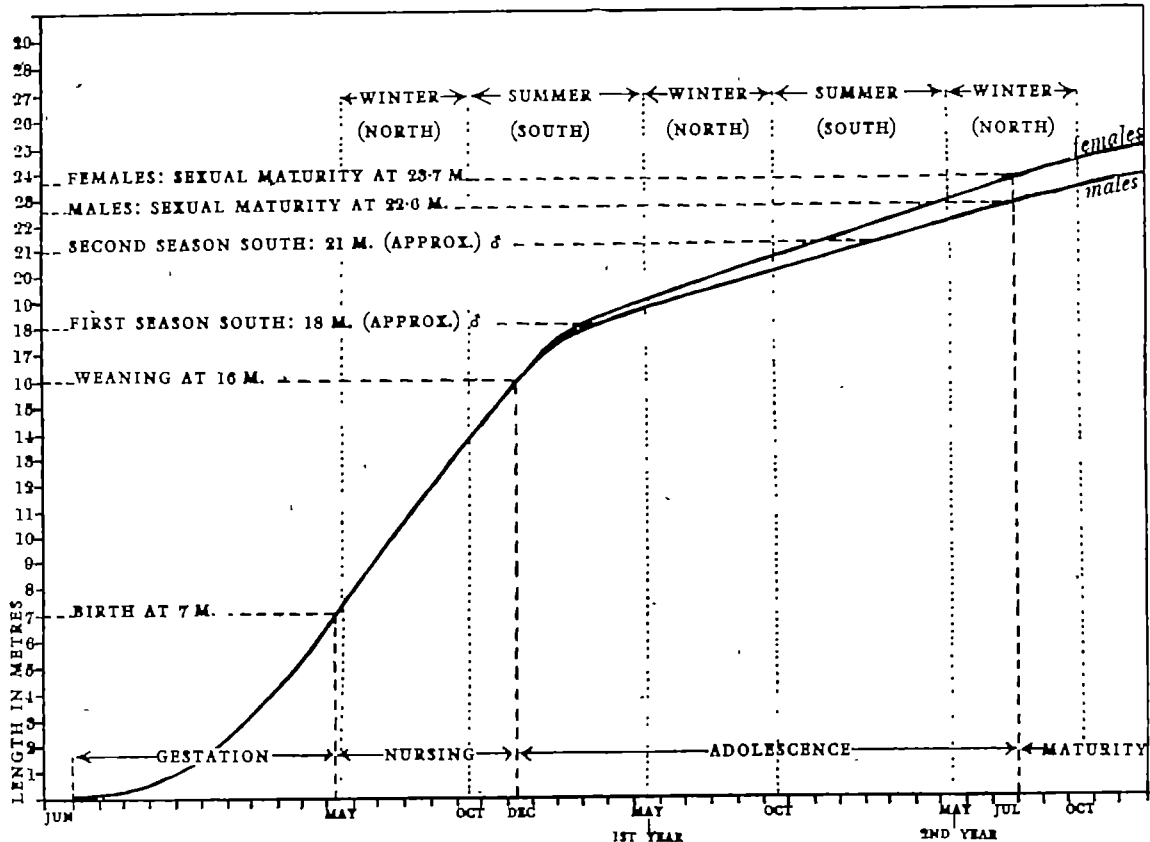


Fig. 1.

EARLY LIFE OF THE BLUE WHALE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

strong as Stephen and his men could make them; but the old lines were not left unaltered, and when she put to sea she rolled terribly. The Hudson's Bay Co. got her later on, and the Colonial Office took her over when she was five and twenty years old and sent her on her first and last cruise to the Falklands and the South Georgian whaling-grounds. She found other Antarctic work to do under the Australian and New Zealand Governments, when our Colonial

a "whale-catcher", to study and mark the whale at close quarters; the Norwegian whaling-skippers at Walfisch Bay (when I happened once to pass thereby) thought they could have built her a great deal better; but still she has marked her whales, and done good work in other ways.

The old and new *Discovery* and their little sister-ship have been at work on and off pretty steadily for twelve years in the fierce cold and almost constant gales of Antarctic seas. Their one main object was to study, for the sake of the whale-fishery, the natural history of the several whales,

* Report on the Progress of the Discovery Committee's Investigations. Pp. 53+11 plates. (London: Colonial Office, 1937.) 3s. 6d. net.

their movements and migrations, the things on which they feed, the waters in which they live and move; physical oceanography, chemistry and all the biological sciences have their part in the story of the whale. The Basque harpooners in the Bay of Biscay killed out the Atlantic whales, one by one, until no more were seen for near a hundred years; the New Bedford men chased the Sperm whale all round the world, with ever-lessening catches; the Dundee ships in Davis Straits pursued the dwindling Greenland whale to the very verge of extinction. But the modern whaler, with his Svend-Foyn gun, his explosive bullets, and his 'floating factories', kills a hundred whales to the

most abundant whale in the Antarctic; the rarer Humpback was the first to show grave signs of depletion. Some 10,000 Blue whales are killed every year down in the Antarctic, besides a good many more (younger on the whole) on the South African coast; and, if the numbers killed do not yet become noticeably less, the mean size falls away, little by little and year by year. The whales do not live so long, their 'expectation of life' grows significantly less; worse still, the mean size over the whole catch is falling below that of first maturity—a larger and larger proportion of the remaining stock no longer breed at all! The Blue whale is about 21 ft. long at birth, nearly 60 ft. long (so it is said) at a year

old, and the females are sexually mature a little over two years old, when they are about 79–80 ft. long. This very rapid growth and very early maturity (on which the hopes and prospects of the fishery largely depend) are vouched for by the *Discovery* naturalists, and are in harmony with Norwegian estimates; they are novel, and unexpected, and extremely interesting determinations. Papers by Dr. Stanley Kemp, Dr. N. A. Mackintosh, Mr. J. F. G. Wheeler and Mr. A. Laurie on the Blue and Fin whale, their rate of growth, their age at maturity, their migrations, their estimated numbers, their curious physiology of respiration and all else about them, are here as large instalments of the work which the *Discovery* set out to do.

The *Discovery's* hydrographic work has proved peculiarly interesting, and Mr. G. E. R. Deacon deserves especial congratulation. Oceanography had its roots in the *Challenger* Expedition, its seeds were sown by Humboldt and Maury, but the tree only began to grow apace some thirty or forty years ago; it was then that Nansen told us something of the peculiar oceanographic interest of the polar seas. The *Challenger* had given us, as a first approximation, the simple story of a bottom-current, cold and heavy, flowing towards the equator, while a surface-current, salt and warm, streamed over it to the pole. That the great oceans show a more complex stratification than this was indicated even by the *Challenger* observations, as Merz saw long afterwards; but the Edinburgh physicists were cautious men, and had been afraid to trust to what seemed the too complicated evidence of their own thermometers.

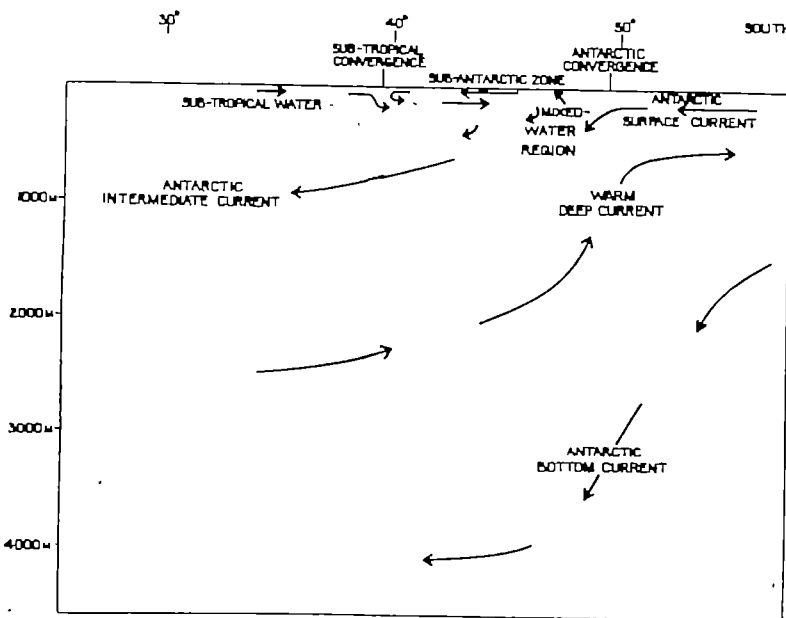


Fig. 2.

OCEANIC CIRCULATION IN THE SOUTHERN HEMISPHERE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS"

old harpooners' one; and it was plain to see that, plentiful as whales were on their southern feeding-grounds, they could not outlast the insatiable pursuit for ever. The aim of the *Discovery* was "to furnish a basis for the rational regulation of whaling"; in other words, to tell the commercial world how far greed might safely go. The whale is a very different thing, say, to a codfish, which lays, year by year at random, its million eggs; the whale nurses its single child for months with all solicitude, but men of business slaughter it as the Red Men killed the buffalo, and no humanitarian considerations enter the case.

The Blue whale, or Sibbald's whale as it was until lately called (after the old Edinburgh physician of three hundred years ago), is the largest and most valuable, the Fin whale (or common rorqual) the

Now the *Discovery*, following on the *Meteor's* work, gives us a new story just a little less simple than the old, telling of four water-layers in the oceanic circulation instead of two. Starting out from the Weddell Sea, toppling to begin with over the edge of the plateau, down to the bottom and away northward, goes a current of cold heavy water. Lying over this and creeping slowly southward, a mass of warm salt water lies; it rises up over the Antarctic current as this plunges down to the depths on its northward way, but it does not come to the surface, for there is other Antarctic water there with a density so far reduced by melting ice as to float, cold as it is, over the warm deep current. Then over all comes the fourth layer, of tropical or subtropical water, very salt but very warm, flowing southward over all the Antarctic waters.

The whole case, simple as it is, is not quite so simple as that! For our two surface-waters, the hot and the cold, the salt and the fresh, one going south and one coming north, meet somewhere, and when two water-masses meet things happen. You may see almost anywhere near the shore, especially in an estuary when the tide is coming in, a line of frothy turbulent water, marked out by a flotsam of sticks and straws; this is the *Schäumrand*, as Otto Petterson called it. Such a *Schäumrand* on a prodigious scale, visible from miles away, marks somewhere about 50° S. the so-called "Antarctic Convergence", the meeting of the warm and cold surface-waters. Here the south-going current is turned back or carried down, and mixes with the Antarctic surface-water which meets it, to form, some way below, the cold northward intermediate current. Thus in the farthest south we have *three* layers of water—cold, warm and cold again; but farther north there are *four* layers, tropical or subtropical ocean-water drifting southward over the other three.

From this easy beginning the story goes on and gathers interest. It is one of Deacon's remarkable discoveries that the Weddell Sea, and that alone, is the source of all the heavy bottom-water, heavy with cold and undiluted by melting ice; from the Weddell Sea the drift creeps along at the bottom of the great oceans, and is traceable even as far as the Bay of Biscay. But there are parts of the Antarctic Ocean so barred by shoals or submarine walls as to be shut off from the main current-system. Ross's Sea has a northern wall so high that the warm deep current does not enter it at all. So Ross's Sea becomes filled up with Antarctic water, extremely cold, and also extremely salt because much water has been removed to form pack-ice; and the fauna of Ross's Sea has (I believe) its consequent peculiarities.

Surface-currents coming northward from the far south hug the west coasts of the great continents,

and the most important and best-known of these, which the *William Scoresby* has specially investigated, is the Peru or Humboldt Current. It flows for more than 2000 miles along by Chile and Peru, now slow, now swift, now narrow and widening out again, even to a breadth of some 200 miles. It seems to arise about 40° S., in one of those convergences or divergences of which we have spoken, where cool and moderately saline water of Antarctic origin wells up from below the warm water of the equatorial counter-current, as indeed it continues to do for all its length along the western edge of the continent. The cold water comes up teeming with nutrient salts; it breeds a plankton-fauna of the richest kind; and this supports a population of whales, and of fishes preyed on by innumerable sea-birds the guano of which is sent all over the world. This cold current dominates the situation, but now and then persistent northerly winds check it or thrust it aside. Then comes *el Niño*, a new warm current upsetting the old equilibrium; the fish die in millions, the water stinks, the birds starve, the guano industry cries aloud. On the west coast of South Africa, at Walvisch Bay and Swakopmund, the same phenomena occur.

After this fashion the *Discovery* reports lead us to many interesting things—interesting chemically and biologically—and arising out of the plain facts of oceanography. At the bottom of the Weddell Sea are found gypsum, calcium oxalate and calcium citrate, the last two especially being of obscure origin and unknown at the bottom of any other sea. A vast abundance of life, microscopic and macroscopic, strikes every naturalist in Arctic or Antarctic seas, and the coldest of Antarctic waters are the richest waters in the world. The biologist is apt to ascribe this abundance to superabundant oxygen, such as the cold waters can dissolve; but that alone would not go far. The nutrient salts, the phosphates and nitrates, are the true limiting factors in the growth of that micro-vegetation with which the whole biological cycle begins. The tropical oceans are often very barren of these salts; in our own latitudes there is never too much, and the burst of growth in spring uses up the supply leaving little or nothing to spare; but the *Discovery* people have shown us that phosphates and nitrates are more abundant in the Antarctic Ocean than in any other seas, and that down there plant-growth is never checked for want of them. Plant-growth in the ocean is limited to a certain depth by its need of sunlight, so the water a little lower down tends to be rich in unused phosphates. In the neighbourhood of any great divergence these waters rise to the surface, and foster an unusual micro-vegetation there. At the edge of the continental shelf we meet with such

rising waters, and have again a richer growth of plants and of creatures great and small to feed on them and one another.

A hundred years ago, Johannes Müller was using the first tow-net, about the time when Edward Forbes was borrowing for the first time a fisherman's oyster-dredge; but only now do we begin to understand properly the importance of the floating life of the sea. Its distribution, its seasonal abundance, its variation with temperature, its presence in this water and absence in that, the vast variety of organisms of which it is variously and with varying importance composed, all these things are a great part of the science of the sea and of our understanding of all the fisheries. Prof. A. O. Hardy of Hull (a most ingenious student of the plankton) and Mr. E. R. Gunther have written an interesting report on the ways and means by which plankton is dispersed and distributed, and how the gathering-places of the whales may be expressed in terms of

plankton, and again of the phosphate supply. Dr. N. A. Mackintosh has demonstrated a seasonal circulation in the Antarctic plankton on a scale unrivalled elsewhere; the big Euphausias, staple food of the Blue whale, first made known by the *Challenger* and met with again by Dundee whalers who went far south unsuccessfully some forty years ago, are fully described by Dr. F. C. Fraser and Mr. Dilwyn John. But without saying more of the ship's company and their doings, let me just say that the *Discovery II*, with a great task to do and ample means to help to do it, has added largely and handsomely to natural knowledge, and given the ship's name an honourable place among voyages of exploration and discovery. There is one omission in the report before us. I have read it all through without encountering the name (save in a list of papers) of the leader and director of the Expedition, the distinguished author of the report.

D. W. T.

Tests in Common Use for the Diagnosis of Colour Defect*

By Dr. Mary Collins

TESTS for colour vision fall into two categories.

In one type of test, transmitted light is used, in the other reflected light. While the former type of test is regarded as the more fundamental, the latter can be of great service for quick diagnosis of colour anomaly. Colour tests may be administered purely for theoretical purposes, or they may be applied for practical purposes, as selection tests for different vocations. This second function assumes its most important role in vocations in which lack of accurate discrimination between different coloured signals may involve human lives. This function is also of significance in other vocations in which the lack of colour discrimination, though not involving danger to the community, is highly disadvantageous to its possessor.

There seems to be no need at the present day to emphasize the importance of the recognition and detection of colour defect. It is, however, very illuminating to study some of the more recent investigations in the field, particularly those concerned with the incidence of red-green defect. The percentages given seem to be much higher than in the reports of the earlier investigations. It does not necessarily follow that the incidence of the defect is increasing; the indications are rather that detection is more accurate owing to the

improvement of the test material. Out of 360 candidates applying for acceptance as apprentice printers, the percentage of red-green colour-blinds was 7.5, this figure being exclusive of the colour-weak and the anomalous.

It seems more or less agreed that red-green colour-blindness is a reduction system of normal colour vision, one cogent argument in support of this contention being that normal colour matches are valid for any type of dichromate. The colour-blinds lack something which the normal eye has, but have nothing which the normal eye does not possess. The individual with normal colour vision sees a spectrum composed of six or seven colours. The red-green colour-blind has a spectrum composed of only two colours, these two colours being yellow and blue. The acceptance of this fact was delayed for a long time, and it is doubtful if it is yet generally accepted. Herschel, in 1845, was the first to put forward the dichromatic explanation of colour-blindness. He pointed out in his article on "Light" in the "Encyclopædia Metropolitana" that certain individuals could only distinguish two colours, and that these two colours were yellow and blue. Clerk Maxwell, among others, opposed this, for he accepted the theory put forward at that time by Young and Helmholtz that colour-blinds were either red-blind, green-blind or violet-blind, and that the red-blind were blind to red,

* From the presidential address to Section J (Psychology) of the British Association, delivered at Nottingham on September 3.

but could see the remaining two colours, green and violet: the green-blind were blind to green, but could see red and violet.

In an account by Pole of his own case, we find he vigorously protests against these prevailing beliefs, and gives a careful analysis of his own colour vision as evidence. He had been pronounced red-blind by Maxwell and green-blind by Holmgren. Pole repudiated both suggestions, and claimed that the true solution was that he was blind to both colours. This conclusion was confirmed by a large number of facts. One was the evidence of the colour-blinds themselves who, whether they were classified as red-blind or green-blind, asserted that their colour sense was composed of blue and yellow. Another was a case of congenital unilateral dichromatism investigated by von Hippel in 1880. The individual tested had normal colour vision in his left eye but was colour-blind in his right eye. With the right eye he confused red and green with yellow, as tested by various standard tests. The colours which the subject could distinguish with his right eye were blue and yellow, these being confirmed when he looked at them with his normal eye. Von Hippel diagnosed the case as one of red-green blindness with spectrum of normal length. Holmgren examined the case with his wool test and proclaimed it to be one of red-blindness with shortened spectrum in accordance with the Helmholtz theory. Von Hippel retested his subject and reaffirmed his finding. This was the first case of monocular colour vision reported, and it undoubtedly strengthened the case for the acceptance of Herschel's and Pole's views. Holmgren, it is interesting to note, ultimately agreed that blue and yellow were the only colours seen. That this point is still controversial may be gathered from the statement made by Pitt in a recent investigation, that the fundamental responses of the protanope are blue and a saturated green, while those of the deuteranope are blue and a mixture of red and green.

Only a few cases of unilateral colour-blindness have been recorded, and these, according to Parsons, are of "doubtful value". In these cases, however, the suggestion is always that the colours seen are blue and yellow. Miles and Beaumont, who tested the two eyes separately in an investigation into colour-blindness, found considerable difference between the two eyes in many cases, and suggest that although there is no conclusive evidence as to the frequency of unilateral colour-blindness, "possibly it amounts to three or four per cent of the colour-blind". They discovered one such case in a group of 23, and Miles and Craig found another in a group of 390 mercantile salesmen. This latter individual was a dry goods

salesman and aware of his condition, and if required to match fabrics he closed the defective eye and made the proper discrimination with his normal eye. If these cases of unilateral colour-blindness are as numerous as suggested, a field seems opened up for further investigation which may lead to definite conclusions as regards the fundamental sensations of the red-green colour-blind.

The results of investigations carried out over a number of years at Edinburgh into the colour-sensations of the red-green colour-blind seem to indicate that their colour sensations are indeed blue and yellow. The extent to which these two colours replace all the other colours in the spectrum is, however, not constant for every colour-blind. With some, yellow and blue may replace all the other colours, that is, red, orange, yellow and green may be seen as different shades of yellow, blue and violet as different shades of blue. Sometimes, instead of the green being replaced by yellow, it may appear as grey, or the blue-green may appear as grey, the extent of the neutral band varying with the gravity of the defect. A second neutral band is also found extra-spectrally in the complementary colour, in the purples. In one extreme case which came under observation, only two narrow bands of yellow and blue existed, the other colours being seen as shades of grey. Red appeared as black, orange as dark grey, yellow could be discriminated, green and blue-green were seen as grey, blue could be distinguished, but violet appeared as dark grey. In one test, out of 76 colours observed, 64 of them appeared as grey.

All cases, however, are not so extreme as the one just described, and the general finding which seems to be gradually gaining ground is that there exist different degrees of colour-blindness extending from extreme cases in which blue and yellow are the only two colours visible, to milder cases in which the blindness to red and green is not total. In these milder cases the individual can see red and green if they are bright enough or vivid enough. It is these milder forms which constitute the great practical problem, for in these cases the ability to distinguish between red and green is likely to fail when the individuals are fatigued, or when the illumination is poor, as in mist or fog. The extreme cases can be easily detected, but the milder cases, which have been described as 'dangerous colour-blinds', require very careful examination if they are to be detected.

That different degrees of colour-blindness exist has been emphasized by more than one writer. Hayes "wonders if we shall presently have to give up all classifications by types, arrange colour defectives in distribution tables and give a colour graph or profile for each subject, showing his

efficiency or deficiency for each colour in terms of a per cent of the normal or average attainment". Troland states that the original restriction of colour-blinds to protanopes, deuteranopes and tritanopes is no longer adequate, and allowances must now be made for more types of variation. Edridge-Green recognizes seven different types of colour vision, and Schjelderup states that there are at least eighteen significant species of colour-blindness. Collins reaches the conclusion that it is quite unprofitable to try to classify the colour systems of the colour-blind because there exist so many individual variations.

One group in which the colour defect is not extreme has been definitely recognized. Seebeck, in 1837, found certain cases which he was reluctant to classify as colour-blinds, who yet showed signs of colour abnormality. It was not until 1881, however, that these cases were understood. In that year, Rayleigh found that a number of individuals with otherwise normal colour vision were unequally sensitive to red and green. In equating red (lithium line 670.8μ) and green (thallium line 535μ) to match a yellow (sodium line 589μ), since known as the Rayleigh equation, some were found to require far more red than the normal, others required an excess of green. Von Kries, in describing an extensive series of experiments, applied the name 'anomalous trichromates' to these cases, and this designation has gained universal currency. Guttman advocated the terms red-weak and green-weak, and distinguished seven characteristics which they manifest, the chief of which are high thresholds, heightened colour contrast and a quick fatigue to colour stimuli.

It is customary to divide these anomalous trichromates into two groups corresponding to the two groups of dichromates, deuteranomalous trichromates or partial deuteranopes in which the sensitivity to green is below normal, and prot-anomalous trichromates or partial protanopes in which the sensitivity to red is below normal. The

green anomalous seem to be more numerous than the red anomalous, the ratio being quoted as 5 to 1.

These cases, it may be, form the connecting link between normal colour vision on one hand and colour defect on the other, and if a sufficient number of cases could be tested ranging from normality to complete red-green deficiency, a continuous series might be obtained.

It is a moot point as to whether these anomalous trichromates form 'dangerous colour-blinds'. The general finding seems to be in favour of the affirmative. Some writers, for example, Troland, actually include them in classifications of types of colour-blindness. Oblath points out that they can only recognize colours when they are saturated and of intense luminosity; "It is evident that these peculiarities render these subjects less fitted for certain services". In a report on "Colour Vision Requirements in the Royal Navy" (Med. Res. Council Report, Spec. Series No. 185; 1933), it is stated that "the mildly anomalous trichromate can be considered a safe look-out. On the other hand, the unfit anomalous trichromate is, in many ways, a greater source of danger than the dichromate". The incidence of this anomaly is estimated, in the same report, as 6 per cent, which is stated to be a very conservative estimate. Both reports emphasize very strongly the fact that the anomalous trichromate behaves as if colour-blind when conditions are unfavourable, such as when mist, fog or smoke are present, and this is all the more disastrous because the individual is rarely aware that he suffers from any colour defect. The heightened contrast and the quick fatigue characteristic of such anomaly may well make the judgment of colour and the discrimination of colour highly erroneous. The testing and discovering of these cases of anomalous trichromatic vision is not easy, and necessitates very careful procedure, and generally not the application of one test, but of a battery of tests.

(To be continued.)

Obituary Notices

Sir David Orme Masson, K.B.E., F.R.S.

PROF. SIR DAVID ORME MASSON, who died at Malbourne on August 10, was born at Hampstead, London, on January 13, 1858. He was of mixed English and Scots descent. His father, Prof. David Masson, editor of *Milton*, *Goldsmith* and *De Quincey*, and *Historiographer-Royal* for Scotland, came of Aberdeenshire stock—there is a saying in the Don valley that "Eassons, Massons an' Kessons a' cam' frae Tarlandside". His mother, Rosaline Orme, had a forbear George Rutt, the father of

Joseph Priestley's biographer, John Towill Rutt; and it may be mentioned, as throwing some light on the family, that the home of the Ormes, in Avenue Road, Hampstead, was a favourite rallying ground of the Pre-Raphaelites. In 1865 David Masson migrated from the chair of English literature at University College, London, to the Regius chair of English in the University of Edinburgh, and so it came about that his son, David Orme Masson, was educated at Edinburgh Academy and afterwards graduated M.A. and B.Sc. at Edinburgh.

In his younger days Masson was a strong walker and swimmer, and he played golf, tennis and billiards. After a short period of research with Prof. Crum Brown, he left Edinburgh for Bristol in 1880, to become Prof. W. Ramsay's first assistant (in later days, his son, Irvine Masson, was to become Sir William Ramsay's last assistant, at University College, London). Before Masson returned to Crum Brown, he and Ramsay had laid the foundations of a lifelong friendship. Meanwhile he had acquired some further research experience at the University of Göttingen. During his second period at the University of Edinburgh, Masson, with R. Fitzroy Bell, founded the first Students' Representative Council in any university, of which Masson became the first Senior President. The ensuing revolutionary improvement in the students' behaviour at graduations, etc., led Principal Sir Alexander Grant to exclaim, at the end of the tercentenary celebrations: "Gentlemen, you have saved the Republic!" Masson was also a prime mover in the foundation of the Students' Union in the University of Edinburgh—again, the first in Great Britain.

In 1886 Masson was elected to the chair of chemistry in the University of Melbourne, a key appointment which he held with high distinction until he retired in 1923, to become professor emeritus. Orme Masson, and his contemporaries Baldwin Spencer and T. R. Lyle, must be numbered among the prime creators and moulders of Australian science; to them Australia in general and the University of Melbourne in particular owe a debt beyond computation. A brilliant and inspiring teacher, Masson built up Australia's most distinctive school of chemical research at Melbourne, and exerted a steady influence upon the development of Australian science through his pupils and research students; but this was only one side of his work. His remarkable clarity of vision, combined with his organizing and administrative ability, his interest in the wider aspects of science, and his flair for public work, naturally brought him out as a leader in the foundation of national scientific institutions in Australia. Among these were the Commonwealth Advisory Council of Science and Industry, of which he was deputy chairman from 1916 until 1920, and which merged later into the Commonwealth Council for Scientific and Industrial Research; the Australian National Research Council, of which he was president in 1922–26; and the Australian Chemical Institute, of which he was the original president in 1924. Masson was also president of the Australasian Association for the Advancement of Science in 1911–13, and was largely instrumental in bringing about the visit of the British Association to Australia in 1914. In addition to all this, he was active in the interests of Antarctic exploration from Australia.

Masson's researches were concerned chiefly with physical chemistry, more particularly with the theory of solutions, ionization, and chemical dynamics. With Ramsay, at Bristol, he worked upon atomic volumes at the boiling point¹. This investigation was followed, at Edinburgh, by some work with M. Hay on the composition of nitroglycerine², and

by a series of researches on sulphine salts, carried out partly in collaboration with L. Dobbin³. The latter theme was afterwards extended at Melbourne with J. B. Kirkland⁴. A paper on molecular volumes⁵ was followed by another early research at Melbourne, in which, with N. T. M. Wilmore, Masson came near discovering the celebrated organic synthetical reagents later associated with the name of Grignard⁶.

In 1891 Masson pointed out the analogies between solution and vaporization which are embodied in his term 'critical solution temperature'; at the same time he brought to notice certain other principles regulating the miscibilities of liquids⁷. He was a keen exponent of the ionic theory in its early days, and between 1897 and 1899 he developed the direct 'jelly-tube' method of measuring ionic velocities⁸. Later notable work emanating from the Melbourne laboratories under his inspiration included various observations on the decomposition of persulphates and of sulphine hydroxides in aqueous solution (Leila Green, Brenda Sutherland⁹), and studies on the viscosity and conductivity of some aqueous solutions (W. Heber Green¹⁰). Another interesting research (1909), dealing with the mechanism of urea-formation from cyanates, was carried out in collaboration with his son, Irvine Masson¹¹. During this period also, B. D. Steele and Kerr Grant¹² developed their quartz micro-balance in Masson's department; this was afterwards used by Ramsay and Whytlaw-Gray to measure the density of radium emanation.

It is not generally known that early in 1895 Masson evolved a modification of Mendelëeff's periodic system, which, apart from the treatment of the rare-earth metals, is practically identical with the later classification of Bohr. Masson's arrangement was printed immediately after Ramsay's discovery of helium¹³, and it contained spaces which were later filled by neon, krypton, xenon, and niton. "Helium and Argon," it is stated in an inset to the table¹⁴, "are placed in the new Group VIII, characterized by valence = 0 and atomicity = 1." It was probably a discussion between Masson and Ramsay in May, 1895, during a visit of Masson to Great Britain, which first gave Ramsay real confidence in the idea of this missing group of rare elements. Masson's arrangement was adopted by Ramsay and incorporated by him in a celebrated wall-diagram which he used in his lectures at University College, London (part of this diagram was reproduced in the well-known caricature of Ramsay by 'Spy').

Another example of Masson's prescience is provided by a paper published so early as 1921, in which he developed what was essentially a proton-electron statement of the composition of atoms and of the consequent form of the periodic classification¹⁵. This striking treatment of a fundamental problem failed to attract the attention it deserved. A similar remark applies to Masson's final contribution to physical chemistry. This work, which was summarized in a paper brought before the Australasian Association for the Advancement of Science in 1935, and afterwards printed, offered a new treatment of the facts of the electrolytic conductivity of strong

and feeble electrolytes, in strong and weak solutions, from which Masson deduced a simple general law based upon the viscosity aspect.

Masson's direct contacts with industrial chemistry were limited, but a constant stream of his students went forth into industrial careers in Australia and elsewhere. Through the close touch which he maintained with his former students and their firms, he exerted a wide influence in this field, directed particularly towards the scientific management of industrial concerns. Among his old students who entered academic chemistry may be mentioned his own successors at Melbourne, Prof. (now Sir) A. C. D. Rivett and Prof. E. J. Hartung, and elsewhere Prof. L. S. Bagster, Dr. A. O. Cumming, Prof. J. I. O. Masson, the late Prof. B. D. Steele, and Prof. N. T. M. Wilmore.

Masson's work received early recognition in his election to the Royal Society in 1903. He became C.B.E. in 1918, K.B.E. in 1923, and LL.D.(Edin.) in 1924. He married Mary, daughter of the late Prof. Sir John Struthers, M.D., of Aberdeen and Edinburgh, who survives him; of his two daughters one survives; and his only son, Irvine Masson, is professor of chemistry in the University of Durham.

David Orme Masson was a man of great charm and urbanity, with a rare gift of lucid exposition and a lively and polished wit. Modest, versatile, and cultured as befitted his ancestry, he possessed an unusually wide range of interests and human sympathies. He was the doyen of chemistry in Australia, a great teacher in the University of Melbourne, and a much-loved citizen of his adopted country.

JOHN READ.

¹ *J. Chem. Soc.*, 80, 40 (1881).

² *Trans. Roy. Soc. Edin.*, 38, 87 (1883).

³ *J. Chem. Soc.*, 47, 56 (1885); 49, 233, 249, 846 (1886).

⁴ *J. Chem. Soc.*, 55, 126, 135 (1899).

⁵ *Phil. Mag.*, [5], 30, 412 (1890).

⁶ *Proc. Chem. Soc.*, 7, 16 (1891).

⁷ *NATURE*, 43, 345 (1891); *J. phys. Chem.*, 7, 500 (1891).

⁸ *Phil. Trans.*, A, 198, 331 (1896).

⁹ *J. Chem. Soc.*, 87, 2063 (1910); 88, 1174 (1911).

¹⁰ *J. Chem. Soc.*, 93, 2023, 2049 (1908).

¹¹ *J. phys. Chem.*, 70, 230 (1910).

¹² *Proc. Roy. Soc.*, A, 88, 580 (1900).

¹³ *J. Chem. Soc.*, 87, 1107 (1896).

¹⁴ Masson's table was published as a folding card by Melville, Mullen and Blade, London and Melbourne, n.d. A note states: "Atomic weights taken from the table of F. W. Clarke, revised to 1st January, 1895."

¹⁵ *Phil. Mag.*, [6], 41, 281 (1921).

Canon B. H. Streeter

CANON B. H. STREETER, provost of Queen's College, Oxford, who was killed with his wife in an aeroplane accident in Switzerland on September 10, was one of the great Biblical scholars of the world. He was a many-sided man, and his intellectual interest was wide. Psychology, modern physics, anthropology, psychical research, the relations between religion and science, were all subjects in which he had read widely and become interested. He had a large circle of friends from whom he could acquire at first hand the information on these subjects he needed. He was, in particular, profoundly alive to the difficulties raised by the relations of science to

religious truth, and some of these were discussed by him in his most popular book, "Reality: A New Correlation of Science and Religion" (1926), more briefly also in "Adventure" (1927), and in the Bampton Lectures for 1932, "The Buddha and The Christ".

By 'religion' Streeter meant religion and not, as so often in similar discussions, theology. In religion as implying a quest for God, an apprehension of things beyond the limits of ordinary experience, he was a firm believer. In "Reality" he discussed the connexion between this and science, as he conceived it, clearly and simply. He held strongly that religion, like science and art, reveals to us genuine aspects of reality. Science, he said, gives us a representation of ultimate reality diagrammatic rather than pictorial; religion the reverse—it gives us the picture, not the exact diagram. The two aspects are there; in a sense they are complementary; they are not, however, commensurable. He put it in another way. Science is concerned with the metrical aspects of existence, religion (as art) with non-metrical or qualitative aspects, with values that are mostly ethical. Science states definitely; religion suggests. One tries to explain what is observed by finding laws covering individual cases; the other isolates an individual event or circumstance and makes it symbolic of some aspect of reality. For Streeter the truth of religion lay mainly in the quality of the myths (in the Greek sense) it embraces. The values enshrined or symbolized there are inherent in reality to the extent that the religion is true.

In the eighth Bampton Lecture Streeter, discussing psychical research, gave some of his own experiences of suggestion, mass-hypnotism and telepathy. In particular he discussed the 'levitation' of D. D. Home in 1871 witnessed by the Master of Lindsay and two friends present. He suggested from his own successful repetition of this exploit that Home probably gave each of the three a 'waking suggestion' which effectively convinced them that what they attested actually occurred.

Streeter was born at Croydon in 1874 and educated at King's College School. He went to Oxford as scholar of Queen's College in 1893 and thereafter spent most of his life there. As undergraduate he obtained three first classes and many university prizes. He was fellow of Pembroke from 1899 until 1905 and of his old college, Queen's, from 1905 until his appointment as provost in 1933. He was a fellow of the British Academy and honorary doctor of several universities. He married in 1910 but had no children.

A. S. R.

WE regret to announce the following deaths:

Dr. J. R. Airey, formerly principal of the City of Leeds Training College, on September 16, aged sixty-nine years.

Prof. de Burgh Birch, C.B., emeritus professor of physiology in the University of Leeds, on September 18, aged eighty-five years.

Mr. F. A. Potts, University lecturer in zoology in the University of Cambridge, on September 15.

News and Views

Prof. G. Barger, F.R.S.

THE appointment, which is announced elsewhere (p. 558) of Prof. G. Barger, professor of chemistry in relation to medicine at the University of Edinburgh, to the Regius chair of chemistry in the University of Glasgow, will give general satisfaction. By his work during the past thirty years, Prof. Barger has exercised a considerable influence on the development of organic chemistry and biochemistry in Great Britain. In his well-known early collaboration with Dr. (now Sir Henry) Dale, in the laboratories of Messrs. Burroughs, Wellesome and Co., he was jointly responsible for one of the most fruitful applications of organic chemistry to biological problems which has ever been made; he is a distinguished worker in the field of alkaloid chemistry and by his own work and through his pupils he has made major contributions to what may be called in general terms organic biochemistry. Prof. Barger's appointment in 1919, after holding the professorship of chemistry at the Royal Holloway College, London, to the newly instituted chair of chemistry in relation to medicine at Edinburgh, was in itself a recognition of the outstanding characteristic of his work, namely, the attack of organic chemical problems related to biology not from a narrowly chemical point of view but with true appreciation of their biological implications. His Department at Edinburgh has continued to work on these lines, and has at the same time been responsible for great improvements in the teaching of chemistry to students of medicine. Prof. Barger's influence in chemistry to-day is further enhanced by the many contacts which he maintains with colleagues in other countries, aided as he is by linguistic attainments of distinction. It is encouraging to those who believe that organic chemistry has still vital contributions to make to biology that an important chair of chemistry such as that at Glasgow should be occupied by one who has shown the keenness of his biochemical interests by his own sustained efforts and through the work of his pupils.

Memorial to Samuel Smiles, LL.D.

IN the latter half of the last century a book called "Self Help" was widely read, and an indication of this is shown by its having been translated into twenty-two languages. It developed from a lecture given by Dr. Samuel Smiles in the old Cholera Hospital, Leeds, to a mutual improvement class of working men. Smiles was born in 1812 at Haddington and educated at the Burgh School and at the University of Edinburgh, where he qualified as a medical man. Not having sufficient patients, he wrote articles, and these were seen by the proprietor of the *Leeds Times* who in 1838 asked him to be editor. In 1842, having then "had enough of unquiet life of newspaper work", he set up as a surgeon in Holbeck,

South Leeds. He was partly attracted there by the activities of a school and in his autobiography he says: "On Sundays I taught young men and sometimes gave addresses in Zion School, New Wortley." Smiles married the daughter of a Leeds contractor and in 1845 became secretary of the Leeds and Thirsk Railway, which was afterwards absorbed into the Midland Railway system. This occupation brought him into contact with engineers, and he began to collect data which later appeared in his five volumes of the "Lives of the Engineers"; "Industrial Biography"; "The Lives of George and Robert Stephenson", etc. By his writings and lectures, etc., he helped to create in the West Riding a strong public opinion on such questions as the repeal of the Corn Laws; Parliamentary reform; national education and free public libraries. Zion School was one of the first to have such a library. A memorial tablet in bronze is to be fixed on the old school building, and a set of his books has been presented by Sir John Murray, whose firm published them. Sir Walter D. Smiles, M.P., is also presenting an enlarged framed portrait. The organizer of the memorial is Mr. E. Kilburn Scott, of 38 Claremont Square, London, N.1.

"Shiva's Temple", Arizona

WIDESPREAD interest has been aroused by the investigation of "Shiva's Temple", in the Grand Canyon, Arizona, U.S.A., which is being explored by the Paterson-American Museum Grand Canyon Expedition, with Dr. Harold Anthony, curator of mammalogy in the American Museum of Natural History, as its leader. Shiva's Temple, an isolated cliff of limestone, rises to a height of 1,200 feet above the floor of the Canyon, and is surmounted by a wooded plateau two hundred and seventy-five acres in extent, which is reputed never to have been visited by man since the cliff was separated from the mainland at some time about the close of the Ice Age. It was anticipated that forms of animal life, if any, surviving on the plateau after so lengthy a period of isolation might afford valuable evidence of adaptation and divergence. Dr. Anthony and Mr. Edwin McKee, chief naturalist of the Grand Canyon National Park, with six other members of the expedition, reached the plateau on September 16 after a three hours' climb. Shed antlers of deer were seen, as well as chipmunk, a rabbit and signs of coyote. The first specimens brought to the base camp were a pair of leaf-eared mice. Traps have been set for other animals by Dr. Anthony, who remained on the plateau when other members of the party returned to the base camp. Supplies were dropped from an aeroplane, including water, of which no trace has been found on the plateau. This makes it remarkable that the party should have been much troubled by mosquitoes.

It would appear that before it was isolated, the plateau was a favourable hunting ground for early man. A number of stone arrow-heads and knives have been found. Unless these are the relics of an early party of adventurous climbers, which seems unlikely, they should help in assigning a date to the period of isolation, more especially if the arrow points should conform to the highly specialized type of stone implement known as the Folsom point, which is widely distributed over the High Lands of the south-western United States from Wyoming to New Mexico, though not yet found in characteristic form in Arizona. As mentioned below, stone implements have been found recently in South America in association with the extinct horse and giant ground sloth, while Folsom points have been found embedded in the bones of an extinct bison, as well as in association with that form and with the mammoth, at Folsom and Clovis in New Mexico and elsewhere. It is now beyond question that in certain parts of North America early man was contemporary with an extinct fauna which in Europe would justify a Pleistocene dating in the later part of the Ice Age. In America, however, it is generally conceded, the characteristic Pleistocene fauna, or at least certain members of it, may have survived to a much later date than in the Old World, while conditions militated against a very early appearance of man in the New. If the implements of Shiva's Temple are of the earliest type, and belong, as appears probable, to the pre-isolation period, they indicate on a conservative estimate an upward limit for the period of isolation of approximately ten thousand years, or possibly a little but not much more.

Ancient Man in Chile

AN expedition to Chile of the American Museum of Natural History, New York, extending over a period of two and a half years, is reported to have discovered a succession of stone age industries claimed to be of greater antiquity than any previously known in South America. More than four thousand stone implements, it is stated by Science Service, Washington, D.C., have been collected by Mr. and Mrs. Junius Bird, on behalf of the Museum, from two cave sites, Fell's Cave and Palli Aike Cave on the banks of the Rio Chico in southern Chile, near the Straits of Magellan. In the former of the two caves was a stratified succession of five cultures, of which the earliest included tanged spear-points, unique in South America, associated with the bones of the extinct horse and giant ground sloth. This culture was covered by a rockfall, while at Palli Aike, twenty miles away, the oldest culture period closes with a deposit of volcanic ash. Some considerable time after the fall of rock, Fell's Cave was again occupied by man. With the artefacts of this period are associated at first bones of the horse and ground sloth, and later of foxes, of which one form is extinct, and birds. The implements are cruder than those of the early stage. In this and the preceding period the animal bones have been split for the extraction of marrow and show the effects of fire.

The succeeding culture introduces the bola, of which the carefully grooved weights have been found with the stone graters used to make the grooves. Arrow points and knives appear with the bola in the fourth culture, which is dated tentatively at 2000 B.C. on comparative evidence. The last occupants of the cave, who show no affinity with their predecessors, were the possessors of a culture in many ways comparable with that of the Ona of Tierra del Fuego, who, up to a few years ago, used stone arrow-points similar to those found in the cave. The cave seems to have been abandoned before the Spanish conquest, as no bones of the horse then introduced into America have been found in it.

University Development at Birmingham

It is reported that the University of Birmingham is selling the Mason College site, and the price is said to be £400,000. If the negotiations are satisfactorily completed, the long-desired transfer of the whole of the University to the Edgbaston site will soon be an accomplished fact, and the uneconomical and very inconvenient separation of the faculties will be a thing of the past. Already the building of the new medical school (between the great new hospital and the University at Edgbaston) is nearing completion, and it is hoped that the school will be ready for opening next year. Such an event would be a fitting crown to the work of the Vice-Chancellor (Sir Charles Grant Robertson) who has expressed his intention of retiring at the end of the coming session and who has taken a leading part in the establishment of both hospital and medical school. The money resulting from the sale of the Mason College site will also make possible the expansion, and improvement of the equipment, of some of the departments already at Edgbaston, the Physics Department in particular, which is at present partly housed in old Army huts, inconvenient and unsightly.

Health and the Community

IN the account of the discussion in Section I (Physiology) of the British Association on "Health and the Community", which appeared in NATURE of September 18, p. 493, it is stated on p. 494 that the safest rate of reproduction for both mother and offspring is the modal rate. The author of the article has asked us to point out that this statement holds for any size of family, but the example of modal rate actually given was for a family of seven. This does not bear the implication that seven is the ideal number per family. Actually the lowest mortality was found in families of three, produced *at the modal rate*. The author has also sent the following supplementary note. "One point in the discussion of immense importance for the future not only of the race but also threatening civilization itself, was not sufficiently stressed in the article, namely, the *differential* birth rate. It follows from the facts that the modal rate is, on the whole, observed only in the lowest paid members of the community, and that they start reproduction early (less than twenty years of age), that the number of the population

below the poverty line, that is, those being maintained by the tax-payers, will steadily increase. In 1930, round about 10 per cent of the families had more than 40 per cent of the pregnancies, 45 per cent of the still-births, 53 per cent of the infant plus child mortalities and 63 per cent of the miscarriages. In 1950, the 10 per cent will have become at least 30 per cent. Nothing short of massacre can alter that now. Births cannot be retrospective. If nothing is done and the process goes on, in 1970, the submerged tenth will be multiplied by seven. This means that, apart altogether from the increasing load of old people, some 30 per cent of the population will have to face the problem of supporting the rest of the community."

The Short-Mayo Composite Aircraft

EXPERIMENTAL flights of the two units of this combination are proceeding successfully at Rochester. *Mercury*, a four-engined monoplane seaplane, which is to be attached to the top of, and launched from, *Maia*, a four-engined monoplane flying boat of a modified Empire type, have both flown separately, and have now to carry out trials, taking off, flying and landing as a combined unit. These will be followed by tests involving releasing in the air and landing as separate units, their normal functions. This experiment is one of fundamental importance in the problem of high-speed long-range flight, as it represents one of several possible methods of getting an aircraft into the air with a load which would make taking-off unsafe or even impossible for a machine under its own power. Heavy loads are not only economical from the transport point of view, but also high wing loading is essential for economical power consumption in high-speed flight. Reduction in engine power used not only reduces costs, but also increases the machine's range on a given fuel tank capacity. When this problem is successfully overcome, it will also help in the case of land aircraft, allowing the use of smaller aerodromes for large heavily loaded commercial machines.

ANOTHER point of the composite type of aircraft is that it will allow the engines of the launched machine to be of the supercharged type necessary for high altitude flying, without their having to carry the complications necessary to allow them to function efficiently at ground level, for the purpose of taking off, as well. Other methods of attaining the same object at present being developed are (1) the use of various wing attachments such as slots or flaps, wing surface and contour changing devices, variable pitch propellers, to increase the speed range of the aircraft, and (2) catapulting the machine into the air, giving it the speed necessary for flight with its high loading, from a momentum applied to it from an external source of power, usually either explosive or hydraulic.

Progress of Marine Engineering

On September 14, Mr. S. J. Pigott, director-in-charge of the Clydebank Works of John Brown and

Co., Ltd., where the *Queen Mary* was built, delivered the presidential address to the Institute of Marine Engineers. In the main it was a review of the development in marine engineering during the last sixty years. The era 1877-87, he said, might be designated "The Advent of Steel in Engineering". In that decade it was possible to raise the pressure in cylindrical boilers to 160 lb. per sq. in., and at the same time forced draught was introduced. The next decade, 1887-97, saw the development of the quadruple-expansion engine, which in the period 1897-1907 attained its maximum size. The year 1897 was also marked by the use by Sir Charles Parsons of the marine steam turbine, and in 1904 the Cunard Steamship Company equipped the *Carmania* with a high-pressure turbine driving a centre-line shaft and exhausting to a low-pressure turbine on each wing-shaft. The Diesel engine first made its appearance on shipboard in 1903 in the small Russian tanker *Vandal*. Another landmark was the fitting of geared turbines in the *Vespasian* in 1909. In 1910 impulse turbines as opposed to the earlier reaction turbines were fitted in H.M.S. *Bristol*, and to-day, the most highly powered British naval vessel, H.M.S. *Hood*, is propelled by impulse turbines with gearing. If the era 1927-37 has seen no epoch-making development, it has produced progressive designs as is seen in the cross-channel motor-ship *Prince Baudouin*, the turbo-electric P. and O. liner *Viceroy of India*, and last but not least the *Queen Mary* and *Normandie*.

Miniature Ball Bearings

AN invention which, apart from its intrinsic merits as a mechanical development, promises to be of especial interest in a scientific sense, is the introduction by a Swiss manufacturer of a range of miniature ball bearings. Ordinary bearings of this class have been made in sizes varying from half an inch to five feet in diameter overall; but nothing small enough has been available to satisfy the requirements of small and sensitive instruments. The bearings now obtainable as a result of this invention are of several different types and vary in size from 1 to 22 millimetres in diameter overall. They are thus of suitable size for use in such devices as small motors, recorders, meters, clockwork, tachometers and scientific instruments of many kinds in which measured movements are produced by infinitesimal forces, and friction must be eliminated as far as possible. Comparative tests on these bearings and the jewelled bearings they are intended to replace show advantages under three different modes of operation. The time to damp down a rotary motion was in some cases so high as eight times that when plain pivots were used and twenty times that when tapered pivots were used, though there is a good deal of variation in the results. In an oscillatory test the corresponding figures were about 4 and 15, while in the deviation test the results claimed are also favourable. As these new bearings are obtainable at moderate prices, it is probable that, after adequate trials, they will play an important part in the

future construction of scientific instruments. They are being marketed by International Technical Developments, Ltd., Thames House, Millbank, London, S.W.1.

The Wettest Place in the British Isles

DR. J. GLASSPOOLE, in an article entitled "The Wettest Place in the British Isles", which appears in the *Meteorological Magazine* of July, seeks to end the false idea so commonly held that Seathwaite, in Borrowdale, is the wettest place in Great Britain. He points out that there are several small areas nearly twice as wet as Seathwaite, and suggests that the common error has lasted so long because meteorological literature has not provided definite figures to disprove it. This lack of precise information has been due to the lack of rain gauges near the summits of the highest mountains in the four wettest areas over which the average annual rainfall exceeds 150 inches—areas in Snowdonia, the English Lake District, on Ben Nevis, and at the head of the River Garry in the western highlands of Scotland. Dr. Glasspoole considers that in the light of records now available and a study of the relationship between average rainfall and the configuration of the land, estimates can be made of the maximum rainfall in each of the four areas. In Snowdonia we have Glaslyn, at 2,500 feet, with 198 inches, which is probably a little less than the figure for the summit, only about 500 yards away. In the Lake District it is thought that 185 inches is not exceeded in the wettest area, which includes Scafell and Scafell Pike, while Ben Nevis, in spite of its greater elevation, is more isolated and in consequence offers less obstruction to the moisture-bearing winds, and its summit has a rainfall estimated at only about 165 inches. At the head of the River Garry, however, the fall on Sgurr na Cioche is thought to be comparable with that of the summit of Snowdon over a small area, namely, about 200 inches, compared with the 129 inches of Seathwaite Farm, which last is not even the wettest habitation in Great Britain.

Fortified Hill-top Site in Sussex

A ~~fortified~~ hill-top site on Mount Caburn, one mile north of Glynde, near Lewes, has been partially excavated by Dr. A. E. Wilson of Brighton Grammar School with the assistance of Dr. E. Cecil Curwen. Since July, it is reported in *The Times* of September 14, portions of the outer and inner ramparts and a length of Iron Age road, with three gateways, have been uncovered. Of the gateways, one on the north side of the town, where the slope is comparatively easy, is of considerable size and is provided with re-entrant ramparts on either side for purposes of defence. A number of sling stones were found. The steep slope of the south side was defended by ramparts and a deep ditch. There are indications in the ceramic evidence that the site was first occupied about 500 B.C., and was fortified about two hundred years later. Stratification revealed by trenching suggests two periods of reconstruction, one about 50 B.C., when the main gate was moved a few feet forward, and a second about one hundred years

later, when a second gate, forming a sort of barbican, was added. Piles of ash near this gate may be, it is conjectured, either a relic of the process of hardening the ends of oak stakes to be driven into the ground, or evidence that the town was destroyed by fire. Flint kerbs mark the edges of the Iron Age roadway, of which the surface is reinforced by flints at a distance of four feet six inches apart, indicating that the gauge of the prehistoric cart was approximately the same as that of the modern cart. One of the ramparts shows what appears to be an early attempt to mix a concrete, powdered chalk apparently being mixed with water and rubble. A grant of £20 made by the Sussex Archaeological Society has made it possible to continue the work of excavation until the end of October.

Prehistoric Finds at Glasgow

EVIDENCE, it is claimed, indicating the site of a wooden circle, or temple, the largest of its kind yet known, has been found at Knappers, on the Dumtocher Boulevard, Glasgow. The site has been under investigation for some weeks by Mr. Ludovic McLellan Mann and Capt. Robert Bush Black, the proprietor of the land. The circle, it is reported in *The Times* of September 15, has a radius of 86 ft., the ground plan being revealed by the socket-holes which held the wooden posts and showing a symmetrical arrangement, "involving circles, ellipses and a large number of serpentine figures". A cemetery adjoins the circle containing fifty-three burials, both cremated and inhumed, with grave furniture and stone settings, many of which are said to be of an unusual nature. The associated funerary vessels fall into four classes and indicate both stone and bronze age datings. For the further exploration of the site financial assistance is required. Should this be adequate the site will be preserved and the monument reconstructed. Donations should be addressed to Mr. J. Eric Fergusson, 166 Buchanan Street, Glasgow.

Educational Films

FROM the British Film Institute we have received three lists, intended for the use of teachers, of about a thousand 16 mm. films: "Geography Teaching and Travel" (about 600), "Science" (400) and "History" (30). Against the title of each is shown its length, whether silent or sound, reference to report, if any, in the Institute's monthly film bulletin, and name and address of distributor. A large majority of the films are silent. Among the sound films are thirty "road-shows" obtainable through Sound-Services, Ltd., which provides a complete projection service in combination with the hire of films. The other sources of supply are very various: camera makers (Kodak, etc.), trade publicity organisations (Australian and Canadian), railway and other travel agencies (L.M.S., Scottish, German, Dutch), firms specializing in educational films such as British Instructional Films, Ltd., Educational Films Bureau, Educational and General Services, Ltd., Gaumont-British Equipment, Ltd., Visual Education, Ltd., and Dance-Kaufmann Technical Films; also the Empire Film Library,

G.P.O. Film Library and the National Film Library of the British Film Institute. Of the science films more than half are classified as zoology; others as physics and meteorology (72), botany (40), mathematics, astronomy, chemistry, geology, physiology and applied science. The prices, exclusive of postage, are: geography, 6d.; science, 4d.; history, nil. The Institute also issues lists of films dealing with agriculture and industry and catalogues of British medical films. The lists should prove useful to teachers, especially those who do not have access to the National Encyclopaedia of Educational Films. The Institute co-operated with the Educational Handwork Association in organizing a Film School, held in the University of London Institute of Education on July 26–August 6, at which there were lectures on the use of the film in school, film making for teachers, technique and manipulation, etc.

The Carnegie United Kingdom Trust

THE Carnegie United Kingdom Trust's annual reports are always worth reading, not only for the intrinsic interest of the Trust's achievements but also as revealing the latest developments of the administrative policies gradually evolved by the trustees. Co-operation with other trusts and relation to Government services are two aspects of the Trust administration that tend to call increasingly for careful study, owing to recent creations of other and comparable trusts and the ever-increasing liberality of the statutory services, notably since the inauguration of the Government's national health and youth programme. In this connexion, the report for 1936 notes that the Trust's playing fields policy, which has been completely successful, has now been discontinued, the future fulfilment of its objects having been sufficiently secured. Of the various land-settlement schemes which the Trust has been helping to finance, very encouraging accounts are given. "One of the most striking features of the new full-time holdings is the brightness of spirits of the whole community", although most of the men (about 110) had been unemployed for several years. Part-time subsistence holdings (about 1,000 in all) have been an immediate success in nearly every district where they have been established. Of the village halls the Trust has helped to finance, the report says their existence "has given new life to the community. Other recipients of the Trust's help during the year were: young farmers' clubs, the National Council of Social Service, new estates' community centres, amateur music societies, conductors' schools, adult education (inquiry into social and educational needs of the 18 + age-group), museums and libraries.

University or Polytechnic

IN the current issue of *Queen's Quarterly*, a Canadian review, "The Higher Learning" is discussed by Dr. R. C. Wallace, formerly president of the University of Alberta and now principal of Queen's University, Ontario. He refers to a recent assessment by R. M. Hutchins, president of the University of Chicago, of "The Higher Learning in America" (Yale

University Press) which confirms Abraham Flexner's estimate of the modern university. Admitting that there is a tendency for the university to become a mere congeries of professional schools deserving rather the name of polytechnic, Dr. Wallace rejects the suggested remedy—the severance of professional schools from the university and the restriction of the university's field to the fundamental sciences and mental discipline, such as metaphysics. He argues that the aim of liberalizing university education may be realized by invigorating and revitalizing the arts school, establishing a system of organic connexions and interchange of thought between it and other parts of the university so that its influence may permeate them all, and selecting for key positions in the professional schools persons of wide sympathies and philosophic outlook capable of using professional courses as instruments of mental culture as well as of vocational training. So confident is he of the potential liberalizing influence of the arts school that he declares its actual impotence to be the gravest fault of the existing university system.

Economic Position and Outlook in Germany

AN admirable review of the economic outlook of Germany, contributed by Alwyn Parker to *Lloyds Bank, Ltd., Monthly Review* of July, deserves attention not only for its sympathetic but dispassionate analysis of the present economic situation in Germany but also for its discerning attempt to understand and interpret the motives and aims of the German system. It is pointed out that the serious cleavage of outlook between the Anglo-Saxon and the German owing to the clash of strong and irreconcilable historical traditions need not be incompatible with broad and real community of aim, sentiment and policy abroad. The author traces the factors which have rendered Germany a peculiarly receptive and fertile soil for the idea of self-sufficiency. Scientific workers will be interested in his critical review of the development of synthetic processes in Germany, notably his assessment of the petrol and synthetic rubber position, as well as in his discussion of the raw materials situation. In regard to rubber, he ventures the opinion that the large-scale substitution of a costly State-subsidized synthetic product for a cheap imported material must cause some abrasion of Germany's capital resources. The greatest interest of this survey lies not in its technical details but in its attempt to understand the German mind, its plea for fair-mindedness and its attempt to forecast the lines of understanding. The author indicates certain steps that the German Government could well take of itself, but while he obviously is unimpressed with Germany's legal or economic case for the return of her colonies, he emphasizes the value of some moderate colonial settlement and the opportunity for the best qualities of philosophic statesmanship and vision. This plea for impartial investigation and goodwill should not be overlooked by any who are concerned with re-establishing an international order in which Anglo-German friendship must find its place.

American Museum Meteorite Collections

DR. CHESTER A. REEDS gives in *Bull. Amer. Mus. Nat. Hist.* (1937) a detailed catalogue of the meteorites contained in this collection, which in 1935 was transferred from the Department of Geology to that of Astronomy, and is now housed in the new planetarium building. The previous catalogue, by Dr. E. O. Hovey in 1896, showed 45 specimens representing twenty-six falls. The collection now contains 3,744 specimens, representing 546 of the 1,073 falls known to the end of the year 1935. The large number of specimens is partly accounted for by 2,129 stones, ranging in weight from 0.2 to 6,850 grams, from the Holbrook, Arizona, shower of 1912. Notable masses are the three Cape York, Greenland, siderites, the largest of which weighs $36\frac{1}{2}$ tons, that is, short tons of 2,000 lb., and is by far the largest meteorite preserved in a museum; and the Willemette, Oregon, siderite of 14.2 metric tons. Much of the general information in the catalogue, even that relating to American meteorites, is reproduced word for word from the late Dr. G. T. Prior's British Museum catalogue.

Mining Industry of Canada

THE Department of Mines of the Dominion of Canada has issued as usual its report for the Fiscal Year ending March 31, 1936 (Ottawa: King's Printer, 1936. 25 cents). This is a valuable paper and deserves careful study, especially the opening pages signed by Charles Camsell, Deputy Minister of Mines, which give a brief review of the whole mining industry of Canada; of course, the record of the gold industry is exceptionally important owing to the increased price of gold, but the base metals, copper, lead and zinc, also improved and played an important part in the increased value of the exports of base metals. This opening chapter is followed by fuller accounts of the various divisions included under mines, such as mineral resources, ore dressing and metallurgical, fuels and fuel testing, etc.

Centenary of Van der Waals

IN commemoration of the birth of J. D. v. d. Waals on November 23, 1837, an international conference on interaction between molecules will be organized by the "van der Waals Fonds" and the "Nederlandsche Natuurkundige Vereniging". The ordinary sessions will be held in the van der Waals Laboratorium at Amsterdam on November 25 and 26, and an official celebration will take place on November 27. The object of the conference is to give a survey of some of the recent work connected with the ideas of van der Waals forces. The programme will be published later. Sufficient time will be left for general discussion. A special number of *Physica* will appear during the conference; it is hoped to be able to publish in this issue a number of papers on a variety of questions having some relation to the work of van der Waals. Physicists willing to contribute to it should send in their manuscripts before October 15, and though it will be impossible to read all these papers during the conference, it is hoped

that they will play an important part in the discussions. The organizing committee, comprising Prof. J. D. v. d. Waals, Dr. A. Michels, Prof. Dr. J. A. Prins and Dr. H. B. G. Casimir, van der Waals Laboratorium, Nieuwe Achtergracht 129, Amsterdam (C), will be glad to give further information.

Solvay Conference

THE Institut International de Chimie Solvay has issued personal invitations to its sixth chemical conference, which is to take place in Brussels on October 4-9, the chosen subjects for discussion being vitamins and hormones. Eight main papers have been promised, namely: P. Karrer, a general report on vitamins; H. von Euler, carotenoid and B₂ vitamins; Ad. Windaus, vitamins D and B₁; W. N. Haworth, ascorbic acid; A. Szent-Györgyi, physiological and therapeutic properties of the vitamins; L. Ruzicka, a general report on hormones; E. Laqueur, sex hormones; T. Kógl, vegetable hormones. Including those named, some twenty-five of the leading workers in these subjects have accepted invitations, so that very valuable discussions should take place during the eight sessions.

Announcements

THE Harben Lectures for 1937 will be delivered in the Lecture Hall of the Institute of Hygiene, London, on October 11, 12 and 13 at 4.30 p.m. by Prof. E. C. Dodds, Courtauld professor of biochemistry in the University of London, on "The Theoretical and Practical Significance of Endocrinology".

THE third National Coal Convention will be held at Harrogate on October 6-7, when the speakers will include Lord Horder and Sir Frederick Sykes, chairman of the Miners' Welfare Committee.

THE Lilienthal Society of Aviation, founded in 1936, will hold its annual congress at Munich on October 12-14, when there will be an exhibition relating to aviation. Further information can be obtained from the general secretary of the Society, Wilhelmstrasse 148, Berlin, S.W.68.

THE ninth International Congress on Psychotherapy will be held in Copenhagen on October 2-4. Prof. C. G. Jung of Zurich and Dr. Paul Bjerre will give the inaugural addresses. The chief subjects for discussion will be psychotherapy in general practice and "Can Psychotherapy be Taught?" Further information can be obtained from the general secretary, Dr. Olaf Bruel, 2 Amagertorv, Copenhagen K.

A SESSIONAL meeting of the Royal Sanitary Institute will be held on October 1 in the Town Hall, Llandudno, when Dr. D. A. Powell, principal medical officer of the King Edward VII Welsh National Memorial Association, will open a discussion on "Tuberculosis in Wales—a Stock taking", and Dr. R. W. Dodgson, director of the Ministry of Agriculture and Fisheries Shellfish Services, will speak on the Conway mussel purification tanks. On October 2 a visit will be paid to the Conway Station for a demonstration and inspection of the tanks. Further information can be obtained from the Secretary, Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 550.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays

It is the purpose of this note to point out how rapidly and efficiently ternary equilibrium diagrams may be elucidated by means of X-ray analysis. In a recent paper, Jette¹ described a partial analysis of the chromium-iron-silicon system by X-rays. We have carried out the analysis of several ternary diagrams which will be published shortly. As an example, we give the diagram for the copper-nickel-aluminium system, the compositions being represented in the usual way by points within an equilateral triangle. Any one such diagram shows the phases at a given temperature, and a series of such diagrams is required to represent the state of affairs at different temperatures. The present diagram actually shows the phases present after a uniform heat treatment of slow cooling at 10° C. per hour. No claim is made that equilibrium has been established, our main object being to show the exploratory power of X-ray analysis. It will be supposed that the binary equilibrium diagrams, represented by the three sides of the triangle, have previously been established by metallurgical or X-ray methods. It is our experience that the investigation of the whole interior of the ternary diagram is, in general, easier than that of a single complicated binary system, since for the most part the phases are the same as those of the binaries. In other words, the appearance of quite a new phase is comparatively rare; we merely have to determine how far the two-component phases extend into areas of the ternary diagram.

The power and rapidity of the X-ray methods are due to the large amount of information which can be obtained from each powder-photograph of an alloy. The extent of this information makes it possible to explore the whole area by making up a relatively small number of alloys, judiciously chosen so as to fix the important feature of the boundaries. An X-ray photograph tells us:

(a) The number of phases present, which may be one, two, or three in a ternary diagram.

(b) The type of each phase, that is, face-centred cubic, body-centred cubic, 'γ' structure, etc.

(c) The lattice spacing of each phase, which in most cases makes it possible to deduce the compositions of the separate phases in a two-phase or three-phase area.

(d) The relative amounts of the phases present, deduced from the relative intensities of their lines

in the photograph. In addition, the presence of superlattice lines can be detected.

The ternary diagram CuNiAl is shown in Fig. 1. It is divided into single-phase, two-phase and three-phase areas. The single-phase areas have curved

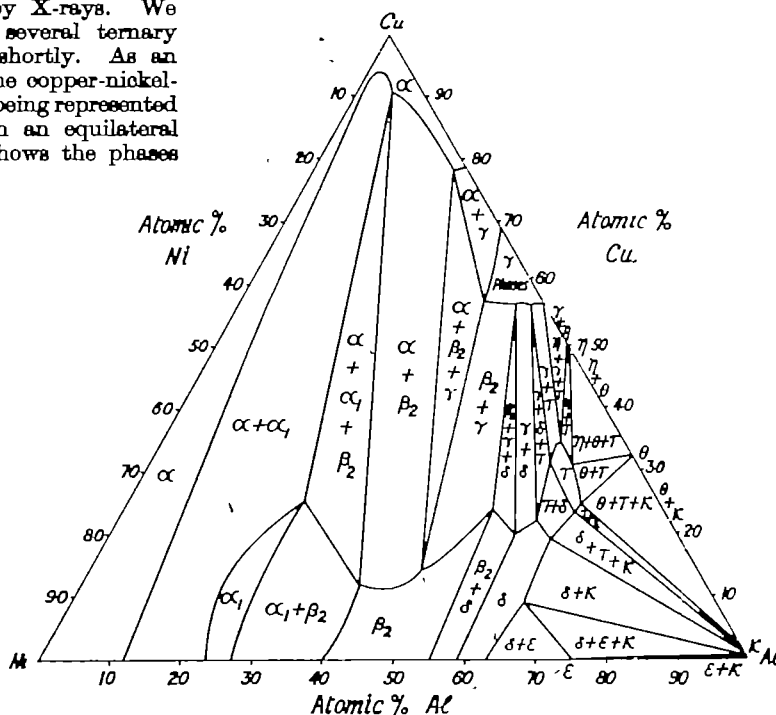


FIG. 1

boundaries. The two-phase areas are covered by 'tie lines' (not shown in the diagram though their general direction can be guessed from the straight-line boundaries of the areas). An alloy of composition represented by a point in a two-phase area breaks up into two phases of compositions represented by the ends of the tie-line running through the point from one single phase area to another. The three-phase areas are triangles, the vertices of which are at cusps on single-phase areas. An alloy anywhere within a three-phase area breaks up into three phases of the compositions represented by the vertices. The diagram exemplifies these points.

Nomenclature presents some difficulties². We have tentatively called all face-centred cubic phases 'α', body-centred 'β' and γ-type 'γ'. Superlattices are denoted by suffixes, for example, α₁, β₁. Phases only appearing with three components are denoted by Greek letters from the end of the alphabet, for example, τ, which checks with the phase found by

Bingham and Haughton³. The γ phases in the CuAl system are of several types, which cannot be shown separately on the present diagram.

We have made such investigations of the FeNiAl, CuNiAl and CuFeAl systems, and are investigating the FeCuNi system. These form ternaries from the four faces of a *quaternary tetrahedron*, and it is already possible to see the general nature of the equilibrium diagram for the quaternary system FeNiAlCu. There are indications of very interesting general features of these diagrams, in particular the effects of electron-atom ratio⁴.

We are indebted to Prof. W. L. Bragg for his kind interest in this work.

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¹ Andersen, A. G. H., and Jette, Eric R., *Trans. Amer. Soc. Metals*, **24** (3), 375-419 (1936).

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³ Bingham, K. H., and Haughton, J. L., *J. Inst. Met.*, **20**, 71 (1923).
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New Observations on Responses to Colours in Egg-laying Butterflies

It has previously been shown¹ that hungry cabbage butterflies give a specific response, "spontaneous feeding response", on red, yellow, blue and violet papers, but not on green, bluish green or grey of any shade between black and white. Whether the insects confused green and bluish green with grey could not be investigated as they could not be trained on these colours.

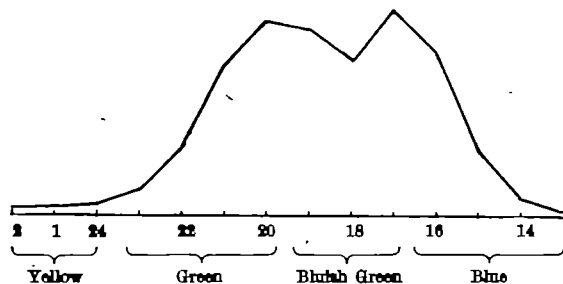


Fig. 1.

I have now found another specific response to colours which makes it possible to investigate this point. As in several other species of butterflies² the female cabbage white, *Pieris brassicae* L., during egg laying will fly to leaves of various plants and on their surface perform what I have called a "drumming reaction". This reaction consists in a very quick alternating movement of the first pair of legs. It can be elicited by any object which shows certain colours. As it cannot be confused with the feeding response, it has been used as a basis for a new series of experiments on colour vision.

In every experiment, fifteen small models, cut out of grey papers of several different shades, and of coloured papers belonging to the twenty-four

Standard Ostwald papers, were offered simultaneously. All the grey papers were entirely neglected. The results for the coloured papers are shown in two curves (Figs. 1 and 2). In Fig. 1, the colours from yellow to blue, according to their position in the spectrum, are plotted against the relative number of drumming reactions on each colour.

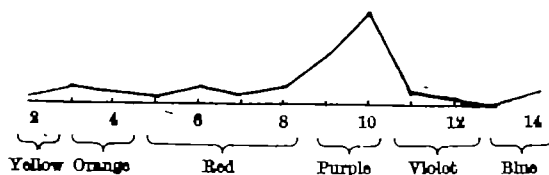


Fig. 2.

It can be seen that the butterflies in the stage of egg laying very distinctly select a continuous range from "Emerald Green" (Ostwald No. 22) to "Oxide Blue" (Ostwald No. 16) which is slightly greenish; whereas yellow and pure blue are practically neglected. This shows that they were able to distinguish this range of colours—the greater part of which had been neglected by the same insect when seeking food—from grey as well as from yellow and pure blue. The definite distinction between yellow and green was surprising, because these two colours are confused by most insects, especially the hive bee³. Thus the humming bird hawkmoth, which during egg laying is attracted by green, visits yellow as well, but neglects bluish green⁴. Exactly those bluish green papers which by most insects are constantly neglected, or even confused with grey⁵, proved to be most attractive to the female cabbage white. This is a new proof that the system of colour vision in *Pieris* must be entirely different from that in the hive bee and most other insects, and nearer to that of man.

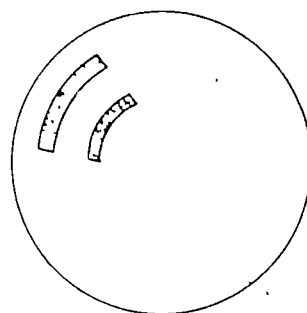


Fig. 3.

COLOURED DISKS WITH GRAY STRIPES (STIPPLED) OFFERED TO INSECTS

Another observation also supports this suggestion. Fig. 2 shows the relative number of drumming reactions on the Ostwald papers beyond yellow and blue. It was surprising to find among these colours a distinct though comparatively small peak in purple (Nos. 9 and 10). A more careful observation of the drumming on purple, however, showed that about half the reactions were performed on the adjacent background, which never happened when the insects drummed on green or bluish green. This raised the suggestion that for the eyes of the cabbage white, as for those of man, the purple colours might induce a greenish colour in their surroundings by a simultaneous colour contrast. (For the eyes of the hive bee, purple seems to induce a yellowish colour⁶.)

To decide this question, in a second series of experiments much bigger models were used, which made it easier to see the exact place of the drumming. Moreover, these models had been furnished with a few small colourless stripes (see Fig. 3) which for our eyes showed an especially strong contrasting colour. In an experiment where two green disks (No. 22 and 21) and two purple disks (No. 9 and 10), each of six inches diameter, were offered simultaneously, the result was as follows:

	Number of drumming reactions on:			
	Coloured disk	Adjacent background	Colourless stripes	Total
Green	48	2	0	50
Purple	0	6	9	15

This provides very suggestive, if not conclusive evidence, that, for the eye of the cabbage white, on the colourless areas adjacent to purple, one of the greenish colours which elicits a distinct drumming reaction had been induced by a simultaneous colour contrast.

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¹ Ilse, D., *Z. vergl. Physiol.*, 8 (1928).

² Ilse, D., *Stimmen der d. Zool. Entomol. Ges.*, 7 (1927).

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Photo-labile Pigments of the Chicken Retina

THOUGH visual purples of the retinal rods have been known for sixty years^{1,2}, nothing has been learned directly of analogous substances in the cones. In the chicken retina, which contains principally cones, attempts to identify photo-labile pigments heretofore have failed³. I have extracted from it two such pigments.

Retinas of ten 8-week old dark-adapted chickens, prepared in very dim red light, are ground immediately in 4 c.c. of 3 per cent sodium chloride and 2 per cent digitonin in water. This mixture is centrifuged after about eight hours in the dark at room temperature. Spectra of a 1 cm. layer of the extract are recorded photo-electrically.

The extract is light orange in colour and possesses a complicated spectrum. On irradiation with deep red light (above 650 mμ), its extinction falls between about 470 and 700 mμ, maximally at about 575 mμ, and rises below about 430 mμ. Sufficiently long irradiation completes these changes. The final difference in extinction between the unbleached and bleached preparations ('difference spectrum') is shown in Fig. 1 A. I believe it to represent the photo-labile pigment of the cones.

When red light produces no further effect, the residue is exposed to bright white light. The extinction now falls between about 435 and 620 mμ, maximally at about 508 mμ, and rises below about 430 mμ. The difference spectrum of this change is shown in Fig. 1 B. It is characteristic of rhodopsin^{4,5}.

If retinas are soaked in 4 per cent alum for several hours following dissection, their digitonin extracts yield the difference spectrum of rhodopsin alone. The alum treatment apparently renders the cone pigment

insoluble. An extract of chicken retinas with 2 per cent disodium phosphate, freezing and thawing several times during extraction, displayed no measurable trace of either pigment.

The rise in absorption below 480 mμ on irradiation shows the cone pigment, like rhodopsin⁴ and porphyropsin—the visual purple of certain freshwater fishes⁴—to bleach to coloured products. Its difference spectrum, therefore, may partly resemble, but obviously is not, its true absorption spectrum.

Rhodopsin, porphyropsin and the cone photopigment form a graded series, in which functions and properties run closely parallel. Their colours are respectively red, purple and apparently violet. I propose to call the cone pigment *iodopsin* (iov = violet).

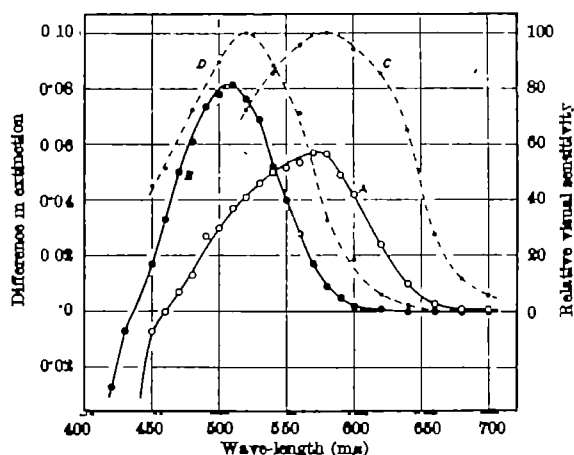


Fig. 1.

CHANGES IN EXTINCTION OF CHICKEN RETINAL EXTRACT DUE TO (A) IRRADIATION WITH RED LIGHT, AND (B) SUBSEQUENT IRRADIATION WITH WHITE LIGHT. BROKEN LINES SHOW HONIGSMANN'S MEASUREMENTS OF SPECTRAL SENSITIVITY OF (C) LIGHT-ADAPTED, AND (D) DARK-ADAPTED CHICKENS.

The positive portion of the difference spectrum of rhodopsin resembles the sensitivity of the rods to light of various wave-lengths⁶ (sensitivity here is the reciprocal of the minimum energy needed to evoke a constant response). A similar relation has been inferred to exist between known spectral sensitivities of cones and the spectra of hypothetical cone photopigments^{7,8}. Honigsmann⁷ has measured the spectral sensitivity of light- and dark-adapted chickens. His data, plotted as percentages of their maxima, are shown in Fig. 1 C (light adapted—cone function) and Fig. 1 D (dark adapted—rod function). Light adaptation shifts the maximal sensitivity from about 520 to about 580 mμ. This is the familiar Purkinje effect, for which clearly the extracted photo-pigments form an adequate chemical basis.

The difference spectra of rhodopsin and porphyropsin are nearly symmetrical in form⁹, while that of iodopsin is decidedly skew, due to stronger absorption on the short wave-length side of its maximum. In this spectral region the visual sensitivity might be expected to be correspondingly high. However, this is also the region in which the effectiveness of light entering the chicken cones is decreased through absorption by carotenoid filters¹⁰. The net result is the nearly symmetrical sensitivity function shown in Fig. 1 C.

Trichromatic vision in man may depend upon the presence in the cones of three distinct photo-labile pigments, differing in absorption characteristics¹. In the chicken retina three groups of colour filters provide a possible basis for hue differentiation. It is unnecessary, therefore, to assume more than a single cone photo-pigment in this animal.

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¹ Boll, F., *Arch. Physiol.*, 1, 4 (1877).

² Kühne, W., *Unters. physiol. Inst. Heidelberg*, 1, 15 (1877).

³ Kottgen, B., and Abelsdorf, G., *Z. Psych. u. Physiol. Sinnesorg.*, 18, 161 (1906).

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⁷ Honigsmann, H., *Arch. ges. Physiol.*, 189, 1 (1921).

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Hæmodynamic Factors in the Uterus during the Latter Part of Gestation

ACCORDING to the data of Barcroft, Herkel and Hill¹, a critical change takes place in the rate of blood flow through the uterus of the rabbit after the twenty-second day of pregnancy. The rate of flow diminishes approximately one third between this and the twenty-fifth day, although it increases again by the twenty-seventh day of gestation. In an earlier paper by Barcroft and Rothschild², measurements were made of the volume of blood contained within the maternal vessels of the uterus on different days of pregnancy. The data of this study show that the volume of blood increases to a maximum by the twenty-eighth day and diminishes by fifty per cent during the next two days. The volume of the placental tissues during this time follows a parallel curve, so leading these investigators to the reasonable conclusion that the volume of blood in the uterus increases as the extent of the placental vascular bed increases. The cause of the changes in the rate of blood flow through these vessels has not, however, been described. When the foregoing data were used to estimate the efficiency of the uterine circulation during the latter part of gestation as certain growth changes take place, an insight was gained into some of the hæmodynamic factors operating at this time, providing a basis for interpreting the effects which Barcroft and his associates have reported.

The percentage of the blood volume which changes each minute (that is, the efficiency of the maternal circulation in the uterus) has been calculated from the data cited above with the result shown in the accompanying table:

Day of pregnancy	Blood volume of uterus	Minute-volume of blood	Efficiency (% turn-over)
14	80.0 cc	5.0 c.c./min.	62.5
18	12.5 "	13.5 "	109.7
20	14.5 "	20.0 "	137.1
22	16.2 "	29.0 "	179.0
25	21.5 "	19.0 "	88.3
27	29.0 "	27.5 "	94.8
28	32.0 "	28.5 "	89.0

Here, it will be seen, a marked increase takes place in the turn-over of the blood each minute until the twenty-second day, as the blood volume increases coincidentally. By the twenty-fifth day a marked decrease occurs in the efficiency of the local circulation. This fall parallels that which takes place in the circulation rate. From this point on, so far as the data go, this level of efficiency in the uterine circulation is maintained. The level at this time equals that found on the seventeenth day of pregnancy when the embryos are almost inappreciable in size, whereas by the twenty-fifth day they are comparatively large and are growing at a nearly maximum rate³. The oxygen requirement of the embryos is met by greater oxygen unsaturation of the blood as it flows through the uterus⁴.

The significance of these considerations is shown by the recent discovery that a critical change occurs in the relationship between the rate of growth of the uterus and the growth of the products of conception about the twenty-second day of gestation. Between the twenty-second and the twenty-fourth days the uterus commences to grow less rapidly, from causes already described^{5,6}. At the same time, the products of conception grow at a rate almost as rapid as at any time during pregnancy^{3,4}. The foetuses and their associated structures must act, therefore, as an impeding influence to the maternal circulation and so serve as a factor which diminishes the quantity of blood flowing through the maternal vessels of the uterus at this time. This resistance to the local flow of blood in the maternal circulation of the uterus is transient, however, as shown by the data of Barcroft, Herkel and Hill.

It is therefore clear that the rate and efficiency of the blood flow in the maternal circulation of the uterus are adversely affected as the influence of distention first becomes manifest, but with increasing degrees of distention as pregnancy nears term, some compensating adjustment takes place which maintains the efficiency of this local circulation of blood. The pumping action of the increasing muscular movements which are known to take place at this time⁷ would serve such a purpose. The efficiency and forcefulness of these contractions would likewise be enhanced by the increasing distention resulting from the disproportion in the rates of uterine and foetal growth respectively.

These considerations suggest, therefore, that the increasing distention which the uterus undergoes in the latter part of gestation first brings about a diminution in the efficiency of the maternal circulation through the uterus. As the degree of distention becomes greater, however, it becomes *pari passu* the means by which the efficiency of this circulation is maintained, mainly by virtue of the influence which distention has upon the contractility of the myometrium.

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¹ Barcroft, J., Herkel, W., and Hill, S., *J. Physiol.*, 77, 194 (1935).

² Barcroft, J., and Rothschild, P., *J. Physiol.*, 76, 447 (1932).

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Devernalization of Spring Rye by Anaerobic Conditions and Revernalization by Low Temperature

A PREVIOUS letter in NATURE¹ presented evidence to show that in winter rye (var. Petkus) anaerobic conditions at normal temperatures (20° C.) when alternated with aerobic conditions at 1° C. quantitatively annul the vernalizing effect of low temperature. It appeared possible, therefore, that spring rye of the same variety might be devernalized by the application of anaerobic treatment at 20° C. Previous work^{2,3} has shown that the process of vernalization in winter rye decreases the number of leaves produced on the main axis before flower initiation, as well as decreasing the period of time required to reach anthesis. An increase in these characteristics in spring rye after anaerobic treatment would thus indicate a process of devernalization.

The experiment was performed by sealing the grains in tubes, with sufficient water to imbibe them fully, in an atmosphere of pure nitrogen, leaving for varying periods at 20° C., and then sowing in sand culture. Periods up to three weeks alone could be used, as longer exposures to anaerobic conditions led to death of the seeds.

The results of this experiment are given in Table 1.

Table 1.
DEVERNALIZATION OF SPRING RYE BY ANAEROBIC TREATMENT

Preliminary period in nitrogen	No. of leaves on main axis	Days to anthesis	No. of replicates
Control (none)	6.80 ± 0.20	50.3 ± 0.49	10
1 week	7.52 ± 0.11	52.6 ± 0.45	23
2 weeks	7.67 ± 0.13	54.4 ± 0.73	24
3 weeks	8.29 ± 0.35	57.4 ± 1.7	7

A significant increase in leaf number and time to anthesis follows anaerobic treatment, thus establishing the possibility of devernalization at normal temperature.

The process of vernalization is held by us to be a specific effect of low temperature, and in confirmation of this view it has been established that spring rye partially devernalized by anaerobic conditions may again be vernalized by subsequent exposure in air to 1° C. The data are given in Table 2.

Table 2.
REVERNALIZATION OF SPRING RYE AFTER ANAEROBIC TREATMENT
All variants, except controls, received 3 weeks' chilling at 1° C. in air after removal from anaerobic conditions.

Preliminary anaerobic treatment	No. of leaves on main axis	Days to anthesis	No. of replicates
Control (none)	6.80 ± 0.20	50.3 ± 0.49	10
1 week	—	47.3 ± 0.34	14
2 weeks	7.10 ± 0.23	50.5 ± 0.79	10
3 weeks	All plants failed		

It will be noted that both leaf number and time to anthesis have been reduced to the level of the controls which were untreated.

These results thus add further evidence for the reversible nature of the vernalization process.

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¹ Gregory, F. G., and Purvis, O. N., NATURE, 133, 1013 (Dec. 12, 1936).

² Purvis, O. N., Ann. Bot., 43, 919-955 (1934)

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Artificially Prepared Visible Paracrystalline Fibres of Tobacco Mosaic Virus Nucleoprotein

A RECENT letter in these columns¹ contained photomicrographs of mesomorphic or paracrystalline fibres of tobacco mosaic virus which had formed spontaneously in clarified juice expressed from diseased tobacco leaves. Similar fibres have now been prepared from solutions of the pure virus protein by suitably adjusting the pH value of the medium and the salt and virus concentrations. Although the fibres may be produced over a relatively wide range of pH values, the best results are obtained at a pH value of about 5 (near to the point where, in the comparative absence of salts, virus solutions are most viscous or gel-like).

The pure virus was obtained by a combination of precipitation with 15 per cent ammonium sulphate solution at pH 7 with isoelectric precipitation from acetate buffers at pH 3.4 as previously described². A suitable salt concentration is provided by 0.4 M ammonium sulphate. The fibres formed under these conditions have the same dimensions and properties as the fibres previously described¹, except that they are frequently more easily broken up.

Spontaneously formed fibres, when separated and dissolved in water, give a solution containing no visible ($\times 1000$) particles, but by adjusting the pH value and salt concentration the long flexible paracrystalline fibres are re-formed. Samples of pure virus protein prepared from spontaneously formed fibres, from artificially formed fibres or prepared in the ordinary way, contain (on a dry weight basis) the same percentage nitrogen (16.6) and phosphorus (0.5), and when diluted to one part by weight in a million give comparable numbers of primary lesions on *Nicotiana glauca* leaves.

The temperature at which artificially formed fibres disrupt is the same as for the spontaneously formed ones. Taken in conjunction with the evidence presented in the previous letter¹, there can be no doubt of the identity of the fibres with the virus.

Bernal and Fankuchen³, by means of X-ray analysis, deduced the arrangement of the virus molecules within the paracrystalline aggregates. They point out that in view of this structure, homogeneity of the aggregates is less certain. I assume that by this they mean that viruses like yellow tobacco mosaic, a closely related mutant strain of ordinary mosaic virus, may form a part of such aggregates without altering the general arrangement. This is a possibility which cannot be overlooked. However, my preparations were derived from plants which had been artificially infected with virus separated at its iso-electric point of pH 3.4, and which had been raised in an isolated compartment of an insect-proof glasshouse and showed no symptoms other than those of ordinary mosaic.

The finding of Bawden and Pirie⁴ that the virus contains nucleic acid has been confirmed, and my preparations contain 0.52 per cent phosphorus. There is evidence to associate the acid prosthetic groups deduced by me⁵ on the basis of the pH activity curve for this virus, with the nucleic acid demonstrated by Bawden and Pirie. The circumstance that Stanley's⁶ earlier preparations contained no demonstrable amounts of phosphorus, and the presence of small but variable amounts in his later preparations⁷ are understandable when it is realized that during the purification processes his preparations were exposed to pH values which are known to

inactivate a large percentage of the virus, and that this action must have been more pronounced in his earlier methods. The test for active virus is much more sensitive than the test for phosphorus.

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- ¹ Best, Rupert J., *NATURE*, 139, 633 (1937).
² Best, Rupert J., *Austral. J. Exp. Biol.*, 14, 1 (1936).
³ Bernal, J. D., and Fankuchen, L., *NATURE*, 139, 923 (1937).
⁴ Bawden, F. O., Pyle, M. W., Bernal, J. D., and Fankuchen, L., *NATURE*, 139, 1061 (1936).
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⁶ Stanley, W. M., *Phytopath.*, 25, 305 (1936).
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Blood-groups of Veddahs

BLOOD-GROUPING in the field in Ceylon presents almost insurmountable difficulties, so that no records of blood-grouping of the Veddahs have been hitherto published. Until recently I had only one record—that of a Veddah whom I had persuaded to come down to Colombo for treatment in hospital. Recently, however, I had the opportunity of making observations on a series of four more Veddahs. These were brought to Colombo, with two others, who refused to give blood, by an enterprising showman, for exhibition at a fair held on the occasion of the Coronation celebrations. All the Veddahs were tolerably good specimens of their race. The blood samples were examined independently by myself and by the staff of the Pathology Department, General Hospital, Colombo, with identical results. I used imported standard sera (Burroughs and Wellcome's) that had been kept in the refrigerator. The hospital authorities make their own standard sera. Although the numbers examined are too few for any definite conclusions to be drawn, I consider they are worthy of record in so far as no previous information is available relative to this important race.

TABLE I BLOOD-GROUPS OF VEDDAHs

Veddah No.	Name	Sex	Locality	Blood-group
1.	Davitha	♂	Buhgabadena Bintenno	B
2.	Kaira	♂	Dambana Bintenno	O
3.	Burunda	♂		B
4.	Kanda	♂		O
5.	Dematha (son of No. 4)	♂		O

These results give a proportion of 60 per cent Veddahs with the O group and 40 per cent with the B group. The proportion of O is thus practically the same as in the Australian aboriginal, but the B group differs considerably in the two races. On the contrary, the Paniyans of South India agree with the Australians in the low proportion of B, but differ from both Australians and Veddahs in the low proportion of O. The difference is made up by a high proportion of group A (see Aiyappan, 1936¹).

With regard to the other inhabitants of Ceylon, I give below the results of a series of blood-groupings which have been taken in the General Hospital, Colombo, for routine blood-transfusion purposes, and for which I am indebted to Dr. S. Thiagarajah, the pathologist to that institution. It will be noted that, in all the communities studied, group O takes the

highest place, except in the Moors, where groups O and B are in equal proportion. Group B is also high in the Tamils, so that the high value of that group in the Moors is to be explained by the amount of Tamil blood present—a fact which is corroborated by their physical characters. The Sinhalese, on the contrary, have an almost equal proportion of individuals with groups A and B blood. The Veddahs, therefore, so far as the meagre numbers examined throw any light upon the question, do not resemble either of the predominant local populations, but fall into a category of their own. Examination of larger numbers would most probably bring them into line with the Australian aboriginals, a supposition which would be expected on the grounds of their physical characteristics.

TABLE II. BLOOD-GROUPINGS OF OTHER CEYLONIAN PEOPLES.

People	Numbers examined	Group O	Group A	Group B	Group AB
Sinhalese	712	335	187	176	14
Tamils	136	69	19	42	6
Burghers	61	35	17	8	1
Moors	29	10	7	10	2

TABLE III. PERCENTAGE REPRESENTATION OF BLOOD-GROUPS IN THE PEOPLES DISCUSSED HEREIN.

People	Group O	Group A	Group B	Group AB
Veddahs	60	—	40	—
Paniyans	20	60	7	10
Australians	57	38.5	3	1.5
Sinhalese	47	24.7	23.1	2.0
Tamils	50.7	14	30.9	4.4
Burghers	57.4	27.7	13.1	1.6
Moors	34.4	24.1	34.4	6.8

In conclusion, I have to acknowledge my indebtedness to Prof. F. O'B. Ellison of the Physiology Department, Ceylon Medical College, and his laboratory staff for the use of apparatus in his department.

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¹ Aiyappan, A., *Nes*, 30, 255 (1936)

Modes in Modern Egyptian Music

WE have been engaged on determining the frequency ratios involved in the principal musical scales or modes in current use in Egypt to-day. These scales were the subject of a controversial discussion at an international congress held in Cairo in March 1932.¹

In the present investigation, three expert tuners (appointed by the Royal Institute of Oriental Music) tuned a Qanun, an instrument consisting of strings stretched on a sounding board, to the different modes, and the frequencies were then measured by means of an audio-frequency valve oscillator to which a calibration curve was plotted by means of a set of standard tuning forks. The actual determination of each frequency was carried out using the method of beats. The notes constituting each scale were taken in ascending and then in descending order, so as to

correct for possible variation in temperature. The experimental error is of the order of 0.1 per cent.

The results for each of the three tuners were recorded separately and an average was then taken. The following table gives the fourteen recognizable intervals into which an octave was found to be subdivided compared with the diatonic and equitempered scales.

The four principal modes correspond to the following groups of notes (quoted by their numbers): (1, 3, 5, 7, 9, 11, 13), (3, 4, 8, 9, 11, 13, 1'), (3, 5, 7, 8, 11, 12, 1'), (1, 3, 4, 7, 9, 10, 14). Of these the last is the same as the minor scale in European music.

No. and Name of Note	Frequency ratios		Equi-tempered scale	Diatonic scale	Symbol
	Our results	Confinee results			
1 Rast	1	1	1	1	C
2 Shahnax	1.067	..	1.067	1.043	C#
3 Doka	1.123	1.123	1.120	1.090	Db
4 Kurd	1.200	..	1.187	1.125	D
5 Sika	1.238	1.237	..	1.171	D#
6 Nim Buzalk	1.274	..	1.257	1.200	Eb
7 Ghika	1.330	1.337	..	1.237	E
8 Higas or Saba	1.417	..	1.411	1.302	Fb
9 Nawa	1.496	1.503	1.496	1.333	F
10 Hissar	1.590	..	1.583	1.390	F#
11 Husnini	1.685	1.685	1.677	1.440	Gb
12 Agam	1.779	..	1.778	1.500	G
13 Irak	1.831	1.838	..	1.562	G#
14 Nim Mahur	1.880	..	1.882	1.600	Ab
1' gawab el Rast	2.000	2.000	2.000	1.647	A
				1.738	A#
				1.800	Bb
				1.875	B
				1.920	Bb
				1.955	B#
				2.000	C

Other modes are obtained by changing the first note (key-note) in a group. The most characteristic feature of the scheme is the appearance of neutral thirds and neutral sevenths.

A fuller account will appear elsewhere.

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A. M. MOSHARRAFA.

¹ "Oriental Music Conference," p. 559 (Cairo, 1932).

Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields

IN an important paper in the *Physical Review* for 1932 Penney and Schlapp¹ have discussed theoretically the Stark-splitting of the energy levels of the rare earth ions in crystals under the influence of the crystalline electric fields, and its influence on the magnetic behaviour of the ions. Experimentally, Spedding and his co-workers² have studied the absorption spectra of rare earth salts of the type $M_2(SO_4)_3 \cdot 8H_2O$, where $M = Pr, Nd, Er$ at different temperatures, and thence deduced the low-lying energy levels of the M^{+++} ions in the crystals. They find that (1) the number of low-lying energy levels and their relative separations are the same as predicted by the theory for a field of cubic symmetry

acting on the M^{+++} ions; (2) the intensity of the cubic field required to produce the observed separations is the same in all the three crystals, as should be expected from their isomorphism; (3) the observed separation of the levels is not inconsistent with the available magnetic data for the mean susceptibilities of the crystals. From these and other results, it has been concluded that the fields acting on the M^{+++} ions in these crystals should be almost rigorously cubic in symmetry.

One direct result of such a cubic symmetry in the field would be a magnetic isotropy for the crystal, and any observed deviation from isotropy will give us some idea of the deviation of the field from cubic symmetry. We have recently measured the principal magnetic susceptibilities of single crystals of several rare earth salts, and we give below the values for the anisotropy of the sulphates; $\Delta\chi$ denotes the difference between the maximum and the minimum principal susceptibilities of the crystal, and χ the mean of the three principal susceptibilities.

Crystal	$\Delta\chi/\chi$
$M_2(SO_4)_3 \cdot 8H_2O$	
$M = Pr$	0.20
Nd	0.11
Sm	0.21
Er	0.12

$\Delta\chi/\chi$ is not small, and when we remember that the group of atoms associated with each M^{+++} ion in the crystal should have at least this anisotropy, and has very probably more (as the different groups present in the unit cell of the crystal—probably eight in number—will not, in general, be oriented parallel to one another) and that it is the anisotropy of the above group (and not that of the crystal) which corresponds to the asymmetry of the field under consideration, it is easy to realize that the deviation from cubic symmetry should be quite marked. From an inspection of the table it becomes clear, as pointed out by Penney and Kynch³, that the non-cubic part of the field has produced separations in levels, degenerate in the cubic field, comparable in size with those of the cubic field pattern itself.

A rediscussion of the valuable results on the absorption spectra of these crystals obtained by Spedding and his co-workers, taking into account the non-cubic nature of the crystalline fields as evidenced by the magnetic anisotropy of the crystals, is very desirable.

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¹ *Phys. Rev.*, **41**, 194 (1933).

² *J. Chem. Phys.*, **5**, 191, 816, 416 (1937).

³ *Nature*, **140**, 109 (1937).

Variations of Cosmic Ray Intensity during Magnetic Storms

IN a paper¹ on trajectories of electric particles with applications to cosmic rays, published January 4, 1937, I directed attention to possible effects of magnetic storms in the following words:

"As to other electromagnetic fields which may modify this supposition (regarding simplifying

hypotheses for the mathematical treatment), the only case of interest may be the *outer magnetic field during magnetic storms*. It would be very interesting to make a careful inspection of the cosmic ray registrations during such a storm (for instance of the order of magnitude of the storm of February 4th, 1872, when auroras were seen almost over the whole earth) in order to discover possible actions due to this field."

It is most interesting that such an effect has just been observed during the recent magnetic storms in April this year, both by Mr. S. E. Forbush in America¹ and by Prof. Victor F. Hess and A. Demmelmair in Europe².

We have here an effect analogous to the effect of magnetic storms on auroras, driving the aurora zones away from their usual situations and towards the magnetic equator as the intensity of the storm increases.

The mathematical theory of the motion of electric particles in the earth's magnetic field, which I developed³ so long ago as 1904, and which Mr. Forbush attributes to Lemaître and Vallarta, receives by these new facts renewed interest and suggests continual observations of cosmic rays both in high and low magnetic latitudes, because the solar activity and magnetic storms both approach their maximum intensity.

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¹ "On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Application to the Theory of Cosmic Radiation, Sixth Communication", *Astrophysics Norwegian*, [H] 4, 195 (1937).

² *Phys. Rev.*, 51, 1106 (1937).

³ *NATURE*, 140, 316 (1937).

⁴ For details see Oslo University Observatory Publications No. 10, Oslo 1934, and *Phys. Rev.*, 45, 835 (1934).

Points from Foregoing Letters

As an example of the ease with which equilibrium diagrams of alloys containing three elements can be obtained, by means of X-ray analysis, A. J. Bradley, H. J. Goldschmidt, H. Lipeon and A. Taylor submit a diagram for the copper-nickel-aluminium system. It shows the phases present at different percentage composition, after a uniform heat treatment (slow cooling at 10° per hour; equilibrium not necessarily established). The X-ray method gives at the same time the number, nature and relative amount of phases present and the lattice space of each phase.

Dora Ilse describes experiments on the response of egg-laying butterflies to coloured papers; these indicate that colour vision in the cabbage butterfly, *Pieris*, is different from that in the hive bee and most other insects and nearer to that of man. The cabbage butterfly in the stage of egg-laying reacted to a range of colours from 'emerald green' to 'oxide blue' and responded also to simultaneous colour contrast (green induced on white background adjacent to purple).

Dr. G. Wald has extracted from chicken retinas rhodopsin and the photo-labile pigment of the cones, heretofore unknown. The shift in visual sensitivity toward the red on light adaptation (Purkinje effect) in the chicken appears to depend upon the spectral characteristics of these pigments. The cone pigment, for which the name iodopsin is proposed, is apparently violet in colour and bleaches to coloured products.

From the data of Barcroft and his associates, Dr. S. R. M. Reynolds has estimated the efficiency of the maternal circulation of the uterus of the rabbit between the fourteenth and twenty-eighth days of gestation. It is found that the minute-volume turnover of blood in the uterus increases until the twenty-second day, after which it decreases sharply. This decrease in the efficiency of the uterine circulation is coincident with a period of diminished uterine growth and accelerating foetal growth. It is suggested that with the onset of increasing distention the uterine circulation is impeded, but as the influence of distention becomes more marked, the circulation through the uterus is aided, chiefly by the increasingly effective contractions of the myometrium which occur as gestation nears term.

Cold-treated ('vernalized') wheat grains, imbibed in water and kept in an atmosphere of nitrogen at 20° C., will survive, according to Prof. F. G. Gregory

and O. N. Purvis, for three weeks, and will become devernalized, as shown by a significant increase in the leaf-number and in the time of flowering. Partially devernalized spring rye may again be vernalized by subsequent exposure in air to 1° C.

The artificial preparation, from pure virus protein, of paracrystalline fibres of tobacco mosaic virus is described by R. J. Best. The properties of these fibres are similar in all respects to the spontaneously formed ones previously described in *NATURE*. Bawden and Pirie's demonstration of the presence of nucleic acid in the virus molecule has been confirmed.

Blood examination of five Veddahs from Ceylon, reported by Prof. W. C. O. Hill, showed two of them to belong to the blood-group B and three to blood-group O. The author believes that examination of a larger number of individuals will probably show that they are similar to the Australian aborigines. He also gives tables showing the blood-groupings of peoples from the island and the percentage blood-groups in each. In all communities of Ceylon which have been studied, group O takes the highest place, except in the Moors, where group O and B are in equal proportion.

A table is given by M. Mokhtar and Dr. A. M. Mosharafa showing fourteen recognizable intervals into which an octave, in modern Egyptian music, could be subdivided, compared with the diatonic and the equitempered scales. The notes were obtained by means of a Qanun, an instrument consisting of strings on a sounding board, and the frequencies were measured by means of an audio-frequency valve oscillator calibrated with a set of standard tuning forks.

From extensive studies on the absorption spectra of crystals of hydrated sulphates of the rare earths at different temperatures, Spedding and his co-workers have concluded that the crystalline electric fields acting on the rare earth ions in these crystals should have cubic symmetry. Prof. K. S. Krishnan and A. Mookherji now report marked magnetic anisotropy of these crystals, which does not support this conclusion.

Prof. C. Störmer quotes a statement which he published last January, indicating on theoretical grounds the possibility of an interrelation between magnetic storms and the intensity of cosmic rays, which has since been observed by Forbush in America and by Hess and Demmelmair in Europe.

Research Items

Problems of the New Stone Age

SOME problems in the changed outlook of the last twenty years on the introduction and spread of the neolithic civilization into Europe have been discussed by Mr. H. J. E. Peake (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, 1936-7). By 1925 it had been shown that the neolithic culture had reached Switzerland from western Asia by way of the Aegean and Danube Valley early in the third millennium B.C. The problem remained whether it reached the west in the same way or had come by sea from the eastern Mediterranean. This question must be viewed from the wider standpoint, in time and space, of when man first began to cultivate grain and domesticate animals, and how such knowledge reached our islands. Cultivation of wheat apparently began in south Syria or northern Palestine. Early grain growers are, with certain exceptions, always possessed of domesticated animals, and the precise origins of agriculture are obscure. Its progress, however, can be traced from Asia, through the Aegean to Switzerland, via the Danube. West of the Rhine, however, is a rude pottery, which has been filiated with the leather bag, derived, it is now suggested, from animal *scrota*. This 'bag-ware' is found widely distributed in western Europe, appearing in Switzerland and Germany from the west, and having as its starting point Lusitania. Important elements in this Lusitanian culture are shown to derive from the eastern Mediterranean—the tomb and the pottery. The megalithic tomb is traced back to Tell Arpachiya and thus related to the Tell Halaf culture of the fourth or fifth millennium, while it descends to the stone cist of the early Bronze Age. The evidence of the pottery depends on a number of decorative, and other details traced from the eastern Mediterranean and ultimately Tell Halaf, beginning not later than the end of the fourth millennium, and appearing in the Iberian peninsula about 2800 B.C. Cattle, which could scarcely have been brought from the Aegean, were probably acquired by contact with Danubian peasants of Switzerland. This culture passing through France reaches Britain by a land bridge from Artois, and appears as the early neolithic culture of Windmill Hill. The red "bag ware" found at Maiden Castle, on the other hand, may have reached Britain from Brittany.

South African Native Cattle

LITTLE has been attempted by Europeans in the way of improving the cattle of Africa by selection within native breeds, the practice being to intergrade with European breeds. H. H. Curzon and R. W. Thornton, realising the potentialities of the native cattle, have laid a foundation for further investigations by outlining the cattle types of Africa and their approximate distribution (*Onderstepoort J. Vet. Sci. Anim. Ind.*, 7, 613; 1936). Probably all the breeds, except the Hamitic longhorn of Egypt, came originally from Asia, and all reached their destination through north-east Africa except the shorthorned zebu which was introduced along the east coast north of the Zambezi River. Three parent stocks are involved—Hamitic longhorn, brachyceros

and lateral-horned zebu; and from these three other types have been derived—short-horned zebu, sanga, and lyre-horned zebu. In West Africa there are possibly two other types derived from admixture of brachyceros and Hamitic longhorn in one case, and in the other from brachyceros and thoracic humped zebu. The paper is illustrated by perhaps the most complete set of photographs of African cattle breeds yet published.

Stomatopoda of the Bingham Oceanographic Collection

G. ROBERT LUNZ has reported on the Stomatopoda from various localities collected by the *Pawnee* and from coastal trawlings by members of the Bingham Oceanographic Laboratory (*Bull. Bingham Oceanographic Collection. Peabody Museum of Natural History, Yale University*, 5, Art. 5; Jan. 1937). There is also included valuable material collected on the west coast of Florida by Miss M. Storey of Stanford University and a few specimens from Tahiti obtained by Mr. Henry Sears. 157 specimens are recorded, referable to five genera and thirteen species. A new variety is described from Tahiti of *Gonodactylus chiragra*, a species well known throughout the tropical portions of the Pacific and Indian Oceans but not before recorded from Tahiti, also a new variety of *Chloridella rugosa*, and there is one new species, *Chloridella edentata*, described from a single specimen, its nearest relative being *C. montoides*.

Cytology of *Gagea spathacea*

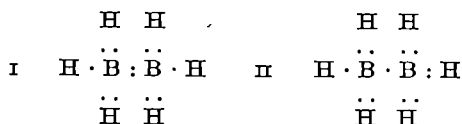
Gagea spathacea is a member of the Liliaceae occurring from southern Sweden through Denmark to Holland and Belgium. It apparently produces no seeds, its pollen is sterile and it reproduces vegetatively by numerous small bulbs. Dr. M. Westergård (*C. R. Lab. Carlsberg, Série Physiologique*, 21, No. 18), who has investigated its cytology, finds that while *G. lutea*, *G. minima* and *G. pratensis* undergo their pollen meiosis in Denmark in January, in *G. spathacea* this is delayed until April. *G. minima*, the most nearly related species, has $n=12$, while in *G. spathacea* $2n \approx 102$ and the chromosomes fail to pair in meiosis, with resulting micro-nuclei. This species is probably a hybrid; but it is not clear how its more than octoploid number of chromosomes has been reached. Its vegetative spread to Sweden must have occurred when the Baltic sea was a lake, unless it arose independently through crossing in the northern area. The embryo-sacs of *G. minima* and *G. lutea* ($n=36$) were examined, and stages were found indicating that the sac is of the type now known in *Lilium*, *Fritillaria* and *Tulipa*, that is, the four megaspore nuclei function, three passing to the chalazal end of the sac and one to the micropylar end. Here they all divide again, the chalazal spindles fusing so that two triploid nuclei result. One of the latter degenerates while the other divides. The mature sac thus contains an egg apparatus composed of three haploid nuclei and two triploid antipodal cells. In double fertilization a pentaploid endosperm arises from the fusion of a haploid and a triploid nucleus with the male nucleus.

Magnetostriction

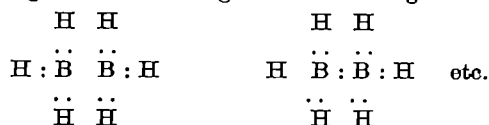
THE June issue of the *Science Reports* of the University of Sendai, Japan, contains two reports of the Research Institute of Iron, Steel and other Metals by Dr. Y. Masuyama, which deal with his recent work on magnetostriction of iron, nickel, cobalt, single crystals of iron and binary alloys of the three metals. The specimens were ovoids placed in the centre of a magnetizing coil, the field of which could be varied from 0 to 400 gauss. The changes of length of each ovoid were determined by fixing it between two quartz tubes coaxial with it, one of which projected out of the coil and ended in a small brass block. To compensate for temperature changes of length of the ovoid, a brass bar of suitable length was placed within the coil parallel to the axis of the ovoid and between two similar quartz tubes. Between the brass blocks a thin spindle carrying a mirror was placed in such a way that differential changes of length of ovoid and brass rod produced a rolling of the spindle and rotation of the mirror. The changes of length observed are generally less than 80 millionths at the maximum field, and are shown by curves in terms of the field and of the magnetization. They are independent of the sign of the field and at low fields are different for increasing and decreasing fields. For cobalt and nickel and alloys of the two the length decreases; for iron and alloys containing iron the length decreases at first, then increases as the field is increased. Each material tested showed hysteresis in its magnetostriction, and the effect will have an important bearing on the theory of magnetization.

Structure of Diborane

AN outstanding difficulty for the valency theory is the molecule B_2H_6 , and the non-existence of the molecule BH_3 , since boron is a trivalent element in numerous other compounds. Some light is thrown on the problem by determinations of the interatomic distances by S. H. Bauer (*J. Amer. Chem. Soc.*, 59, 1096; 1937), by means of the electron diffraction method. The values for the B—B (1.86 Å.) and B—H (1.27 Å.) distances are considerably larger than the single-bond separations expected from other diatomic hydrides. This is interpreted as meaning that the bonds in the molecule have to some extent a character weaker than single bonds. This would be expected for the B—H bonds on the basis of structure I:



which gives each B—H two thirds single-bond and one third one-electron-bond character. A slight extension considering resonance to structures such as II would further account for the increased B—B distance. The distances are also compatible with a structure representing resonance among the seven arrangements:



giving each bond 6/7 single-bond and 1/7 no-bond character. Theoretical arguments support the view that the molecule resonates among all the above structures, the B—B and B—H bonds having single-bond, one-electron-bond and no-bond characters.

Shortening of the B—B distance below the single-bond value is not observed; this is regarded as eliminating all structures such as Wiberg's, which attribute some double-bond character to the B—B link. The stability of B_2H_6 relative to BH_3 is explained as due to the resonance energy made available by the full use of the four orbitals of boron.

High Intensity Light Sources

AN article by Dr. J. A. V. Fairbrother in the *Electrical Review* of August 6 discusses the light source required to project a beam within a fairly small angle. Practical considerations permit only a small source, as otherwise a large paraboloidal reflector would be required. The lower limit to the size of the light source is fixed by its brightness (intrinsic brilliancy) and the quantity of light obtainable from it. The intrinsic brilliancy is measured by the candle power divided by the projected area of the source on a plane perpendicular to the direction of view. It is convenient to measure it in candles per square millimetre. For bodies which emit full radiation the intrinsic brilliancy increases rapidly as the temperature approaches the melting point. As carbon and tungsten have the highest melting points, the carbon arc and the hot tungsten filament are the two high-intensity light sources usually employed for projection purposes. But owing to the fact that much of the spectral emission from a hot surface is not in the visible region, it is an inefficient converter of heat into light. One of the earliest light sources was the Welsbach mantle, which made use of the selected radiation from cerium and thorium. At the present time the most promising of all is the selected light emission from gases and vapours the molecules of which are excited by the passage of an electric current. By exciting mercury vapour in a quartz envelope at a high pressure, a light source is attained which has a higher efficiency and greater intrinsic brilliancy than over-run tungsten. The author has obtained with a carbon arc a maximum brilliancy of 330 candles per sq. mm. which is about eighteen times the average intrinsic brilliancy of the 5-kw. tungsten filament spot lamp. Mercury vapour quartz lamps are now being made the length of the arc of which is only about 10 mm. and which when the temperature is kept low by cooling water in contact with the outer wall of the envelope can take an input of 700 watts. This lamp approaches the carbon arc in intrinsic brilliance and is more than twice as efficient.

Sunspot Photography with a Small Visual Refractor

THIS is the title of a paper by Mr. Cecil Maby (*J. Brit. Astro. Assoc.*, 47, 9, July 1937), in which the author gives the results of his experiments with different filters and photographic plates. He made use of his telescope and its Huygenian eyepiece as projection lenses, and those who are interested in the photography of sunspots will find much useful information in this paper on the employment of visual refractors for this purpose. The paper should be studied by amateur astronomers, who will find a full description of the equipment, which is both efficient and inexpensive.

ERRATUM. The paper referred to under the heading "Petrofabric Study of Moine Schists" in *NATURE* of September 4 (p. 429) was by Dr. F. O. Phillips, Department of Mineralogy and Petrology, Cambridge, and not by F. C. Cole as stated.

Engineering and Marine Exhibition at Olympia

AT this Exhibition, which will remain open until October 2, there is so much of scientific interest that it is possible only to select a few representative items as indicative of the extent to which the results of research are being utilized with the aid of mechanical ingenuity. One gets, for example, a definite impression of a universal effort being made to deal with the problem of noise both by improvements in design and workmanship and by the adoption of new types. At one stand a noiseless sliding door is exhibited, and of silently operating machinery a notable example is the Mirrelec-Imo pump for oils and other liquids. This has only three moving parts—a central screw which is the actual pumping unit, and two side screws which act as seals and are rotated merely by their engagement with the central screw. In high-speed Diesel engines vibration is destructive of the exhaust pyrometers which, by the close relationship between exhaust temperature and horse power, are necessary to ensure that an even and efficient balance is maintained between the several cylinders. Messrs. Negretti and Zambra are exhibiting pyrometers in which a few inches of the tube immediately below the instrument have been replaced by a helical spring, and instruments so constructed are to be seen mounted on a vibrating table yet relatively unaffected.

The hygienic importance of the reduction of dust lends interest to means for its measurement, and the Tyndallometer shown by E. Leitz (London) provides a new and rapid means of its measurement. It consists of a dust chamber, a photometer head, an observation telescope and the necessary means of illumination. In the field of view is a beam of the scattered light and a comparison beam and, when these are equalized, the scale reading and the calibration curve give an instantaneous value for the dust content. On the same stand is shown a simple profile projector for the metal industry with several other optical aids. Messrs. Kelvin, Bottomley and Baird, Ltd., have on view the colour vision lantern developed by Dr. L. C. Martin in collaboration with the Medical Research Council, and also the K.B.B. Cabinet for ultra-violet fluorescence. The latter can be seen in operation with a very representative group of samples which illustrate its value in scientific testing and research, and also in industrial, medical, police and other investigations. In Messrs. Avery's recent design of Brinell and diamond impression testing machine the arrangement is such as to enable results to be obtained very rapidly, and in this respect alone this exhibit marks an advance on the usual design.

Under modern conditions, metals are frequently required to conform to very severe specifications, and Barronia Metals, Ltd., are exhibiting examples of many such problems which they have solved. One of these was the preparation of a non-ferrous alloy with a coefficient of expansion greater than steel for use with a hydrocarbon gas containing sulphur at a pressure of 200 lb. per sq. inch and a temperature of 1150° F. Other instances of new developments in manufacture of materials are the glass cloth now being made by Chance Bros. and Co., Ltd., to replace asbestos cloth in low-temperature services and likely also to develop in decorative and other directions,

and the method of electric forging which has been brought to a fine art by Messrs. Omea, Ltd. The samples of forgings exhibited indicate the wide application of the process and the high quality both of material and of surface which is obtainable. In conjunction with H. A. Brassart and Co., Ltd., Messrs. Imperial Chemical Industries Ltd. illustrate the Brassart process for acid burdening the blast furnace. By regulating the flux so as to form slag of the lowest possible melting point and viscosity, iron production is increased while less coke is used and low-grade ores can be dealt with. As a result also of the sodium carbonate treatment there is a reduction of sulphur and, due to oxidation, of silicon content. The Macrome treatment of tool steel by an electric process, applied after the usual heat treatments have been given, is claimed by Messrs. Macrome Ltd. to increase the working life of tools by 50–300 per cent according to the steel treated and the work performed. An electric process exhibited by the O.C.P. Company is that for conditioning water and preventing scale in boilers. The water is made to pass through tubes each containing an electrode, and this process effects a physical change in the mineral salts which, on being heated, appear as crystals and do not build up scale. The elimination of chemical treatment is an obvious advantage of the method.

The Marconi Company has arranged a series of historical exhibits illustrating the development of wireless apparatus. Another exhibit of this firm shows how one type of echometer can indicate to a trawler the depth of the sea-bed and also that at which a shoal of fish may be passing. The Accurate Recording Instrument Co. has working models of a liquidmeter which will very soon be manufactured. This, although very sensitive and carefully compensated, is of a robust construction and is not likely to get out of order. It operates by means of two pairs of opposed hydraulic bellows so that the displacements made in the tank are exactly reproduced at the dial. Among other recording instruments, Messrs. Radiovisor show the counting unit such as is used in the Mersey Tunnel to give a record of vehicles entering and also in factories for counting sacks, tins, etc., by the interception of a beam of light.

Of the many Diesel engines on view, that of the Brush Electrical Engineering Co. Ltd. will be of considerable interest to engineers. It is a horizontal type and has four cylinders arranged in pairs on opposite sides of the crankshaft. An independent test by Mr. W. A. Tookey showed the fuel consumption to be 0.357 lb. per B.H.P. hour when developing 250 B.H.P. at a speed of 250 r.p.m.

The exhibit, however, which takes the highest place in scientific importance and which at the same time appeals to all who are mechanically minded is that of the Department of Scientific and Industrial Research and associated bodies. It illustrates researches carried out in engineering and metallurgy, showing how the tests are made on models of ships' hulls and propellers, on coal, on the transport and storage of food and on fire resistance of structures. By the use of short films the visitor sees more than the mere instruments and materials of the test; he is enabled to follow the course and operations of the investigation.

Origin of the Red Rocks

THE subject for discussion in Section C (Geology) at the British Association on the morning of September 2 was the "Origin of the Red Beds of the Northern Midlands". Speakers, however, did not confine themselves to local conditions, and other parts of England were also considered.

In opening, Dr. R. L. Sherlock remarked that the region discussed forms an indefinite area but may be supposed to include the Cheshire Basin, the synclines between the fanning-out ridges of the Pennine Range and the easterly dipping beds of Nottinghamshire.

It is agreed that the British Permo-Trias is of Continental origin and that the climate became progressively drier from the beginning to the end of the period. This fact seems to be of almost world-wide application, for it is also true for the United States, South Africa and other countries.

Late in Carboniferous time, earth-movements on a great scale probably raised Great Britain into mountains, but rapid erosion of the soft Coal Measures soon reduced the elevation, and the detritus filled the hollows and formed red beds. This indicates oxidation of grey strata in a dry climate. There is a relation between colour and texture; the finer the grain the richer the red tint, owing no doubt to ease of oxidation. The green colour found at times appears to indicate wetter periods. Although there is no doubt that secondary changes of colour have occurred, it is highly probable that both red and green strata are primary. Evidence for the primary origin of red beds is that the colour is constant in depth. It is noteworthy that green marls occur at the top of the Keuper, just before the Rhaetian Sea burst in, when base-levelling of the land had presumably allowed wet oceanic winds to bring in a damper climate.

Although the saline deposits were no doubt deposited in drying up inland seas and lakes, the source of supply offers difficulties. Ordinary sea water, if evaporated, would deposit only 0.7 ft. of gypsum or anhydrite for each 1,000 ft. of depth, yet beds 10 ft. or more in thickness were deposited from shallow seas. Evidently there was local concentration.

Gypsum often shows swirl-like structures, and so does rock-salt. In Cheshire, stratification and cross-bedding are also present in the salt, indicating a possible explanation of the thickness of saline deposits. If evaporation caused supersaturation of the water, the salt would be deposited very rapidly and the granular precipitate might be concentrated by currents. It sometimes happens that, if two bore-records are compared, one containing thick salt and the other none, the records agree roughly if the salt is ignored, suggesting that the time of formation of the salt was negligible.

While the rest of our salt deposits were formed in desert lakes, the Middlesbrough deposits represent a dried-up sea.

Mr. F. W. Shotton communicated the results obtained by the Lapworth Club of the University of Birmingham in an investigation, lasting several years,

of the outcrops of Lower Bunter in Worcestershire and East Shropshire between Oakengates, Bewdley and Stourbridge. Every accessible outcrop was examined and careful measurements made of dip and false bedding; more than a thousand readings being taken and examined statistically. In addition, numerous rock specimens were collected and examined for variation in the size of the sand-grains. Conclusions arrived at were that, throughout the area, the Lower Bunter is false-bedded and that it was deposited on land by easterly winds coming from the Mercian Highlands. The sand is remarkably well-graded and free from clay or silt-bands, and 90 per cent lies between the ranges of 0.50 mm. and 0.10 mm.

Mr. A. N. Thomas then described the Trias of north-west Somerset between Porlock and Williton. The Triassic subsurface is highly irregular and the earliest deposits fill in isolated depressions, the later ones being increasingly widespread so that the areas tend to coalesce.

Dr. S. E. Hollingworth gave an account of some results of recent borings in the Vale of Eden. These borings have proved the presence of three horizons of anhydrite in the 'Permian' Hilton Plant Beds at Kirkby Thore, although only two horizons are known elsewhere in the area. As these chemical precipitates indicate periods of desiccation, they are probably due to regional climatic changes, and it is reasonable to suppose that sequences of such deposits in adjacent areas may be correlated. This does not necessarily mean that two areas of deposition were united. Dr. Hollingworth correlates the lowest anhydrite bed (base of Hilton Plant Beds) with the lower salt (and anhydrite) at the base of the 'Permian Middle Marl' of the region east of the Pennines. The two higher horizons of the Vale of Eden he correlates with the upper salt and anhydrite and the upper anhydrite respectively of Yorkshire. Correlations between Cumberland and Furness indicate the probability of a lateral passage from 'Permian' Hilton Plant Beds to 'Triassic' St. Bees Shales. Dr. Hollingworth's conclusion is in accordance with the evidence from the east of the Pennines of a lateral passage of 'Permian' into 'Trias' brought forward in 1911 by Dr. R. L. Sherlock.

No time was left for discussion, but inquiries were made as to where the formation of red beds in Continental areas is at present in progress. This difficulty is analogous to that felt by students of coal formation—the origin of which by swamp-growth is generally agreed upon, although the exact conditions for it do not seem to exist anywhere at the present day. Nevertheless, in various parts of the world certain kinds of Triassic-like rocks are being formed, for example, in Turkestan, although nowhere can all the types be found now forming.

As was pointed out by Dr. Rudolf Richter on another occasion, when describing conditions of sedimentation off the German coast, we must not carry uniformitarianism too far; special conditions existing at certain periods have never been repeated.

R. L. S.

The Teaching of Mathematics

THE mathematical subsection (A*) of the British Association departed this year from its usual policy of presenting papers on specialized branches of research, and its sessions at Nottingham were devoted chiefly to two discussions on the teaching of mathematics. On Saturday, September 4, Prof. E. H. Neville opened a discussion on the unification of algebra in schools. Mr. T. A. A. Broadbent condemned the older school text-books as a collection of watertight compartments, and pointed out the need for the course to be systematized and unified. Mr. G. L. Parsons contrasted the older method of putting all the emphasis on technique with the newer methods of bringing out the ideas of the subject. He favoured the approach by means of the formula or the equation rather than by tedious drill in elementary algebraic processes. Mr. M. H. A. Newman gave the university point of view, particularly as regards the importance of linear transformations and matrices. Mr. W. J. Langford pointed out that changes in the school course could not be made unless such examinations as that for the School Certificate were modified correspondingly. He suggested that teachers should agree upon a policy, and then submit alternative syllabuses to the examination authorities.

The papers attracted a large audience, including many from other sections, and the lively discussion that ensued proved that the subject was felt to be of great interest and importance.

On Tuesday, September 7, Prof. H. T. H. Piaggio opened a discussion on the bearing of higher geometry on the school course. Prof. E. H. Neville protested against the policy of drill in the application of devices of which no rational explanation had been given. Mr. H. G. Green showed how to give this explanation in the case of the 'line at infinity', and Prof. W. H. McCrea in the case of the 'circular points at infinity'. Prof. H. S. Ruse pleaded for an extended treatment of differential geometry, including vector methods. A general discussion followed.

At the end of this discussion Mr. C. H. H. Franklin exhibited a most interesting collection of models representing four- and five-dimensional solids, by a principle analogous to that employed to represent three-dimensional solids by a sketch on two-dimensional paper.

The secretary of the subsection, Dr. Dorothy M. Wrinch, is to be congratulated on the success of the policy of replacing isolated papers by discussions on topics of wider interest.

H. T. H. P.

Biological Standards*

THE proceedings of the meeting of the Permanent Commission on Biological Standardization held at Geneva in the autumn of 1935 have been published, together with the reports of the technical experts to whom a number of different questions dealing with biological standards had been referred.

Six standards were adopted or redefined by the Commission. The pituitary (posterior lobe) powder and the *Digitalis purpurea* leaf powder, at present in use as standards in Great Britain, stocks of which are held at the National Institute for Medical Research, Hampstead, were adopted as international standards, and the Institute was asked to distribute them on behalf of the Health Organisation. The original international standard pituitary powder was prepared by Prof. Voegtlin and was available for issue to authorities desirous of testing their national standards, but up to that time no laboratory had been entrusted by the Commission with its general distribution: the two preparations are of the same activity. The original international digitalis standard powder is nearly exhausted; but the stock of the British Standard is sufficient for international requirements for some time: its potency is, however, greater than that of the previous standard, so that one unit is represented by 0.08 gm. of the new standard, as compared with 0.1 gm. of the previous preparation. A crystalline sample of insulin was adopted as standard and defined as containing 22 units per mgm. The previous standard was amorphous

and contained 8 units in one milligram. Two standards for substances for which standards had not been previously available were recommended for adoption: one for *B. histolyticus* antitoxin, and the other for diphtheria antitoxin for use in the flocculation test. The question of the standards for asphenamine and its derivatives was left for further consideration by a small technical committee.

It was further agreed that work should be carried out on tetanus antitoxin, poliomyelitis convalescent serum, staphylococcus antitoxin and antityphoid serum. The recommendations adopted by the inter-governmental conference on biological standardization were considered and certain subjects recommended for further examination, including the standardization of anti-anthrax serum, anti-swine erysipelas serum, anti-venom serum and the preparation of a standard *Digitalis lanata* leaf powder.

The bulk of the report is devoted to the reports of the experts who have been examining proposed new standards, and gives the evidence on which the Commission has based certain of its recommendations: for the details of these experiments the original report must be consulted. The separate sections deal with insulin, histolyticus antitoxin, diphtheria antitoxin, tetanus antitoxin and antipoliomyelitis convalescent serum. The bulletin also includes reports of the Standards Departments of the National Institute for Medical Research, Hampstead, and the Statens Serum Institute, Copenhagen, and concludes with a useful description of a simple laboratory method for the desiccation of serum and other protein solutions.

* Quarterly Bulletin of the Health Organisation. Special Number, November: Biological Standardization (2). (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1936.) Pp. 571-745

University Events

GLASGOW.—Prof. George Barger, professor of chemistry in relation to medicine in the University of Edinburgh, has been appointed Regius professor of chemistry in the University in succession to Prof. George Henderson, who has resigned.

Dr. Noah Morris, lecturer in biochemistry, has been appointed professor of materia medica and therapeutics.

Science News a Century Ago

The Iron Ship *Sirius*

THE first iron ship to be classed by Lloyd's Register of Shipping was the steamer *Sirius*, the records of Lloyd's Register stating she was built under the inspection of the Society's London surveyors, and intended for service on the River Rhone, her port of registry being Marseilles. The *Sirius* was built by William (afterwards Sir William) Fairbairn at his yard at Millwall, which afterwards formed a part of the yard at which the *Great Eastern* was constructed. According to the *Railway Magazine*, she was launched on September 26, 1837, and she was the longest vessel so far built of iron. She measured about 164 ft. in the keel and 176 ft. on deck. Her beam was 17 feet. She was intended to be worked by two high-pressure engines of 35 horse-power each having a 24-in. cylinder with a stroke of $3\frac{1}{2}$ ft. She was to have three boilers with copper tubes. "The iron planks of which she is made", said the *Railway Magazine*, "are about 7 ft. long, 14 in. wide and a quarter of an inch thick, and her ribs are of double angle iron with diagonal stays. Her mould is handsome, but rather narrow; and when she has her machinery and water, it is calculated she will not draw above two feet of water. She is besides, divided into four compartments by three iron water-tight bulkheads; so that if a fracture should happen in any one part she will still float safely."

Fossil Discoveries in France

IN its column of Miscellanea, the *Athenaeum* of September 30, 1837, under the title "More Fossils", said: "M. Axéna has found some fossil bones of mastodons and the rhinoceros, reptiles, and some well-preserved fruits in the parish of Sauveterre, near the district explored by M. Lartet, whose discoveries we announced some time back. We should like to ascertain whether the skeleton of the new and remarkable rhinoceros brought from behind the Cape by the expedition under Dr. Andrew Smith, presents more affinity to the recent or to the fossil species. It seems that the new fact concerning fossil quadrumana has been succeeded by a similar discovery in the Himalaya mountains, but which is not so curious as the circumstance of finding these animals in Europe; and what is still more extraordinary, the comparative anatomists have determined the European species to be similar to those Gibbons which inhabit the remotest parts of Asia. M. Lartet's discoveries have given rise to much discussion in the French Academy of Sciences. . . ."

Reforms in the Hospitals

A CORRESPONDENT signing himself "Spectator" in a letter to the *Lancet* of September 30, 1837, mentions the following improvements which had taken place

at the London hospitals during the previous ten years:

"1. The introduction of clinical lectures, a department of instruction which was before shamefully neglected in this country, and is even yet but imperfectly taught. 2. The publishing of hospital reports, a measure forced upon the medical officers by *The Lancet*. 3. The annual distribution of prizes to the students (which did not become general until after 1826). 4. The withholding of certificates unless a few lectures have been attended; for I remember the time when it was not an uncommon occurrence for a student to boast that he had received a certificate without having attended a single lecture. Lastly, I may mention the posting of post-mortem examinations; the absence of hole and corner operations; the establishment of clerical clerkships, the greater punctuality in the visits of the medical officers (although, I confess, there is much yet to reform in this respect) and the frequency of periodical examinations by some of the teachers may also be added to the list of benefits on the part of the students which have reluctantly been obtained from the 'Dubs and Pures'."

Medal Striking

THE *Gentleman's Magazine* of September 1837 contains the following announcement: "M. Pistrucci, chief medallist in the Royal Mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and yet still make the medal identically the same with the original model in wax; an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver or copper, by striking it according to the usual process. The model being made in any substance, wax, clay or wood or other fit material, a mould of it is taken in plaster, from which mould when dried and oiled to harden it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come out sharply, and the iron attain the hardness almost of a steel die hardened."

Spirit Drinking in India

AN editorial in the *Indian Journal of Medical and Physical Science* of October 1, 1837, contains the following warning to the Government: "The lives of European soldiers in this country are unhappily passed in a state of imprisonment in their barracks from 10 o'clock in the morning to 4 o'clock in the evening. There is nothing of that change of scene and agreeable occupation of time as experienced by British soldiers in their own congenial and delightful country. Their indolence and want of amusement tend to a despondency of mind, and to depression of the whole animal functions, to arouse which spirits are had recourse to, and which is in fact looked upon as a necessary and luxurious pastime, sanctioned as a ration, and approved of as a custom. Canteens are rooms appointed by military rule as a place of refuge to gratify the appetite, by adding the indulgence in liquor to social conviviality. But is the Government of the country aware that all this breaks up the physical energies both bodily and mental of their brave troops?"

Societies and Academies

Paris

Academy of Sciences, July 19 (*C.R.*, 205, 185-264).

MARCEL DELMONT and CHARLES HANEGRAAFF: The catalytic hydrogenation of cinnamic aldehyde and of citronellal. Study of the order of attack of the aldehyde group and the double bond, using Raney nickel with and without platinizing.

RICHARD FOSSE and ROGER DE LARANCHEGUE: The mechanism of the synthesis of cyanamide in the oxidation of glucose in the presence of ammonia.

HENRI COLIN and HENRI BELVAL: Chemical affinities and classification in the *Hordeae*.

PIERRE LEJAY: New determinations of the acceleration of gravity in Europe and in the Levant.

JACQUES DE LAPPARENT: Ancient phenomena of rubefaction in the central Sahara.

LUCIEN DANIEL: New observations on grafting.

FOLKE ODQVIST: Equations of compatibility for any system of orthogonal triple co-ordinates.

LUCIEN GODHAUX: Algebraic varieties of genus unity containing cyclic involutions.

M. EIDELHEIT: Systems of linear equations with an infinity of unknowns.

J. KUNTZMANN: Homomorphy between multiform systems.

ROBERT WAGNER: Multivalent functions in space of matrices.

FLOREN VASILESCU: An application of normal families of distributions of mass.

NICOLAS CIORANESCU: The deformation of elastic plates in the case of analytical data.

JEAN GALIBOURG and PIERRE LAURENT: Sub-permanent deformations (reactivity phenomena).

JEAN MALFITANO: The constitution of the photon considered as a dipole.

MME. ZINA SOUBARNW-CHÂTHLAIN: The variations of conductivity undergone by dilute solutions of molybdic acid in the course of their neutralization. The experiments described support the theory of the existence of the acid H_2MoO_7 .

O. DONY-HÉNAULT and A. DE JAMB: Study of electrolytic vessels with mercury cathode.

MAURICE FALLOT: The magnetic properties of the alloys of iron with ruthenium and osmium.

ROGER SERVANT: The double refraction of quartz in the extreme ultra-violet and the Schumann region.

LUCIEN MAILLET: The emission of X-rays by vacuum tubes of very small dimensions, submitted to a high-frequency current. The tubes described were 2-6 cm. long and 3-5 mm. in diameter, fitted with a single wire anode. Some applications in the field of radiotherapeutics are indicated.

MORDECHAI BOBTILSKY and MILM. MELANIE RAPPOPORT: The decomposition of hydrogen peroxide in the presence of a cobaltictric complex compound as catalyst.

PIERRE TEUNEL: The electric moments of some fatty dinitriles.

RAYMOND QUELLET and JEAN ALLARD: The chloromethylation of anisic aldehyde. Passage to 1-methoxy-2-methylol-4-methylalbenzene.

LUCIEN DAUTERIBANDE, PIERRE ANGENOT and EDMOND DUMOULIN: Study of antiserol esparto grass filters. The influence of the hygrometric state on the penetration of antiserol filters. The influence of the time of passage of the moist atmosphere.

R. RUSSO: The Kimmeridgian age of the terminal layers of the western Beni Snassen (Morocco).

CHARLES CHABROLIN: The germination of the seeds of *Orobancha speciosa*.

ROBERT ECHVIN and ROGER ULRICH: The nature of the intravacuolar inclusions in the fruit of the ivy (*Hedera Helix*).

PIERRE DRACH: Generalities on the development of the crystalline textures in the tegumentary skeleton of the brachyurous Decapods.

JEAN RÉGNIER and ANDRÉ QUINVAUVILLER: The influence of the nature of the acid on the action exercised on the motor nerve by different salts of novocaine and morphine: different qualitative behaviour according to the concentrations.

PAUL FORTIN: Very clear entoptic vision of the retina in the orange red.

MARCEL AVEL: Experimental analysis of the determination of the dorso-ventral axis in the regeneration of the head in worms.

ETIENNE WOLFF: Egg laying anomaly in an intersexed fowl, after the action of androsterone, on the Müller ducts of the embryo.

AUGUSTIN BOUTARIO and MME. MADELEINE ROY: Spectrophotometric researches on aqueous solutions of bile.

JEAN LOISELUR and MILM. RENÉE COLLIARD: The adsorption of polypeptides by the proteins of the blood serum.

CHARLES CHAMFY, MAURICE HEITZ-BOYER and ROGER COUJARD: The mechanism of the hormonal sexual actions on the dysuria of prostatitis.

Moscow

Academy of Sciences (*C.R.*, 15, No. 5, 1937).

S. BERGMANN: A theory of functions satisfying a linear partial differential equation (1).

V. S. IGNATOVSKI: The Laplace transformation (8).

L. LUSTERNIK: A generalization of the equation of the Sturm-Liouville type.

A. BOBROV: The relative stability of sums of positive quantities.

V. FOCK: The Bose amplitudes in the neutrino theory of light.

A. TOPORSO: The mechanism of the formation of atomic and colloidal centres of silver in alkali phosphorus halide.

L. I. BELAJEV: The problem of the electrophoresis of lamellae at the interface of liquid phases.

P. J. SCHMIDT and G. P. PLATONOV: Anabiosis and fish transport without water. Experiments are described showing the possibility of preserving chilled fishes alive for more than twenty-four hours, while smaller fishes can be revived after chilling for ten days.

J. N. GOLUBINSKI: A tetraploid form of *Ocimum corymbosum* Sinis produced experimentally.

D. J. VAKULIN: Reaction of reversibility in *Perilla ocymoides* L. under natural conditions.

T. T. DEMIDENKO: Iron in the nutrition of higher plants.

V. L. VAGIN: The position of the Ascothoracida ord. nov. (Cirripedia Ascothoracica Gruvel 1905) in the system of Entomostraca.

P. J. SCHMIDT: The Pacific genera *Eurymon* Gilbert and Burke and *Gilbertidia* C. Berg (Pisces, Cottidae).

G. V. LOPASHOV: (i) The formation of organs in organisms deprived of the nervous system. (ii) The specificity of inductive influences.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Wednesday, September 29

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY, at 8—(at University College, Gower Street, W.C.1).—Dr. D. McKie: "Some Early Work on Combustion, Respiration and Calcination".*

NATIONAL SMOKE ABATEMENT SOCIETY, October 1-2.—Ninth Annual Conference to be held at Leeds. Dr. H. A. Des Voeux: President.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

CIVIL ENGINEERING ASSISTANTS in the Headquarters and Divisional Road Engineer's Offices of the Road Department of the Ministry of Transport—Establishment Officer of the Ministry, Metropolis Buildings, Northumberland Avenue, W.C.2 (September 27).

ASSISTANT IN THE DEPARTMENT OF CIVIL ENGINEERING, Queen's University, Belfast—Prof. Hummel (September 28).

ENGINEER in the Directorate of Factories, War Department—Chief Superintendent, Ordnance Factories, Royal Arsenal, Woolwich (September 28).

ASSISTANT MASTER FOR MECHANICAL ENGINEERING in the Llanelli Mining and Technical Institute—Clerk of the Education Committee, County Education Office, 24 King Street, Carmarthen (September 28).

A DESIGNER (Ref. No. 543 B) and AN ASSISTANT (Grade II) (Ref. No. 540 B) for work in the Stress Section of the drawing office, and a TECHNICAL OFFICER (Ref. No. 574 B) and ASSISTANTS (Grade III) (Ref. No. 589/590 B) for work on electrical equipment of aircraft, at the Royal Aircraft Establishment, South Farnborough, Hants—Chief Superintendent (October 1).

ASSISTANT LECTURER in the CHEMISTRY DEPARTMENT at Robert Gordon's Technical College, Aberdeen—Secretary and Registrar (October 2).

JUNIOR ASSISTANT in the Science Museum Library—Director (October 4).

LECTURER in PHYSICS in the South-East Essex Technical College, Dagenham—Clerk to the Governors (October 4).

OFFICER-IN-CHARGE OF POULTRY RESEARCH SECTION, Imperial Veterinary Research Institute, Izanagar, United Provinces, India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 8).

CHIEF LECTURER in MECHANICAL ENGINEERING at the West Ham Municipal College, Stratford, E.15—Principal (October 9).

TWO ASSISTANT KEEPERs (Second Class) on the Higher Technical Staff of the Science Museum—Director, envelopes marked "Assistant Keeper" (October 11).

SECOND ASSISTANT PETROLEUM TECHNOLOGIST for the Government of Trinidad and Tobago—Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (October 15).

WM. HUDSON PROFESSOR OF ECONOMICS in Natal University College, Pietermaritzburg and Durban, South Africa—Registrar, Natal University College, Pietermaritzburg, Natal (November 9).

ASSISTANT in Zoology in the University of Glasgow—Secretary, University Court.

MASTER FOR MECHANICAL ENGINEERING at the Technical Institute, Ashford—Principal.

RAILWAY ENGINEER (temporary) for H.M. Office of Works—Chief Architect, Room 66A/3rd, H.M. Office of Works, Storey's Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 21: The Growth and Structure of Wood. By B. J. Rendle. Pp. iii+24+1 plate. (London: H.M. Stationery Office.) 6d. net.

Ordnance Survey. The Magneto-Theodolite. Pp. 12+4 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

Mines Department. Fifteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1936. Pp. 180+14 plates. (London: H.M. Stationery Office.) 2s. net.

Board of Trade. Survey of Industrial Development, 1936: Particulars of Factories opened, extended and closed in 1936; with some figures for 1935. Pp. iv+83. (London: H.M. Stationery Office.) 6d. net.

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1937-38. Pp. 414. (Manchester: College of Technology.) 6d.

City of Birmingham. Annual Report of the Mental Hospitals Committee, April 1st, 1936, to March 31st, 1937. Pp. 80. (Birmingham.) 6s.

Record of the Royal Institution of Great Britain, 1937. Pp. 180. (London: Royal Institution.) 5s.

Proceedings of the Physical Society. Vol. 49, Extra Part, No. 274: Report of Conference on the Conduction of Electricity in Solids, held at Bristol, July 1937. Pp. vii+154. (London: Physical Society.) 7s. net.

Department of Scientific and Industrial Research. Forest Products Research Records, No. 20 (Timber Series, No. 6): The Properties of British Honduras Pitch Pine (Slash Pine)—Pineus caribaea Mor. Pp. ii+9+2 plates. (London: H.M. Stationery Office.) 6d. net.

Birkbeck College (University of London). The Calendar for the Year 1937-38. Pp. 272. (London: Birkbeck College.) 6s.

Battersea Polytechnic. Technical College for Day Students: Calendar for the Session 1937-1938. Pp. 47. 3d. Domestic Science Department and Training College: Calendar for the Session 1937-1938. Pp. 34. 3d. Department of Hygiene and Public Health: Calendar for the Session 1937-1938. Pp. 30. 3d. Evening and Afternoon Courses and Classes: Calendar for the Session 1937-1938. Pp. 35. Free. (London: Battersea Polytechnic.) 6s.

Other Countries

Canada: Department of Mines and Resources. The Canadian Mineral Industry in 1936. Reviews by the Staff of the Bureau of Mines. (No. 786.) Pp. vi+78. 25 cents. Analyses of Coals and other Solid Fuels, 1934 to 1936. Appendices. 1. Analyses of Coals and Peats, 1918 to 1935, hitherto Unpublished; 2. Analyses of Ash from Coals, Cokes, Peat and Woods. Compiled by J. H. H. Nicolls and O. B. Mohr. (No. 779.) Pp. iii+139. 25 cents. (Ottawa: King's Printer.) 6s.

Royal Observatory, Hong Kong. Magnetic Results, 1936. Prepared under the direction of O. W. Jeffries. Pp. 49. (Hong Kong: Royal Observatory.) 1 dollar.

Det. Kgl. Danske Videnskabsnernes Selskab. Biologiske Meddelelser 13, 7: Rhythmic Diurnal Variations in the Ostrous Phenomena of the Rat and their Susceptibility to Light and Dark. By Axel M. Hemmingsen and Niels B. Kjarup. Pp. 61+4 plates. 3.00 kr. Biologiske Meddelelser 13, 8: The Production of Mating Instincts in the Rat with Chemically Well-defined Oestrogenic Compounds. By Axel M. Hemmingsen and Niels B. Kjarup. Pp. 10. 0.50 kr. (Copenhagen: Levin and Munksgaard.) 6s.

Department of Agriculture, Straits Settlements and Federated Malay States. Insects, Fungi and Bacteria associated with Copra in Malaya. 1: Insects associated with Copra in Malaya; 2: Deterioration of Copra caused by Bacteria and Moulds. By G. H. Corbett, Mohamed Yusoff, Abu Hassan and F. B. Ward. Pp. iii+108+11 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents.

Memoirs of the Geological Survey of India. Paleontologia Indica, New Series, Vol. 24, Memoir No. 1: The Belemnite Beds of the Punjab Salt Range. By Lieut.-Col. L. M. Davies and H. S. Pinfield. Pp. iii+79+7 plates. (Calcutta: Geological Survey of India.) 6.2 rupees; 10s.

The Genus Youngia. By Ernest B. Babcock and G. Ledyard Stebbins, Jr. (Publication 484.) Pp. iii+106+5 plates. (Washington, D.C.: Carnegie Institution of Washington.) 7s.

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1936. Pp. 45. (Salisbury: Government Stationery Office.) 7s.

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University. Vol. 3, Art. 7: Concluding Report on Fishes, with Species Index for Articles 1-7 (Fishes of the Third Oceanographic Expedition of the Pewees). By Albert Rude Parr. Pp. 79. Vol. 6, Art. 1: A Contribution to the Chemistry of the Caribbean and Cayman Seas. By Norris W. Rakestraw and Homer P. Smith. Pp. 41. Vol. 6, Art. 2: On the Longitudinal Variations in the Dynamic Elevation of the Surface of the Caribbean Current. By Albert Rude Parr. Pp. 20. (New Haven, Conn.: Peabody Museum of Natural History.) 7s.

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December 1936. (No. 65.) Pp. 105+6 plates. (Adelaide: Government Printer.) 6s.

South Australia: Department of Mines. Geological Survey of South Australia. Bulletin No. 16. Geology of the Northern Part, Hundred of Macleanfield, with Special Reference to its Economic Aspects. By Ralph W. Seignie. Pp. 63+3 plates. (Adelaide: Government Printer.) 6s.

Catalogues, etc.

A Pamphlet on Cambridge CO. Apparatus for the Steam Raiser (Folder No. 60.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Priced Catalogue of B.D.H. Laboratory Chemicals. Pp. iv+204. Plant Hormones: Substances promoting and controlling Cell Growth and Root Formation in Plants. Pp. 4. (London: The British Drug Houses, Ltd.)

Catalogue of Books on Natural History: including Anthropology, Botany, Entomology, Evolution, Zoology, Ornithology, etc. Pp. 44. (London: W. and G. Foyle, Ltd.)

Natural History. List No. 1. Pp. 6. (Den Haag: Antiquarist W. Junk.)

Coma-Glo Luminescent Products. Pp. 4. (Cleveland, Ohio: Continental Lithograph Corporation.)

A Catalogue of Books and Periodicals on all Classes of Zoology. (No. 540.) Pp. 120. (London: Bernard Quaritch, Ltd.)

Photomicrography with the Vickers Projection Microscope. (Publication No. 872.) Pp. 64. (York: Cooke, Troughton and Simms, Ltd.)

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Vol. 140

Scientific Aspects of Industrial Accidents

THE annual report of the Chief Inspector of Factories and Workshops for the year 1936 (Cmd. 5514. H.M. Stationery Office, 1937. 2s. net), raises several questions with which scientific workers are concerned, whether actually engaged in industries or as citizens interested in the protection of national health from conditions which would degrade it. Anyone reading the report would be disturbed at what is revealed in it as to the very long hours that are being worked in some of the newer industries. While in the nineteenth century, broadly speaking, Great Britain undoubtedly led the world in imposing limitations on hours of work and the observance of minimum standards of safety and health in factories and workshops, in the last few decades it is clear that the country has fallen sadly behind other important industrial countries in these matters.

The report shows that although the 47 or 48 hour week is considered normal, many cases are reported where the working week exceeds 48 hours, not only for busy periods but often also continuing for months at a time or even for most of the year. Work up to 50 and even 60 hours a week has been common in laundries, the metal trades in the Midlands, as well as in leather, bakelite and other industries and in the woollen and worsted trades, and some disconcerting examples of illegal employment of women and juveniles are cited in the report. Despite the improvement in the employment situation, unemployment is still far too severe and widespread for this situation to be regarded with equanimity. Obviously the inspectorate requires very much stronger and clearly expressed support from public opinion if even the minimum standards required by the law are to be enforced

and these abuses suppressed, nor can we feel confident that the advance represented by the provisions of the new Factories Act now passed will effect any improvement unless there is a very considerable increase in the inspectorate.

A significant share of that support may well be looked for from scientific workers, whether engaged in industrial work or not. Apart altogether from the posts of responsibility in the management of industry which many of them hold, they should not require this report to realize the connexion between long hours of work and industrial accidents and sickness, which is once again so clearly portrayed in its pages. On this subject parts of the report are painful reading. A substantial increase in accidents over the previous year is again recorded—about 15 per cent for accidents generally and 9 per cent for fatalities. Although the analysis and graphs submitted by the chief inspector afford some evidence that the risk of accident is tending to decrease, through such factors as the work of the inspectorate, the educational work of the National Safety Association, the Industrial Welfare Society and similar organizations, the closer supervision of the growing number of factory safety organizations, and especially through the growing recognition of their responsibility in this matter by employers, disturbing fluctuations in the risk of accident as well as in the numbers of accidents still occur from year to year.

Some of the causes of these fluctuations are obvious. The longer hours to which reference has already been made are a significant factor. The greater speed of production, the absorption of more inexperienced or unpractised workers, both old and young, and the installation of new plant

and machinery with unknown risks, are among other factors which are responsible for the rising toll of death and injury, and appear at present to be associated with increased production and prosperity.

That this position should be accepted as inevitable may well be challenged. Already there are many firms, both large and small, in which the safety of the worker is a first consideration, and where no new machinery or process is put into operation without every possible measure being taken to ensure that it is as safe as it is eventually intended to be. It should not be too difficult a task for professional associations and safety organizations to arouse public opinion in such matters to a point which would ensure not merely that the minimum requirements of the law were rigorously enforced, with adequate penalties if need be, but also that a high incidence of avoidable accidents, especially among the young workers, would be regarded as a definite slur on the reputation both of the firm and of its management.

The position of the juvenile worker requires special stress because of the exceptionally high accident rates among workers under eighteen years of age to which the report again directs attention, and also because of the possibilities of a much more rapid reduction in this accident rate among juvenile workers than among adults in the same occupation. While accidents to young workers are usually of the less serious kinds, the situation was regarded as sufficiently important to receive special attention from the inspectorate, and a separate chapter of the present report deals with accidents to young workers and methods of preventing them. In relation to young workers the question of industrial safety presents its own problems, and too often it appears beyond doubt that the special protection which should be accorded to young workers is wanting.

An attempt to apportion responsibility between the employer and the victim indicates that in only 23.8 per cent of the accidents to boys could no blame be attached. In 32.3 per cent of the accidents the firm was mainly responsible and in 44.3 per cent the boy. The figures for girls do not differ greatly, but in 51.1 per cent of the accidents the girl was mainly responsible. The inquiry also emphasized the greater liability to accident in the initial stages of employment; about 10.4 per cent of the boys and 24.4 per cent of the girls who were injured in the first six months being injured during the first week.

These figures alone emphasize the significant part which a sense of responsibility on the part of the management, combined with active oversight, can play in determining the standard of safety in a works, and they stress, too, the importance of educating the young worker in the risks attached to his work as well as the importance of selecting that work, and adequate supervision and training in the initial period of employment. In spite, however, of the attention directed to this matter as a result of a memorandum issued following a conference convened by the Home Office, in which the National Confederation of Employers' Organizations participated, the general progress has been unsatisfactory. The publicity given to the matter has as yet aroused little, if any, interest in many employers, and others have had no knowledge of it.

A large proportion of the accidents to juveniles appear to occur in the smaller factories, where only individual approach is likely to be effective, and the chief difficulty lies here rather than in the larger and better organized factories. Whether the factory is large or small, however, the interest of the occupier, managers and foremen is indispensable before there can be much hope of a noticeable reduction in these accidents.

For this reason, the interest and co-operation of the scientific worker in this matter is of prime importance. Whether or no he occupies a position on the management side, an experienced chemist or engineer, for example, is usually able to initiate steps leading to improved working conditions and to secure the formulation and observance of strict safety rules. He has also an indispensable contribution to make on the technical side in improved design or safer operating methods and conditions in new or established processes. His personal interest may largely determine the success or failure of attempts at educating the young recruit or in securing that the training and supervision he receives is efficient and not perfunctory.

Nor is this the only contribution which scientific workers can make in the field of industrial safety and accident prevention. Besides the enthusiastic and skilled leadership and co-operation of the man of science, whether in a technical or an administrative capacity, there is needed an alert and informed public opinion which will not tolerate the continuance of the abuses revealed in this report. Ridiculously inadequate penalties are at present inflicted for such exploitations of health and safety as the employment of boys of fourteen to

seventeen years of age for as many as eighty hours a week, of girls of fourteen from fourteen to fifteen hours a day, and women for an unbroken twenty days work, which are in themselves an obvious cause of industrial ill-health and accidents. Clearly the strong pressure of public opinion is urgently needed to stir some magistrates to a sense of responsibility in this matter, and a Government which professes so great an enthusiasm for physical health and training might do well to convey a strong hint to the offending quarters to discourage lenity as ill-timed as it is reprehensible.

This problem of arousing a public opinion will secure the observance not so much of the minimum standards of the law but rather of the practice of the more progressive firms, whether large or small, and supply the support which such firms, no less than the factory inspectors, themselves require, is less a matter for an individual scientific worker than for his professional associations. They indeed can afford the individual worker the

moral support he may need in making his stand against specific negligence or abuses which he may encounter in his ordinary industrial life, as well as supplying the stimulus and vision which may induce him to initiate constructive measures whether in the technical or more general sphere. Equally they could, if they chose to speak with a united voice and authority, mould public opinion and bring to an end the neglect and indifference which are as detrimental to industrial efficiency as to the health and well-being of the whole nation, and not only that of the individual workers, young and old, of whose lives and happiness so distressing a toll is now taken. The present report may well stir such professional associations as the British Association of Chemists and the Institute of Chemistry to take a more active part in creating an informed public opinion and in strengthening the hands of their members, especially when employed in professional isolation in the small firms where improvement is most needed.

National Factors of Physical Fitness

National Fitness:

The First Steps. (Issued by the National Advisory Council and the Grants Committee for Physical Training and Recreation.) Pp. 24. (London: H.M. Stationery Office, 1937.) 2d. net.

Physical Education in Germany

(Board of Education: Educational Pamphlets, No. 109.) Pp. 80. (London: H.M. Stationery Office, 1937.) 1s. net.

ON Tuesday, July 20, a striking leader appeared in *The Times*, entitled "The Empty Chair". It referred to the fact that physical culture had no conspicuous place among the subjects to be discussed at the annual meeting of the British Medical Association at Belfast. "If the doctors will not fill the empty chair, others less well qualified than they will fill it". "Into this pageant of life in action the science of nourishment and the science of personal hygiene will fit easily and with propriety. . . . This is the larger physiology. . . ." The complaint is just and timely. Physical training is largely neglected by doctors and physiologists in Great Britain, and it is almost impossible to obtain expert scientific advice on it.

The Physical Training and Recreation Act passed through Parliament this year. The little

pamphlet "National Fitness" shows how the National Advisory Council and the Grants Committee are beginning to plan the organization by which the Act may achieve its ends. It is curious that Great Britain—the home of 'sport'—is so backward in matters relating to the physical education (in its widest sense) of the people. How many of its towns have running tracks, gymnasia, swimming baths? How many of its schools and universities have means and personnel for the physical examination and assessment of their students? How many of our young people, lacking advice and encouragement, know anything of the joys of bicycling, tramping, camping (and singing) about the countryside? How many more than at present, even without help and leadership, might find out for themselves, in their holidays and week-ends, were the Youth Hostels multiplied ten times in number and capacity? How much health, happiness and content might result were there reasonable means of physical recreation, with organization, leadership and advice, within the reach of all instead of a small fraction of our people?

The beginning of a national effort is being made. Its success will depend on various factors: first, on public opinion, which, as the pamphlet truly says, "in this country means the opinion of the

people". It will be a sad thing for democracy if "the opinion of the people" in this matter of health and happiness continues to lag behind the accepted teaching of dictatorship. Secondly, on the provision of teachers and leaders: here again democracy has proved lamentably slow, but the pamphlet promises that "a new National College is being established". Will people of sufficient character, intelligence and enthusiasm come to be trained? And will there be assured careers for those who come? Thirdly, on the provision of financial and material means: the funds available to the Grants Committee are not small, but will they be sufficient? This is, or ought to be, a big business. Fourthly, on expert scientific advice on the physiological, medical, nutritional and psychological aspects of a many-sided problem. Such expert advice implies, not mainly consultation in committee (though that is necessary), but chiefly the handling of human beings: it requires, on one hand, something analogous to the clinical experience, the aptitude and sympathy of the good physician, on the other a trained capacity for making correct assessments and drawing accurate conclusions from human data. The "empty chair" will remain empty, or will be filled—as *The Times* said—by someone less well qualified, unless physiologists, medical men, experts in nutrition and psychology, realize that the production of health and fitness is at least as important as the treatment of disease.

The other pamphlet is the "report of a delegation who visited Germany in November last to investigate Physical Training there". It will be deplorable if a great and generous achievement, from which Great Britain might learn much, is disregarded or depreciated because of the indignation which many of the manifestations of national socialism have rightly evoked here, or because of some of the exaggerations and excesses of the achievement itself. The Hitler-Youth, with its six million (most of them) eager youngsters, is admittedly political: that, as the report points out, is no doubt unfortunately—the German habit in physical education: and it has many aspects which, from the British point of view, are odd or objectionable. It takes children unduly from their homes; it sometimes injures them by over-exertion; although nominally voluntary "he is a rash lad who ventures to say that he proposes to stay out of it". It encourages its children to read some queer literature. Its potential military value, also, may be enormous; but so indeed is that of any group, sufficiently large, of happy, healthy people, disciplined in outdoor sports and activities, inured to hardship, bound by common loyalties. The fact that healthy loyal youngsters may make better and more ready soldiers is no

reason why unhealthy, cramped and discontented ones should make a better population.

The truth is, whether we like it or not, and as a comparison of these pamphlets shows, that, in its encouragement to youth (and middle age) to find happiness and recreation in the open air, and to develop health, skill, stamina, strength and self-respect by games and bodily exertion, Germany has gone very far beyond Great Britain. In some respects it has gone too far, but that may be repaired as experience is gained. The achievement is not due only to enthusiasm and devotion. In the "Napoli" schools "the doctor is a most important member of the staff". Research in physical education "is beginning to be of interest to the biologists in the universities". The National Physical Training Academy offers "facilities which are far beyond those which any institution in this country can provide". The training of teachers in physical education, and of leaders in sport, gymnastics and outdoor recreations (teachers and leaders of either sex), is rigorous and scientific: and some of the best and most eager of the young people are enrolled. Architecture, music and psychology are called in: "the spaciousness, simplicity and very often the beauty of the surroundings of establishments in Germany were most noticeable". Singing is widely encouraged and "is invariably excellent". "Kraft durch Freude" (strength through joy) may have a slightly comic ring in English ears, but its appeal to the German masses is based on sound psychology and on skilful, arresting propaganda. This organization affects the lives of millions of young (and older) workers: it is generous and reasonable in spirit: it provides, apart from anything else, cheap, ready and beneficial holidays for the masses: it is "possibly the most instructive phenomenon of the Third Reich". If its cost is great, so also will be its result in health and happiness to the German people.

A free democracy such as ours is liable to be slow in its enthusiasms and to be inhibited by criticism, and it may be a long time before we learn to do for our young people what Germany is already doing for hers. A comparison of these pamphlets shows how far, in eagerness, in organization and in science we are behind. Our best, in physical education, is doubtless at least as good as the German best, but Germany is doing well for far more people. Britain may have little else to learn from national socialism, except by way of warning, but we shall be fools—or worse—if we allow prejudice to blind us to a real achievement in human betterment, if we refuse to acknowledge the one generous experiment which, whatever its motives, exaggerations and shortcomings, Nazi Germany is now making.

A. V. HILL.

Enzyme Research

Ergebnisse der Enzymforschung

Herausgegeben von F. F. Nord and R. Weidenhagen. Band 6. Pp. x + 289. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 23.60 gold marks.

THIS year's volume of the "Ergebnisse" deals in the main with the remote sections of the subject and to that extent is of special rather than general interest. Inasmuch as progress on the experimental side depends on the development of new technique, some of the contributions are of importance. For example, two Indian investigators in Bangalore deal with the application of dilatometry to enzyme reactions, which involves the measurement of volume changes under carefully standardized conditions. Though the mechanism through which volume change is caused is not clearly understood, it is claimed that the validity of its application has been established in specific cases by a comparative and critical study. The practical difficulty is to be sure that the reaction, or rather mean result of possibly several reactions measured, is the one which the experimenter describes.

Perhaps the most interesting chapter is that by Hugo Theorell of Stockholm on the yellow ferment and its component, known in crystalline form as lactoflavin, which appears to be vitamin B₂ and about which so much has been discovered working with extremely small quantities of material. In the ferment, the presence of which must be regarded as essential to life, the lactoflavin is joined to a pentose sugar, phosphoric acid and protein, a combination which seems usual in the cell. It acts as a hydrogen carrier, the physiological problem being whence comes this hydrogen and whither it goes. Lactoflavin has been synthesized. The summary is a useful one of this most important subject.

Miss Stephenson, of Cambridge, writes of hydrogenylase—an alarming word to describe bacterial enzymes which produce molecular hydrogen from formic acid. The work done on this reaction indicates that since all substances so far known to yield hydrogen by bacterial action also yield formic acid, the hydrogen is liberated from this substance.

A somewhat lengthy paper contributed from Lwów, by J. K. Parnas, deals with the vexed question of the changes which take place during the breakdown of glycogen in muscle. The changes are complex, and they involve phosphates; there

is much controversial matter in the article, which would have been improved by a summary. The editors of the "Ergebnisse" should encourage authors, even in the most specialized fields, to make clear wherever possible the probable position in relatively simple language and not leave it to the unfortunate general reader to become lost in the confusion of contradiction and detail.

Everyone must experiment with heavy water in these days, and there is a section on ferment reactions in its presence from K. F. Bonhöffer of Leipzig. It is largely mathematical and does not make any particular point.

The chapter by Emil Abderhalden on the protective ferments demands careful study. Apparently when foreign substances of a hydrolysable character are introduced into the blood stream, it is not long before appropriate new enzymes appear capable of breaking them down, and these enzymes afterwards appear in the urine. These protective proteinases are characterized by being sharply specific towards the substrate which has called them into being. Their origin has not been discovered; they can be detected in blood serum and in urine within less than 24 hours of the introduction of the foreign substance. The subject is a new one and obviously of outstanding importance. It is interesting to note the two conflicting trends in enzyme theory—some emphasize the absolute character of the specificity, others consider a particular enzyme, for example emulsin, to have a wide range of activity though it acts on some substrates with extreme slowness.

Lastly may be mentioned an American contribution, by J. B. Summer of Ithaca, on antiurease, a member of the class of anti-enzymes of which sixteen have already been mentioned in the literature. Crystalline urease being available, it was possible to study the production of antiurease by injecting it into an animal. The author speaks of having made the purest antibody preparation yet obtained, though he has not yet succeeded in crystallizing it. This work is of importance.

These brief extracts must suffice to show some of the directions in which hopeful progress is being made. The work is truly international, the laboratories of the world are co-operating in it and it is worth while to stress this, the real and the predominant aspect of scientific chemical activity, as the true state of affairs, and to regard the excessive reference to warlike activities as largely an overstatement.

E. F. A.

The Rengma Nagas: A Changing Tribe

The Rengma Nagas:

By J. P. Mills. (Published by direction of the Government of Assam.) Pp. x + 381 + 17 plates. (London: Macmillan and Co., Ltd., 1937.) 25s. net.

MORE than fifteen years ago, the reviewer in *NATURE* of an earlier monograph in this series expressed the hope that it might be followed up by monographs on other Naga tribes including the Rengma, and Mr. J. P. Mills, honorary director of ethnography for Assam, in dealing with that tribe, has now filled in one gap in our existing knowledge, so that we have a series of works dealing with all the tribes occupying the middle of the major portion of the administered area of the Naga Hills.

The gaps in our knowledge have been filled in more ways than one, for while Mr. Mills has found less to say about the social organization, for example, of the Rengma, than he had to say about the Ao in his last monograph, he has given even greater details of minor observances, formulæ and superstitions of daily life. Thus we are told exactly what a man should do when he is going out to snare hornbills, or precisely what misfortunes befall a man who remarks how good a wild yam tastes.

The author is, by the way, perhaps too sweeping in describing the Great Indian hornbill as feeding "exclusively on fruits and berries"; at any rate, a tame one, which belonged to the reviewer and lived unopinioned in his garden, spent much time in searching for spiders in the thatch, and preferred butter even to mulberries. Incidentally, also, the Angami dye referred to in a footnote on p. 66 is made from the leaves not, strictly speaking, of an oak tree, but of the *Macaranga denticulata*, and, in order to obtain the true black, a cloth must first be boiled with macaranga leaves and then steeped in black mud, the iron salts in which act on the gallic acid from the tree to make a fast black.

Particularly interesting are the details which Mr. Mills gives of a purificatory ceremony of a kind not previously described, the reviewer believes, in any monograph of this series.

The Rengma are a tribe now split into three groups; one of these migrated westwards to the Mikir Hills in the first quarter of the nineteenth century; the other two remained in the Naga Hills, but have become widely separated by the northward migration of the Sema tribe. It is with the last two sections that Mr. Mills's monograph deals, and he speaks of them throughout with reference to the Naga Hills administrative district as the

Western and the Eastern Rengma, but the Middle, or Central, and Eastern would be more precise terms. It is unfortunate that official duties made it impossible for him to deal with all three groups, since the changes which have taken place in the westernmost group, everywhere in contact with other peoples, have been very great, and would have afforded an interesting, if depressing, example of the effects of cultural contact and subsequent sophistication.

Even so, Mr. Mills has some very important reflections to make on certain aspects of missionary teaching, particularly as to the policy sometimes pursued of discouraging the payment of marriage prices. The tendency of the mission has been, if not actually to discourage, at best to refrain from encouraging the practice of paying a substantial sum for the privilege of marrying a man's daughter. The practice is a healthy one, as it provides some economic insurance for proper treatment of the bride by her husband, who stands to lose the sum paid if his wife leave him under provocation, and for the good behaviour and fidelity of the wife, who in turn must refund the payment if she give good ground for divorce. In some Sema villages where the custom had been dropped on conversion to Christianity, a tendency was manifested towards a quite uncalled-for and unjustifiable putting away of wives, or desertion of husbands, since the unfaithful party stood to lose nothing by the change.

Mr. Mills defends the payment of marriage prices among the Rengma on similar grounds, and it might be added that the retention of the custom is particularly desirable in the interests of the bride where there has been a recent change from polygyny to Christian monogamy, and where the tendency towards marrying more than one wife is likely to show itself in divorce and re-marriage if there be no serious obstacle.

The Government of Assam is the one administration in the Indian Empire that has the wisdom, the foresight and the interest in good governance to produce a series of detailed accounts of the customs and lives of the peoples of primitive culture surviving in the wilder parts of its province. This one is more than worthy of its precursors; it is well produced, well illustrated and well indexed. Two misprints only (on pp. 69 and 92) were detected by the reviewer, but he badly missed a map. Both Mr. Mills and the Assam Government are to be congratulated on this addition to their unrivalled series of tribal monographs.

Mitogenetic Radiation and the Theory of Nerve Excitation

Mitogenetic Analysis of the Excitation of the Nervous System

By Prof. A. G. Gurwitsch. Pp. ii+114. (Amsterdam: N. V. Noord-Hollandsche Uitgeversmaatschappij, 1937.) 3.75 f.

THE outcome of Prof. A. G. Gurwitsch's latest monograph is a new 'chain reaction' theory of excitation, based, in its more concrete form, on the experimental results described in the body of the book. The peculiarity of the new theory is that it allows for the existence of many qualitatively different states of excitation, while ignoring completely the electrical, thermal and chemical phenomena studied by classical methods. The more general considerations which appear in the concluding chapter will perhaps receive better attention, and will doubtless awaken the sympathy of those who, with Gurwitsch, feel that the study of electrical changes in artificially stimulated nerve affords an inadequate basis for the comprehension of the "unlimited variability . . . and the continuity of functional states" of the nervous system. These ideas are derived from Driesch and from Gurwitsch's earlier work on the "cerebral field", and owe little to his study of mitogenetic radiation.

The experimental foundation of the new theory is somewhat as follows: Resting medullated nerve, in common with many other biological systems, is said to emit a complex ultra-violet spectrum of exceedingly low intensity, which originates in the nerve fibre itself. The medullary sheath, although highly opaque to ultra-violet radiation of macroscopic intensity, contrives to transmit the radiation emitted from the nerve fibre by a remarkable chain process of absorption and secondary emission, so that it can conveniently be observed externally by its effect on the rate of division of yeast cells—an aspect of the subject that has already been subjected to destructive criticism (see *Biol. Rev.*, 10, 42 (1935); and *NATURE*, 133, 860 (June 9, 1934)). "Biological" spectral analysis of the radiation, and comparison with that produced by enzyme reactions proceeding *in vitro*, suggest that it can be used as an index of the chemical processes occurring in nerve. It is found that whereas the resting sciatic emits radiation due to glycolysis, oxidation and proteolysis, the stimulated nerve gives a different radiation, the composition of which depends on the mode of excitation—mechanical, electrical, reflex, etc. Thus, in Gurwitsch's opinion, the existence of a qualitative variability of states of excitation is established. Sub-threshold stimuli, moreover, also give rise to a propagated

disturbance, accompanied by characteristic chemical changes, so that the all-or-none law appears to be a mere artefact, ascribable to the too exclusive interest of classical physiologists in action currents, excitability, and so forth.

Not only does nerve show this variability of response to stimuli of the usual type; it also responds, with a propagated wave of chemical action, to intermittent exposure to mitogenetic radiation from some other source. This so-called "mitogenetic excitation" appears after a latent period of 0.001 sec., is transmitted at a rate of 30 m./sec., and its nature varies with the nature of the exciting radiation. A single line from the glycolytic spectrum, of wave-length 217–218 μ , say, will set up a propagated disturbance involving emission of this same line, and, in addition, of other lines of the glycolytic spectrum—one, for example, at 190–192 μ . An interesting case, as Gurwitsch puts it, of "antistokes". A pure glucose solution, it may be mentioned, shows a similar secondary excitation which travels through the solution at a rate of 10–12 m./sec.

With regard to the behaviour of the central nervous system, Gurwitsch has studied the radiation emitted from the surface of the optic chiasma, the optic lobes, the hemispheres and the medulla of a frog stimulated visually. He finds that the "visual act" is accompanied by emission of radiation from all these regions; the stationary spatial distribution intensities in the cortex are a function of the nature of the stimulus—varying, for example, when a white visual field is replaced by a moving black pattern on a white ground, although a half white and half black field gives the same pattern, whether the black or the white portion forms the upper half. The spectra from the optic nerve and the hemispheres are also different with stimuli of different colours.

Sufficient has been said to indicate the general nature of Gurwitsch's experimental evidence, although it is not possible in a short review to deal with all its complexities, and surely not necessary to indulge in any lengthy criticism. Gurwitsch's discoveries speak for themselves, and the reviewer may be forgiven for taking to heart the author's advice, in a footnote dedicated to his critics, "to act more cautiously in the future, in order not to find themselves in a ridiculous position". He may nevertheless be allowed to suggest that the discoveries in question are open to serious doubt on physical, chemical and physiological grounds.

J. B. BATMAN.

The Nature of Human Nature:

and other Essays in Social Psychology. By Prof. Ellsworth Faris. (McGraw-Hill Publications in Sociology.) Pp. xii+370. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21s.

AMERICAN sociology has been often described as suffering from two major though mutually exclusive complaints: a tendency to systematization which borders on vacuous verbosity; or, in contrast, a raw empiricism satisfied with increasingly detailed descriptions and the endless and aimless collection of fact, numerical in preference. On the whole, this indictment is as unfair as in a few exceptional cases it is amusingly apposite.

The present volume by one of the veterans of American sociology is a proof that Prof. Faris—and he represents the best and most numerous group of his colleagues—can be at the same time concrete and theoretically inspired; interested in facts, yet always infusing them with theoretical insight and human sympathy. The volume consists of collected essays ranging over a variety of subjects, and written over a period of years.

Some of the chapters are vigorously controversial. His robust, almost brutal handling of Pareto will be a delight to those of us who dislike irrational fashions in science (or pseudo-science) and quasi-religious cults in abstract sociology. The chapters on race and racial problems show once more the American mind at its best. Prof. Faris is, needless to say, strongly opposed to all extreme racial theories. He does not, however, dismiss the factor of race as a mere figment but deals with it in a truly scientific spirit. The group of essays on ethnographical subjects are based on the author's personal acquaintance with Central Africa, where he has lived for seven years. In his treatment of psycho-analysis and behaviourism, in the fundamental problem of human instincts in society and in his discussion of the Jewish question, we find everywhere an outspoken, honest, shrewd and at the same time, widely read and rarely cultivated mind. The book is written in simple and direct English; it is witty and full of vigour; it is as interesting as it is instructive; it vindicates the scientific character of American sociology.

B. M.

Comets:

their Nature, Origin and Place in the Science of Astronomy. By Mary Proctor and Dr. A. C. D. Crommelin. Pp. xi+204. (London: The Technical Press, Ltd., 1937.) 8s. 6d. net.

THIS work is written in simple and non-technical language and for this reason it will prove attractive to the general reader. The student of astronomy too will find it a most useful book, especially for references, as it supplies very useful information on famous comet hunters and also on the history of some of our well-known comets, Pons-Coggia-Winnecke-Forbes, Halley, Biela, Encke, etc. There is a description of the return of Halley's Comet in 1910—a return which caused considerable interest in the astronomical world especially, as Drs. Cowell and Crommelin had devoted a lot of time to the

computation of the perturbations by the planets. They predicted the time of perihelion passage as April 17, 1910, and this prediction was correct to less than three days.

Miss Proctor's father, Richard A. Proctor, showed many years ago that there were insuperable difficulties against the theory of the capture of comets by planets, and this is discussed in the present book. Dr. Crommelin supports Proctor's position and has devoted much attention to the view that the comets are not extra-solar. He agrees with Proctor that the short-period comets were expelled from the giant planets, but considers that Proctor was in error in postulating this expulsion millions of years ago. Crommelin believes that it took place in comparatively recent times—a view which is supported by the well-known fact that these short-period comets are rapidly disintegrating and last only a few centuries, not millions of years.

The book has a number of useful illustrations and an index is a great convenience. It is a very readable and interesting work. M. D.

Das Gallium:

eine kritische Würdigung der Erkenntnisse mit experimentellen Beiträgen. Von Dr. Erich Einecke. Pp. 155. (Leipzig: Leopold Voss, 1937.) 12 gold marks.

THIS monograph gives a detailed account of the element gallium, which is now available on the market. After a historical introduction, it specifies the sources of gallium and the methods of extracting the element from them. The physical and chemical properties of gallium and of its alloys and compounds, including organo-metallic compounds, and the analysis of gallium, are described with 450 references to literature and 15 patents. Since 1932 gallium has been separated from the by-products of the copper schist of Mansfeld by the Vereinigten Chemischen Fabriken at Leopoldsdahl, and the price is now about 10 marks per gram. The metal has a very low melting point, 29.78°, and remains supercooled much below 0°, and a high boiling point, so that its use in high-temperature thermometers in quartz has been the object of research. Gallium compounds have also found application in pharmacy. The book contains some original observations by the author and is a valuable survey of the present knowledge of gallium and its compounds.

Photography

By Dr. C. E. Kenneth Mees. Pp. xii+214+63 plates. (London: G. Bell and Sons, Ltd., 1936.) 7s. 6d. net.

IN January 1936 the "Christmas Lectures" at the Royal Institution were given by Dr. Mees. His book covers the ground of the lectures in a very readable and extremely well-illustrated way. The history of photography is fairly fully summarized in a chapter of thirty-three pages. Another chapter describes the manufacture of photographic materials. The remainder of the book deals with the principles and applications of photography.

Mechanics of Sport*

By Sir Gilbert Walker, C.S.I., F.R.S.

IN games with a ball in their most primitive stages, the ball may be simply a convenient lump to be thrown or hit; but effects of spin soon play their part. It is well known that Prof. P. E. Tait measured the starting speed of a golf ball and thought he had proved mathematically that its range could not be more than about two-thirds of the distance that his son proceeded to drive it. The cause lay in the upward force due to the under-spin, and the explanation of such an effect had been given by the late Lord Rayleigh, as well as in general terms by Sir Isaac Newton. Similar effects may be seen in a slice at golf, a swerve in cricket or baseball, or an American service at lawn-tennis.

Another game in which a swerve occurs is curling, and the path of a stone happens to have the same relation to its spin as that of a ball moving through the air. Now the bottom of a stone is not flat, but is hollowed, so that it is in contact with the ice over a circular line about 6 inches in diameter. Let us suppose that the direction of spin is such that the forward side is travelling towards the left. If we think of the sideways friction on the circle of contact, that in the front half of the circle is to the right and on the rear half to the left. Now the stone moves to the left, so the friction on the rear half must be the greater. But as the forward motion of the stone as a whole is retarded by friction on the ice, the pressure on the rear half must be less than that on the front half; and if the stone were moving over a glass plate the rear friction would be the less and the stone should swerve to the right. This actually happens. On ice, however, it swerves to the left and so there must be better lubrication on the front half, or greater pressure, than on the rear half. Now we know that when ice is not far from the melting point, pressure in excess of a critical value melts the ice and reduces the friction: it is this property that makes skating possible, for it produces a film of water between the skate and the ice. So there should be more melting in the front half; also a stone should refuse to curl when its pressure cannot melt the ice, that is, when it is very cold. This agrees with experience.

Curiously enough, there is yet another case in which rotation sets up deviation in the same direction as for a ball. It is that of a falling long strip of cardboard. As Maxwell pointed out, if a spin is started, the downward velocity will be

least after the plane of the strip has passed through the horizontal and greatest after passing through the vertical. So the couples tending to increase the spin will be greater than those tending to decrease it; and the spin will grow. Also the horizontal forces will be greater after the vertical position has been passed through, and the sideways motion will appear. An example of this may be seen in the bull-roarer, an implement used in magical rites by primitive men over a large part of the earth. When the bull-roarer is twirled round, the string describes a cone on the side indicated by the theory, and when it has twisted so far that it must start untwisting, the cone shifts over to the other side.

Some effects of the 'nap' of a cloth may now be considered. A billiards player learns by experience that the path of a ball travelling slowly with much 'side', that is with a rapid spin about a vertical axis, will be diverted to the right or left according as the spinning motion on the right side is with or against the nap. The deflexion may be something like an inch in the length of the table. I have seen pages of mathematical analysis vainly devoted to the subject. But if we state the result in the form that the path bends away from the side on which the nap is being rubbed up and toward that on which it is being rubbed down, the explanation is obvious; for on the rubbed-up side the effective surface is higher than that on the stroked-down side, and the ball moves, as it were, on an inclined plane.

Let us consider now some of the weapons of primitive people. Slings and stones are still widely used, but the range of an arrow or a throwing spear is much greater than that of a stone of the same weight starting with the same speed. A few efforts to throw a wooden stick five feet long by hand will show that, unless precautions are taken, there is a marked tendency for it to travel in the stable transverse attitude with its length at right angles to its path, so that the range is poor in the extreme. For steady flight with the axis longitudinal we must either provide resistance in the rear end, as in an arrow, or put the centre of gravity forward, or spin the weapon about its axis; in a throwing spear both the latter devices are commonly employed. The natural way to give the spin is by wrapping the thumb and fingers round the spear, so that it rolls off the hand on release. The assegai is thrown in this way, and flies like an arrow from a bow; its penetration is very great.

* Substance of a lecture delivered at Derby on September 6 in connexion with the British Association meeting at Nottingham.

In the course of time, primitive peoples have developed two devices for throwing, the spear-thrower and the beckett. The former is a stick about two feet long and in its use the spear lies along the spear-thrower with its butt resting against a projecting peg. This makes possible an invaluable flick of the wrist and, strangely enough, imparts a considerable spin. This would be impossible if the spear were not slightly 'whippy', so that an imperceptible flick to one side in its slightly bent state will apply a couple about its longitudinal axis. I believe that a range of 150 yards can easily be attained in this way.

The beckett is a short cord wrapped around the spear and also the first finger of the thrower's hand. It enables the wrist to be freely used and gives the valuable spin. The Roman *pilum* was thrown in this way with a thong called *amentum*.

A boomerang can to-day be looked on as an anticipation of the 'autogiro'; for as with the horizontal fan of the autogiro, its rotation provides support similar to that of the wings of an aeroplane. The couples necessary for its steering are produced partly by the warping of its plane and partly by the lack of symmetry in its cross-section. Returning boomerangs may describe paths of various types; we may have several circuits in front, or a figure of eight. But for an ordinary missile to be thrown at an animal, the shape is designed to give a straight and very flat trajectory. Its efficiency is considerable; when my range with a cricket ball weighing $4\frac{1}{2}$ oz. was seventy yards I could throw a straight-going boomerang weighing twice as much a distance of 185 yards. One of my literary friends used to maintain that a boomerang alighted rotating faster than when it left the thrower's hand; and I used to reply, with the cocksureness of a mathematician, that such a thing was impossible. But we are now familiar with the way in which, except in recent patterns, the rotation of the fan of an autogiro was provided, not by the direct drive of an engine, but by the forward rush of the machine through the air. So my literary friend was not far wrong.

A well-known tool of the Stone Age is the adze, of which the head, or celt, may have a curious property; when placed on a fixed plate of clean glass it may spin in one direction but not in the other. The celt is oval and at the point of contact with the plate the lines of curvature are not, in general, precisely parallel with the dynamical axes—the axes based on the distribution of matter. There is rotational asymmetry, and this shows itself when the celt is spun. Theory brings out another paradox; when tapped at one end rotation is set up, and the direction of this may be reversed merely by raising the centre of gravity.

Let us now turn to some problems of the motion of living beings. The art of swimming has been revolutionized by copying primitive peoples in methods so obvious that we ought to have thought of them. Thus in 1892 the record for the mile was 29 min. 25 sec.; it is now 21 min. 7 sec., an improvement of about forty per cent. In the crawl stroke the body is horizontal instead of sloping, so that the resistance is reduced and the energy is nearly all spent in propulsion, whereas much was spent in keeping the head out of the water. In it, also, useless resistance is not caused by moving the arms forward or sideways in the water, instead of backwards, and the legs, which are not well designed for propulsion, remain nearly straight; their movement, whether the flutter or the scissors, is made three or four times to one of the arms and has a very small range; its object is largely that of controlling the position of the body.

We will now consider a high jump. A good performer crosses the bar in a nearly horizontal attitude, so that as he approaches it vertically he would, unless something occurred, turn through another right angle in descending and alight nearly upside down. In fact he learns to make violent contortions to avoid a dangerous descent. Perhaps the best exponent of this art is the cat, which, if suspended by the paws with its back only a few inches above a table and released, will fall on its feet. It performs the whole operation of rotation in the air in about a quarter of a second. This can be illustrated by mounting a platform able to rotate without appreciable friction, when, by repeated use of the arms, a man can turn his body completely round as often as he wishes, although at no instant is there the slightest angular momentum about the vertical.

Another theme is that of sailing flight. In the tropics when the sun has sufficiently heated the earth's surface, we see kites and vultures flapping their way upwards until about fifty feet above ground; and then, having reached an up-current, their labours cease and they soar in spirals to a height of perhaps 2,000 feet; they may wander at will all day and descend at sunset. At the first glance it would appear from the inclination of the wings that the up-current would drive the bird backwards, not forwards, but on plotting the motion of the bird relative to the air and remembering that its wings are slotted the paradox is solved.

I believe that the mechanical efficiency of a modern sailplane easily beats that of a vulture, the flight of which is handicapped by carrying much flesh; so that in the tropics a skilful and experienced pilot should be able to roam all day at will. But even in our comparatively feeble European sunshine, the distance record is 313 miles and a height of more than 19,000 feet has been reached.

Tests in Common Use for the Diagnosis of Colour Defect*

By Dr. Mary Collins

THE testing of colour-blindness in all its forms presents a problem of great practical importance involving the adoption of a definite technique.

The spectrometer is undoubtedly the most fundamental test of colour vision, but it is seldom available for practical purposes, and the majority of tests, apart from those in scientific laboratories, are carried out either with some kind of lantern test or some kind of pigment test. There are various types of lantern tests available. The Edridge-Green colour perception lantern is the only one which has been used by the writer. A newer model is the Board of Trade lantern test, recommended with modifications by the committee set up to consider colour vision requirements in the Royal Navy. In using this the eyes have to be dark-adapted for 15 minutes. The Giles-Archer perception unit is also a new and simple model, and it, too, requires the eyes to be dark-adapted. These lantern tests, and many others, have the advantage that coloured lights are used instead of pigments, which brings conditions of testing nearer to everyday conditions in the Services, the railroad, navigation and aviation.

Certain pigment tests have also been extensively used, and it is these I should like to discuss in some detail. In some of these tests, it is puzzling to find mistakes made sometimes by individuals with normal colour vision which should only be made by colour-blinds. The printing of the tests may be partially to blame, but it must be recalled that decisions are constantly being made on the results from these tests, and therefore it is essential to recognize which responses are diagnostic and which can be ignored. In order to reach a valid basis for diagnosis, I have given a battery of tests under constant conditions of distance and illumination to an unselected group of about 340 candidates, exclusive of colour-blinds, applying to be accepted as apprentice printers. Their responses, therefore, to the tests may be compared with the responses of a group of colour-blinds tested under the same conditions. This normal group acts as a control group against which the results for each test used can be evaluated at its proper worth.

Owing to exigencies of space it will not be possible to discuss the details of the results obtained with all the tests which have been used. I can indicate the type of investigation under progress by giving the results from one of the tests only, "The Ishihara Tests for Colour Blindness" (5th Edition).

The Ishihara test is composed of a number of pseudo-isochromatic plates in which coloured numerals appear on coloured backgrounds. In some of the plates only part of a numeral appears to a person who is colour-blind, this being dependent on the colours used. For example, an 8 may be the numeral read by one with normal colour vision, but only part of it may be seen by the colour-blind, and he reads it as 3. Or a totally different numeral may be seen by the colour-blind from the arrangements of the spots before him, and instead of seeing a 5 as the majority would do, he sees a 2 standing out distinctly from the background. Further, in some plates, the position is reversed as it were, and although the person with normal colour vision sees nothing but a blur of colour, the colour-blind sees a numeral quite clearly. If one with normal colour vision looks at these plates through a blue glass, the 'hidden' numbers become visible.

The individuals forming the control group who were tested were found to vary markedly in their colour discrimination. It seemed advisable to divide them into two groups termed respectively *N* (normal) and *N-* (showing greater deviation from the normal). The classification is of necessity an arbitrary one because it is difficult to know where to draw the dividing line; in fact, the line of demarcation between colour-blinds and non-colour-blinds may itself vary according to the purpose in hand. In the report of the "Colour Vision Requirements in the Royal Navy", already referred to, it is stated of a certain test that if used alone it causes extravagant rejection of candidates who may be fit even for the seaman branch. This merely indicates that the standard for rejection can be changed in accordance with the post to be filled. It is interesting to note that three grades, so far as colour discrimination is concerned, are suggested in this report.

The colour-blinds in the present test have been classified thus because of their responses not to any single test but to at least six tests, and in some cases a spectrometric examination was also made. Similarly, in the *N* and *N-* groups, their allocation to these classes is based on the results obtained from the same battery of tests.

The accompanying table shows the results from the Ishihara test when given to these three groups. The percentage frequency of the responses in each group has been calculated with regard to normal responses and colour-blind responses. The table

*Continued from page 554.

is read thus: in plate 5, 56 per cent of group *N* read the figures correctly as the normal do, that is, read them as 74, whereas 11 per cent of group *N* read the figures as the colour-blinds do, that is, read them as 21. The frequency of responses other than normal and colour-blind has been omitted. In the *N*-group, 29 per cent gave the normal response, 31 per cent the colour-blind response. In the colour-blind group, 0 per cent gave the normal response, 81 per cent gave the colour-blind response.

ISHIHARA TEST.

Frequency in percentages of normal and colour-blind responses for *N*, *N*-, and colour-blind groups.

Plates	As read by normal	As read by C.-B.	Normal <i>N</i> . C.-B.	<i>N</i> - <i>N</i> . C.-B.	Colour-Blind <i>N</i> . C.-B.
1	12	12	100 0	100 0	100 0
2	8	3	100 0	100 0	40 55
3	6	5	100 0	100 0	21 71
4	5	2	99 5	92 4	12 74
5	74	21	56 11	29 31	0 81
6	2	—	99 0	83 1	0 100
7	6	—	100 0	96 4	5 96
8	5	—	100 0	96 2	5 96
9	7	—	100 0	100 0	2 96
10	—	5	91 4	80 6	0 96
11	—	2	72 27	28 48	0 100
12	26	2 } or 6 }	99 0	90 1	59 } 10 }
13	42	4 } or 2 }	100 0	100 0	55 } 26 }

The frequency of responses other than normal and colour-blind has been omitted.

N = 236 males; *N*- = 48 males; C.-B. = 45 males.

Plates 2 and 3 are never wrongly read by either the *N* or *N*-group, but Plate 3 seems the better diagnostic test of colour-blindness, as 71 per cent of the colour-blinds failed on it, and only 21 per cent passed. Plate 4 is equally good, although 0.5 per cent of the *N* group and 4 per cent of the *N*-group gave the typical colour-blind responses. Plate 5, which is read as 74 by the normal and as 21 by the colour-blind, is said by Miles to be "certainly the most sensitive indicator of colour weakness that we possess", and in the summary at the conclusion of the article, he suggests that in testing men for mercantile establishments only Plate 5 need be used at the original interview. It is also regarded in the "Report on Colour Vision Requirements in the Royal Navy" as one of the most searching plates. It is true that 81 per cent of the colour-blind read the figures as 21, and the others in different erroneous ways, but if we look at the results from the *N* and the *N*-groups, we must modify our opinion. Only 56 per cent of the *N* group passed, whereas 11 per cent failed, that is, read the 74 as 21. The remainder read the 7 as a 2 or as a 9 or as a 1, so that the figures read as 24 (7 per cent), or 94 (2 per cent), or 14 (1 per cent): or the 4 was read as a 1, and the numbers read as 71 (20 per cent), or 91 (2 per cent) or 11 (1 per cent). In the *N*-group, the

percentage of those passing is even smaller, 29 per cent, and the failures 31 per cent. The other variations also occurred. It may be, of course, that this plate offers a very delicate test of colour weakness, and therefore is very effective in picking out colour defect of varying degree. But sometimes it was the only error the individual made not only in this test but also in a group of tests.

The next four plates seem to be very significant. The normal group shows a perfect pass in all four and the colour-blinds almost a complete failure.

The next two plates containing the hidden numbers differ very much as regards efficacy for detection. The hidden 5 is certainly not visible to the normal eye, and the fact that 4 per cent with normal colour vision saw it easily is a curious result. These 4 per cent have perfect colour vision on all the tests, and one would be almost inclined to rate them as *N*+. Whether the supersensitive see the 5 or not requires further investigation. The 2, on the other hand, is not satisfactory. It could be seen fairly easily by all groups, as will be evident from the percentages quoted. Twenty-seven per cent of the *N* group and 48 per cent of the *N*-group were able to read it.

The last two plates are very satisfactory.

The Ishihara test is a very reliable test of colour-blindness and did not allow any of the colour-blinds to pass. It also seems to detect colour weakness in a highly efficient manner.

The results from this test may be sufficient to give some idea of the type of investigation which has been carried out. A similar analysis of the results obtained with other pigment tests—the Stilling, Schaaff's mosaic plates, the Nagel, the Podesta, the Edridge-Green, etc., leads to similar conclusions, namely, differences in the value of individual tests, inconsistencies in the findings arrived at with any single series, and so on.

There is a good deal of doubt whether we ought to speak of reliability and consistency in connexion with the results of this analysis. It may be that the discrepancies disclosed are due to the great variety of those deviations from normal colour vision which are so marked as to justify their being regarded from a practical point of view as cases of colour-blindness. This interpretation of the facts is to some extent confirmed by the results of filter analysis. Plates which all profess to diagnose deuteranopia, for example, show very differently under filter analysis, and similarly evoke different responses from different deuteranopes. The inference would appear to be that we are dealing not with linear variations in degree but with multidimensional variations. A wide new field for investigation is thus disclosed, the working of which may yield valuable results for the whole theory of colour vision.

Work of the Discovery Committee

FIFTH COMMISSION OF THE R.R.S. *Discovery II*

THE Royal Research Ship *Discovery II* is again on the point of departure from London for the Antarctic: she is expected to sail from St. Katharine Dock on October 7 and will be away from England for twenty months. During this time she will be continuing the research on the distribution of whales, hydrology and plankton, the progress of which has been the subject of the recent report referred to in *NATURE* of September 25.

The first seven months (the southern summer) are to be spent in making a circumpolar cruise planned to provide data for comparison with those obtained on the winter circumpolar cruise of 1932 and with those of the survey of the southern part of the Pacific Ocean in 1934. A circumpolar cruise in summer was started in 1935-36, but this was not completed as it was necessary to revise the programme after a voyage had been made to the Ross Barrier to pick up the American airman Mr. Lincoln Ellsworth.

Leaving Cape Town in November, the ship will steam south-south-east as far as the edge of the pack-ice. On the way southwards a full station will be worked every day: this includes temperature measurements and collection of water samples from a series of 22-25 depths between the surface and the bottom, and the fishing of fine and coarse nets vertically and obliquely down to a depth of at least 1,000 metres.

When the ice-edge is reached, a course will be set towards the east, but tacks will be made north-east and south-east so that the conditions in the warmer water of the open sea to the north of the pack-ice can be examined as well as those at the ice-edge itself. While the vessel is to the southward of the Antarctic convergence—the boundary between antarctic and sub-antarctic conditions at the surface—a constant look-out will be kept for whales; estimations will be made of the relative numbers of Blue and Fin whales seen, and some comparison will then be made of the relative abundance of whales in the different sectors.

In Antarctic waters special nets will be fished for krill (the food of whales) and particular attention will be paid to the collection of young krill near the ice-edge. Where the ice conditions allow the ship to reach the continental shelf, there will also be more intensive work.

In order to complete the circumpolar voyage, the ship must steam northwards to Australia and

New Zealand to replenish her bunkers with oil fuel, and she is expected to be in Fremantle late in December and in Dunedin early in February. Further supplies of fuel will be taken from the Falkland Islands and South Georgia. On both northward and southward voyages the routine observations—at least one full station daily—will be continued; they will give sections across the Antarctic, sub-Antarctic, and sub-tropical zones, and comprehensive data for further research on the problems of the meridional circulations of water and plankton.

In the Atlantic Ocean four lines of stations will be worked across the cold current which flows towards the east from the northern part of the Weddell Sea, and observations will be made between 0° and 20° E. in the current that flows westward into the Weddell Sea along the fringe of the Antarctic continent. The purpose of these observations is to obtain a substantial sample of the krill population in the Weddell Sea current.

The ship is expected to complete the circumpolar voyage and to arrive back in Cape Town early in May 1938, and she will sail southwards again, in midwinter, about July 1.

The second half of the commission will be spent in the eastern part of the Atlantic Ocean and the western part of the Indian Ocean, and repeated lines of observations will be made along the meridians 0° and 20° E. The repeated cruises will only differ in so far as they are affected by the position of the ice-edge, and great care will be taken to preserve a uniform method of making all the observations so that comparisons of the results of successive cruises will be as valid as possible. The work will include observations on whales; measurement of temperature, salinity, nutrient salt and oxygen concentrations between the surface and the bottom; intensive plankton fishing—particularly for krill—down to a depth of at least 1,500 metres; and meteorological observations and bird counts. It is hoped to repeat the cruise—southwards along 0°, eastwards near the ice-edge, and northwards in 20° E.—at least seven times before April 1939, when the ship will return to England.

The director of research, Dr. N. A. Mackintosh, will accompany the ship during the first part of the work, and the scientific staff will include Mr. H. F. P. Herdman and Mr. A. J. Clowes as hydrologists, and Dr. T. J. Hart and Mr. J. A. Nicholson as zoologists. Lieut. L. C. Hill, R.N.R., is again in executive command.

At the recent Imperial Conference the possibility was mentioned of some form of co-operation between the Dominions in any form of economic or scientific activities which might be undertaken in the future in the Antarctic. In this connexion the governments of South Africa, Australia and New Zealand have been invited to nominate scientific or other workers to sail with the *Discovery II*, each for a section of the circumpolar cruise, in order to study the methods of research used by the Discovery Committee.

WHALE-MARKING VOYAGE OF THE R.R.S. *William Scoresby*

The Royal Research Ship *William Scoresby*, the Discovery Committee's smaller ship, which is now used mainly for whale-marking, has already sailed, the purpose of her early start being to search for

whales in sub-Antarctic waters before they have reached the Antarctic feeding-grounds. The route to be taken depends largely on the abundance and movements of whales. Fuel will be taken, however, at South Georgia in November, and it is probable that operations will then be extended eastwards towards Bouvet Island if ice conditions are suitable. In the second part of the season the ship will move to more westerly regions, near the South Shetland Islands and in the eastern part of the Pacific sector.

The *William Scoresby* sailed on September 16 and is expected to return about April 15, 1938. Mr. G. W. Rayner is in charge of the operations and Lieut. R. C. Freamer in executive command.

Some four thousand whales have now been marked and more than ninety marks have so far been returned.

Genetics and Taxonomy

VARIOUS articles and letters that have appeared in *NATURE* during the past few years suggest that workers in special branches of biology (particularly in cytology, ecology, and genetics) are showing an increasing interest in the impact of their discoveries on taxonomy, and that this interest is shared by their taxonomic colleagues. Papers and discussions at the annual meeting of the British Association may also frequently be accepted as an indication of what subjects are developing in scientific favour. At the recent meeting at Nottingham a morning was devoted by Section K (Botany) to "Genetics and Taxonomy", with a rather wider range in the papers and discussion than is suggested by this general title.

It would appear from Dr. W. B. Turrill's opening paper that plant taxonomy is to some extent at the cross-roads. The old orthodox (or 'alpha') taxonomy, based largely or entirely on morphology, has remarkable achievements to its credit and there is still much to be done by its traditional methods, especially in the floras of the botanically less explored parts of the world. On the other hand, the new methods, especially those with an experimental basis, are leading to the discovery of important characters or attributes, many essentially physiological, which show that the old classification needs improvement or even altering fundamentally if it is to be of the widest use. Cytogenetical investigations, while not the only lines of research which are making contributions to a new taxonomy, are of very considerable

value since they are throwing light upon the following problems which concern the taxonomist: the degree of plasticity of the genotype, the occurrence and constancy of correlation of characters, the occurrence and nature of sterility barriers, the evaluation of characters, the recognition of hybrids, and the phylogeny of species. Examples illustrating the influence of experimental investigations on taxonomic concept, with reference to the above problems, are furnished by the research at Kew and Potterne on species of *Ranunculus*, *Silene*, *Centaurea*, *Anthyllis*, *Plantago*, and other genera.

Not infrequently modern investigations support morphological classification, as Mr. W. J. C. Lawrence showed for the genus *Dahlia* and Dr. K. Blackburn for *Silene*. For an increasing number of genera, cyto-genetical and biochemical analyses enable rapid and precise comparisons to be made between species, thus providing the taxonomist with a further measure of the relationship and evolution of species. The work at the John Innes Horticultural Institute on *Streptocarpus* and *Delphinium* serves as an example.

In such a group of plants as the grasses, taxonomists have sometimes attached undue importance to easily observed but relatively inconstant characters. Dr. T. J. Jenkin suggested the desirability of close co-operation between the taxonomist and cytogeneticist in elucidating the history and behaviour of pasture grasses and thus preparing the way for a better general classification of these economically important plants than at present

exists. Problems of interspecific and intergeneric hybrids are the concern of both the cytogeneticist and the taxonomist, as is also the determination of phylogenetic relationships. The taxonomist has to evaluate the characters he uses, making some of generic, some of specific, and some of varietal value, and so on. In *Lolium*, genetical research shows that height has little value as an indicator of relationships and specific distinctness, since a plant two inches high may be a sib to a plant twenty inches high. In the genus *Dahlia*, corolla colour definitely characterizes two groups of species and the wide colour range shown by the garden *D. variabilis* is, in agreement with other evidence, a witness to its origin as a hybrid between species of the two groups. Such examples of recent research illustrate the help the taxonomist may expect from the biochemist and cytogeneticist in his attempts to classify plants that the classification is not only widely useful but also indicates relationships.

In return for such help the taxonomist can assist his colleagues not only by identifying their original material on the basis of 'alpha' taxonomy, but also by indicating problems which are recognized as unsolved by the older methods. Prof. J. R. Matthews gave examples of closely allied species which were probably derived from a common ancestral stock but which have now a different geographical range. Cytogenetic research on such plants as *Ranunculus Flammula* and *R. reptans*, *Callitha palustris* and *C. radicans*, *Primula farinosa* and *P. scotica*, combined with other methods of investigation, might lead to the formulation of general views regarding the influence of isolation in speciation. Knowledge of the origin of the geographical race or subspecies may well give us a more complete knowledge of the origin of species.

The results of modern lines of work are beginning to influence taxonomic thought by making taxonomists consider the logical basis of their classification. There seems a general agreement that 'alpha' taxonomy (based essentially on morphology) should be maintained for the present. Subsidiary classifications, often based on a very limited and deliberately abstracted number of attributes are, however, essential for special purposes and especially for deductions from correlation of attributes. Such a classification as that of Turesson, which was ably advocated in the discussion by Dr. J. W. Gregor, has a considerable value both as a means of stating and comparing the results of eco-genetical research and as a guide in the practical application of such research to agriculture. Such special classifications, however, cannot replace a more general one, and exactly how far they can be combined with morphological criteria to lead to a practical and logically sound classification is a matter for continued experiment. As Dr. Turill said: "by trials and errors this 'experimenting taxonomy' will enable, one hopes, orthodox relatively stabilized taxonomy to incorporate new data and so to advance, gradually and cautiously, from an alpha position towards a far-off omega perfection of the classification of all biological knowledge".

The formation of the Association for the Study of Systematics in Relation to General Biology (see NATURE, July 24, 1937, p. 163 and Aug. 7, 1937, p. 211) was cordially welcomed at several sectional meetings of the British Association. It has evidently awakened considerable interest amongst biologists and should do much to stimulate and co-ordinate research into the many problems of equal importance to taxonomists and their colleagues in other branches of biology.

Obituary Notices

Prof. Albert Heim, For. Mem. R.S.

THE news of the death on August 31 at the age of eighty-eight years of the veteran geologist Albert Heim, though not unexpected, comes as a sad shock to many admirers. A very great man has gone, and a treasured connexion with the early days of Alpine structural interpretation has at last been broken. As a student, Heim came under the spell of Arnold Escher von der Linth, an open-air researcher, a great talker, but no writer. Heim loved the mountain side no less, but fortunately he was an artist, excelling with both pen and pencil; and in his early publications he preserved in truly glorious fashion Escher's discoveries, enriched by numberless observations of his own. Heim's technical skill was such that he

himself engraved the copper plates of many of the illustrations that adorn his text.

The great drama of Heim's scientific life had its origin in one of Escher's favourite ideas, the 'double fold' of the Glarus. In 1841 Escher argued for the existence of 'colossal overshoving' of older rocks on to younger in the Canton of Glarus. He wanted to make the displacement involved as small as possible, and, as the cover of older rocks was discontinuous, he presently imagined that he could explain their situation by postulating two shoves from opposite directions, each with rather less than half the magnitude required if the shove were single. Heim adopted this theory in his classic "Untersuchungen über den Mechanismus der Gebirgsbildung", published in 1878;

and he maintained it for many years in face of slowly developing opposition.

We may recall Marcel Bertrand's paper unifying the movement in 1884, Suess's conversation with Heim in the same sense in 1892, and Schardt's one-way interpretation of Pre-Alpine tectonics in 1893. Schardt's revolutionary ideas led on to Lugeon's synthesis of Swiss Alpine structure considered as a whole, published in 1902. Lugeon was a pupil of Heim's, and while his masterpiece was passing through the press he received a noble letter from his old professor, in which the latter confessed that he now favoured Bertrand's interpretation and expressed joy at the new vision that had come.

The marvel of Heim's career is that it began in early youth and culminated in old age. When only twenty-four years old, Heim succeeded to the chair of geology at the Polytechnic in Zurich, and in the following year to that at the University of the same town, and held both posts until 1911; and yet, in 1919-22, he produced his three-volume "*Geologie der Schweiz*", the finest national text-book that is ever likely to be written.

Heim was keenly interested in many aspects of geology besides tectonics. Here there is only room to mention his work on glaciers, of the erosive powers of which he did not have a high opinion.

Heim became a member of the Swiss Geological Commission in 1888, and directed its activities from 1894 until 1925. With C. Schmidt he published a very valuable map of Switzerland on the scale 1:500,000. He received honorary doctorates from Bern, Oxford and Zurich, and was elected a foreign member of the Royal Society of London. He has left a distinguished son, Arnold, called after Escher, who was truly helpful to his father during the latter half of his long life's work. E. B. BAILEY.

Lord Rothschild, F.R.S.

In Lionel Walter Lord Rothschild, who died on August 27 at the age of sixty-nine years, a scientific worker has passed away of whom it may justly be said that he was better known at home and abroad than any other contemporary zoologist. It was inevitable that a Rothschild deeply interested in biology and possessing large zoological collections which he was indefatigable in increasing for the benefit of science, should inspire the imaginative Press of many lands to publish fanciful reports, which gave him a publicity often very embarrassing and inundated him with offers of collections and service and with requests for help. But he would have gained high distinction in science without a family name already world-famous. His interest was so intense and so wide, his ever-ready support of science so valuable and his scientific publications so important, that he held a high place of honour in zoology and was elected an honorary fellow by many foreign scientific societies. Entomologists, ornithologists, herpetologists and mammalogists all claimed him as one of their own.

Being of delicate health as a boy, Rothschild was educated at home and then spent some years at Bonn and Cambridge, following all the time his great love for natural history. The boyhood collections of Lepidoptera and Coleoptera increased to such an extent that in 1889, when he became of age, he built a cottage at Tring for the safe housing of the collections, and soon after a public museum in which were exhibited mounted specimens of all classes of animals. Following family tradition, he entered the bank of Messrs. N. M. Rothschild and Sons to study finance, which left him little time for the supervision of the growing collections. In 1892, on the recommendation of Dr. Albert Günther, he put Mr. Ernst Hartert, the ornithologist, in charge of the collections, and six months later entrusted the Evertebrates to the care of the writer of the present lines. It became the definite policy gradually to build up in the research department collections of birds and Lepidoptera as complete as possible, and to increase the public department as resources permitted.

In 1888, Rothschild had bought a collection of New Zealand birds from Sir Walter Buller, and he became so interested in the fauna threatened by the spread of the white race that he sent a bird-collector to the Sandwich Islands, took up the study of the giant tortoises restricted to the Galapagos and Mascarene Islands, and of marsupials, and supported all measures for the protection of animals and plants by the creation of Nature reserves. His reputation as a zoologist was established before he was thirty years of age. In 1898, the University of Giessen conferred upon him the degree of Dr. phil. and in 1899 he was elected a trustee of the British Museum. He gave up finance in 1908 and then could devote himself entirely to science and to civic duties. From 1899 until 1910 he represented Mid-Buckinghamshire in Parliament, and in 1911 he was elected a fellow of the Royal Society in recognition of his services to the natural sciences. He travelled a good deal in Europe and North Africa, but being a bad sailor never visited the tropics. On the death of his father in 1915 he succeeded to the title.

At the time of Lord Rothschild's death the buildings of the museum had an aggregate floor-space of nearly an acre and a half. The public department now contains more than 2,000 mounted mammals, among them 13 gorillas, 25 chimpanzees, 24 echidnas, more than 200 marsupials; among the 2,400 mounted birds there is a magnificent series of 62 cassowaries, the great auk and other extinct species. The research department lost in 1932 the collection of 280,000 bird skins, which a sudden heavy call on his finances compelled Lord Rothschild to sell; the large collection of eggs contains the best series in museums of eggs of birds of paradise and two great auk eggs; but the greatest asset is the collection of some two million Lepidoptera invaluable for the study of geographical variation and other problems of evolution. The collections were placed with great liberality at the service of scientific workers, who always found a cordial welcome at Tring. The museum is left to the trustees of the British Museum.

KARL JORDAN.

President Masaryk

By the death of Prof. Thomas Garrigue Masaryk on September 14, Czechoslovakia has lost its first president and the world is deprived of an eminent and much-respected philosopher and statesman.

Thomas Masaryk was born of humble Slovak parents at Hodonín, Moravia, on March 7, 1850. He had a chequered boyhood and youth. A primary school inspector secured for him the consent of the authorities to allow him to attend a secondary school to train for a teaching post. His parents' poverty, however, made it necessary for him to earn his living, and he was apprenticed first to a locksmith in Vienna and then to a country blacksmith. A former teacher arranged for his return to school, and in 1865 he entered Brno Grammar School. He made good progress, but his passion for truth brought him into conflict with the authorities, who forced him to leave. Fortunately, he was able to continue his studies at Vienna where, in 1878, he graduated as a doctor of philosophy.

A work on hypnotism in 1880 was followed by "Suicide and Modern Civilization" (1881). It was an analysis of causes of the high number of suicides recorded in Central Europe, and attracted attention both at the time and later. This philosophical study secured for Masaryk a Vienna lectureship, but in the following year he was made a professor at Prague. In 1885 he completed a lengthy work, "Concrete Logic", having previously written several shorter philosophical works, which were also translated into German. His later books mostly took on a political aspect. Thus "The Czech Question" appeared in 1895, and the "Philosophical and Sociological Foundation of Marxism" in 1898. Besides writing for the literary and philosophical journal, *Čas* (Time), which he founded, he kept in touch with science sufficiently to contribute a weekly scientific column in the Prague newspaper, *Národní Listy*. He did not identify himself with blind nationalism, and his scepticism (justified as investigation proved) of the genuineness of some alleged old Czech manuscripts brought him much abuse.

From his philosophical studies he was led to the formation of a 'Realist Movement' amongst educated Czechs. This was "an attempt to popularise the whole realm of Science and Philosophy. Without distorting scientific exactitude, Realism strives to render science accessible to every class of the people. It is a protest against the monopoly of learning, its endeavour is to socialise scientific learning and philosophical culture".

In 1878 Masaryk married Miss Charlotte Garrigue, a distinguished American, and incorporated her name in his own. She entered ardently into all his work until her death in 1923. They paid several visits together to England, America and Russia, and Prof. Masaryk continued to write many philosophical works dealing particularly with modern problems. He entered the Austrian Reichsrat as a 'Realist' in 1902, and rapidly made a reputation for honesty and uprightness, and he was quick to express his dissatisfaction at the methods practised, it appeared, by

all parties. His realism was a reaction against this and against the Tolstoyan slavonic philosophy of non-resistance to evil. Just before the Great War he wrote "The Philosophy of History and Religion in Russia", one of the most important books on the subject, whilst after the War he described his work for Great Britain and the allies and for the liberation of the Slavs. He was, for a time during the War, a professor at King's College, London.

On October 28, 1918, the Czechoslovak Republic proclaimed its independence with Prof. Masaryk (still in exile) as its first President. He held this post until December 1935, when he relinquished it with the recommendation that his younger collaborator, Dr. Eduard Beneš, be elected to succeed him. During the seventeen strenuous and difficult years of his term of office, Masaryk gave very active support to many educational movements. The new University of Brno was named in his honour, whilst the Masaryk Academy of Work, which concerns itself with supplying funds for researches in pure and applied science and in securing publication of the results, received his very keen approval and valuable support. Masaryk was in no small measure responsible for many educational advances associated with his country. Through his ministers, he was able to institute an enlightened policy advancing not only the hitherto restricted culture of the Czechoslovaks themselves, but also not overlooking the needs of the German, Hungarian and Polish minorities living within the frontiers of Czechoslovakia.

Prof. Masaryk leaves a son, Mr. Jan Masaryk, the Czechoslovak Minister Plenipotentiary in London, a married daughter and Miss Alice Masaryková, who had been his companion during the last years and is well known for her Red Cross and humanitarian activities.

G. D.

Mr. F. A. Potts

We greatly regret to record the death in London on September 15 of Mr. F. A. Potts, University lecturer in zoology and fellow (formerly tutor) of Trinity Hall, Cambridge. He was a member of a remarkable group of young men who were specialising in zoology at Cambridge in 1906-8, his group including Prof. W. E. Agar (Melbourne), the late Dr. W. S. Perrin (London Hospital) and the late Rev. S. A. McDowall (Winchester). In his final examination he obtained first classes in both zoology and geology, being one of the last students to obtain the double honour.

Mr. Potts, after visits to Naples and Plymouth, then settled in Cambridge, assisting in the teaching of the Zoological Department until the outbreak of the Great War. During this period he became well-known for his activity in the then rather modern lines of research. He directed his interest first of all to the effects of *Pellogaster* and *Sacculina* on their crustacean hosts, *castration parasitism*, extending this to a general consideration of phenomena associated with parasitism. His next investigations were devoted to the Rhinocophalan *Myxosomorphs* and to Nematoda, here a notable research dealing

with the free-living, hermaphrodite species. In 1913 he commenced an association with A. G. Mayer which continued until the latter's death in 1923. He several times visited the Carnegie Station off Florida, and in 1913 joined the Carnegie Expedition to Torres Straits. This association produced three important researches, now almost classical, namely: on the Rhizocephalan genus *Thompsonia*, which gave suggestions as to the evolution of the group; on the crabs forming galls in corals, including a study of their modes of life and their adaptations; and on the Crustacea, Ophiurans and Polychaets in association with the Crinoids of coral reefs. A post-War visit to Samoa and to further coral reefs was responsible for studies of rates of growth, of Cirripedes and other forms. In addition to the above, there are a series of papers dealing with the systematics of Polychaets of the Indian Ocean and an important study of *Teredo*.

On the outbreak of the Great War in August 1914, Mr. Potts was much exercised as he had been brought up to abhor war—but he felt strongly the devastation of Belgium and Louvain. His brothers had families and could not serve; therefore he must play the family's part. He at once put himself in training and in November almost "coerced" the colonel of one of the Duke of Wellington's West Riding battalions to give him a commission as he "had to get out to the trenches before Christmas". He was a great success, keeping the men cheerful, and on the formation of a machine gun section was placed in charge "because he knew all about science". He was there on the Western front for four years—and the writer, knowing his upbringing, his psychology and his extraordinary powers of imagination, feels that here was the highest form of courage.

Mr. Potts was a man with a host of friends, whose sympathy will go out to his widow and son. He was always cheerful, bright, happy, helpful and full of fun. In his teaching he dealt with every grade of student and liked to undertake new courses; his special subjects were worms and molluscs. He was thus eminently suited to the production as editor of that text-book on "The Invertebrata", in which he was associated with Borradaile, Eastham and Saunders, and to which he devoted the last years of his life.

J. S. G.

Prof. J. E. Duerden

THE death of Prof. James Edwin Duerden, which occurred on September 4 as a result of a fall sustained on his way to attend the meeting of the British Association at Nottingham, removes a man who has rendered devoted service to science in many fields.

Prof. Duerden was a student at the Royal College of Science, South Kensington, during the years 1885–1889, and obtained his associatehip of the College in zoology. His first appointment was as demonstrator in biology and palaeontology at the Royal College of Science, Dublin, where he developed an enthusiasm for marine work, resulting in valuable published contributions to knowledge of the Hydroids and Polyzoa of the Irish coast. During this time, he was appointed

a member of the Irish Fishery Survey. In 1895 he accepted the position in Jamaica of curator of the Museum at Kingston. Here he commenced a series of studies of the Actinaria and corals of the West Indies. He pursued his investigations into living and fossil corals at the Johns Hopkins University, Baltimore, U.S.A., and was appointed Bruce Fellow there in 1901.

The value of Duerden's work was recognized when the Carnegie Institution of Washington granted him facilities for the study of European fossil corals, and he was also selected as leader of an expedition to the Hawaiian Islands to study Pacific corals. He was soon recognized internationally as an authority on the structure and development of corals, and became assistant professor of zoology in the University of Michigan. In 1905, he was appointed professor of zoology in the new Rhodes University College, Grahamstown, South Africa. Whilst there, he was placed in charge of ostrich investigations for the Government. He quickly became an authority on the development of ostrich plumes and showed how the serious defects known as bars in the feather were produced by a reduction in blood-pressure during the night period. After the slump, in 1913, of the ostrich plume industry, he became interested in the scientific aspect of wool production, and was appointed Director of Wool Research in the Dominion, whilst retaining his professorship at Grahamstown. He was a pioneer in work on the assessment of quality in the fleece and studied the embryology and evolution of the South African merino fleece.

Duerden served successively as president, member of council and honorary secretary of the South African Association for the Advancement of Science. He retired from Grahamstown in March 1932 and became an honorary member of the staff of the Wool Industries Research Association at Torridon, Leeds, in May 1932. Here he followed up embryological work on the coats of British sheep, specializing on follicular arrangement, and arrived at important conclusions on the specificity of the follicle. At the time of his death he was collating his results prior to publication. His enthusiasm and personality made him a delightful colleague and an inspiration to all who worked with him.

We regret to announce the following deaths:

Prof. D. H. Bergey, formerly professor of bacteriology and hygiene in the University of Pennsylvania, known for his work on food preservation, on September 5, aged seventy-six years.

Prof. H. H. Collins, professor of biology in the University of Pittsburgh, known for his work on mammalian anatomy, on August 31, aged fifty-two years.

Prof. Adolf L. F. Lehmann, in 1909–30 professor of chemistry in the University of Alberta, and earlier associated with the Department of Agriculture of Mysore, on September 27, aged seventy-three years.

Senator Alessandro Lustig, formerly professor of general pathology in the University of Florence, known for his work on bubonic plague and sanitation, on September 23, aged seventy-nine years.

News and Views

The Globular Corona

THE sensational and distorted press comments on the coronal photographs secured from the stratosphere at the total eclipse of the sun last June, to which reference was made in *NATURE* of August 21, p. 310, have now been followed by more reasoned statements about the photographs. They amount to this: the photographs show more clearly to the eye what the measurements of von Klüber (*Z. f. Astrophysik*, 3, 159; 1931) and others have already proved, namely, that the successive isophotes of the corona round the sun are nearly circular. Graff, Bergstrand and Ludendorff were early workers in the same field of study and they have shown the differences in the behaviour during the solar cycle of this more regular corona and the superposed streamers. That some essential difference exists in the nature of the two main constituents of the corona was shown by the difference in the polarization between the inner corona and the streamers noted by Newall so long ago as 1905 and referred to again in a letter by K. G. Zakharin which appears in this issue of *NATURE* (p. 586).

The Storstrøm Bridge

A SHORT history and description of the Storstrøm bridge connecting the Danish islands Falster and Møn, which was opened by King Christian X on September 26, appears in *The Times* of September 25. Møn was linked up with Zealand by the Mønsund Bridge constructed in an earlier section of the bridge building programme initiated in 1933. The Storstrøm Bridge, which crosses an arm of the Great Belt, curving in a wide sweep of more than two miles, has been built for the Danish State Railways by the British firm, Messrs. Dorman Long and Co., Ltd., and completed seven weeks before the scheduled date. In its construction, the new 'chromador' steel, which has improved corrosion-resisting properties, has been used. The bridge has three navigable spans, the centre one 430 ft. in length and with about 80 ft. headroom, and forty-six shorter spans in the approaches. Tidal conditions, pack-ice and sea-scur were provided for by new and ingenious methods adopted in the building of the concrete and granite piers and in the erection of the steel girders. The bridge is described as being of a slender appearance but having a magnificence which can best be appreciated when the aluminium coloured steel is viewed in the morning sunshine. It provides a carriage way, a foot and cycle track, and a single line of railway on which trains can pass at a speed of 50 miles per hour. It completes the railway link between the Continent and Scandinavia for, by its opening, trains or cars can now run, via Warnemünde train-ferry, from Hook of Holland, Paris and Berlin, direct to Copenhagen, whence they can proceed by another train-ferry to Malmö, so that the Danish route now

compares favourably with that via Trelleborg-Sassnitz. It has the additional importance that it makes possible the extended use of modern streamlined 'lightning' trains in consequence of the longer journeys now undertaken.

Bimillenary of the Emperor Augustus

ON September 23, Signor Mussolini inaugurated the celebration of the bimillenary of the Emperor Augustus Caesar, who was born on September 23 in the year B.C. 63, by declaring open the "Augustan Exhibition of Romanism". Great Britain was represented by delegates from the British Museum, the Society of Antiquaries of London, the Societies for the Promotion of Hellenic and Roman Studies, and the University of London. The assistance which had been given by Great Britain in the preparation for the exhibition was generously recognized by Prof. G. Quirino Giglioli, who has been responsible for its organization—the work of five years. Nor does this long period of preparation seem excessive, when the vastness of the field covered by the exhibition is taken into consideration. Not only do they illustrate every side of life and culture of the city of Rome itself as the centre of the Empire, but they also include reproductions of the most remarkable monuments Rome has left in other parts of the ancient world. Further, they cover the religions, the arts and the material culture of the many and varied peoples who came under the sway of Rome, as well as trace in a special section the rise and growth of Christianity from the birth of Christ down to the Edict of Constantine. In this aspect the exhibition has a double significance for the archaeologist and the historian. On one side it emphasizes an internal mobility of peoples and cultures, which at a momentous phase in the history of civilization brought about such an interchange of beliefs and ideas as that, for example, which left for the contemplation of later generations a characteristic emblem of the eastern Mithraic cult in north Britain below the Roman Wall. At the same time, from the other side, it demonstrates the solidarity of the Empire, as against the rest of the ancient world, which has set its seal on European peoples, the heirs of imperial culture, no less effectually than the more familiar contrast of East and West.

Racial History in the Arctic

DR. ALBIS HEDLÖKA, of the Smithsonian Institution, Washington, D.C., on his recent return from his ninth expedition of anthropological investigation in the arctic regions of North-West America, has issued through the Smithsonian Institution a preliminary report on the results of his season's work in the Aleutian Islands, in which he discusses the character and distribution of early racial types in the Far North. The investigations and excavations carried out by

Dr. Hrdlička in 1936 and 1937 have been directed more particularly to the study of the problem whether racial migration from Asia, in addition to the Bering Sea route, may have made use of the more southerly passage by the Aleutian Islands—a suggestion which on a general line of argument would appear to have much to support it, but for which until recently positive evidence has been regarded as inadequate. In the expedition of 1936, it may be remembered, evidence was obtained which was held to support Dr. Hrdlička's view. Skeletal material and a large quantity of archaeological material accruing from the expedition's excavations in 1937, and now awaiting further detailed examination in Washington, Dr. Hrdlička holds, confirm his previously formulated theories, and afford him a basis for the racial classification to which reference is made above. "The finds," he states, "make more probable than ever the hypothesis of a 'race nursery' in the Far North for the aboriginal population of the New World."

BRIEFLY, Dr. Hrdlička's preliminary conclusions are that the present-day Aleutians, a broad-headed people, who do not fall precisely into either an Indian or an Eskimo classification, were preceded by an oblong-headed race, who had a much longer occupancy. This race he regards as the same as that which he discovered in the deepest parts of his excavations on Kodiak Island in 1931-35; while a similar type has been found in the lower layers of a mound at the mouth of the Frazer River, British Columbia. There are indications that this stock may have spread so far south as California. The Aleuts cannot be regarded as descendants of this people, and may, in fact, represent a backward migration from Alaska towards Asia. Dr. Hrdlička is now prepared to recognize in the North-West, not one or two racial types, as previously held, but five distinct, though basically related strains, as follows: (1) the long- and high-headed Eskimo of the Seward Peninsula, Barrow, and eastward along the arctic coast to Labrador and Greenland; (2) the broad-headed and medium-vaulted Eskimo of the Bering Sea coast and along the interior rivers from the Yukon southward; (3) the Aleuts with broad heads and low-vaulted skulls; (4) the Alaskan Indians; (5) the oblong-headed pre-Aleuts, whose remains were found by the expedition in the exploration of the past season. The archaeological finds included a new stone industry belonging to this people.

"Minnesota Man"

FURTHER investigations by Prof. A. E. Jenks in the northern lake area of Minnesota, from which were obtained the skeletal remains described elsewhere in this issue of NATURE (see p. 596) have brought to light evidence of what would appear to be an extensive camping ground of early man. From a kitchen midden buried some three feet under a bog of grasses and marsh weeds in Itasca State Park, Prof. Jenks has excavated some two thousand knife-marked bones, with knives of stone and other implements of both stone and bone. The bone bed varies in

thickness up to about four feet five inches. Associated with the bones of bear, elk, caribou and other big game animals in the kitchen refuse are the remains of an extinct form of bison (*Bison occidentalis*), confirming the early character of the site and the early date of its occupation by man. Prof. Jenks states in *Science* of September 10 that of five stone artefacts recovered from the bone bed, three are flake implements with retouch, while two are chopping tools, chipped to rough parallel faces, and retouched on the cutting edges.

Roman Jerusalem

THE discovery of an interesting and important relic of the Roman occupation of Jerusalem is reported. The Department of Antiquities, it is stated by the correspondent of *The Times* in the issue of September 28, while conducting excavations in connexion with the plan of the municipality for clearing away buildings from the Damascus Gate, has brought to light a Roman moulded plinth ten feet high, of which the top was found at a depth of thirteen feet below the surface. The plinth consists of massive blocks of stone, which, it is said, recall the finest work of the Roman period. The site has been identified provisionally with the city gate beside the "Women's Towers", mentioned by Josephus. It is hoped that excavation will be carried further in the expectation that it will throw light on the much-discussed problem of the Third Wall of Jerusalem.

Brood Diseases of Bees Investigations

EARLIER in the present year an appeal was made to beekeepers and beekeeping associations to support financially the continuation of the research on brood diseases of bees at Rothamsted Experimental Station. This work had been carried on for three years by Dr. Tarr with funds half of which were provided by the Government and half by the British Beekeepers Associations. The results of the first three years' work were so promising that it was unanimously decided by the Bee Research Advisory Committee at Rothamsted to continue for a further period of three years if possible. The estimated cost is £550 per annum, of which the Agricultural Research Council has promised £300, if £250 per annum can be raised from other sources. As the result of the appeal a sum of £226 has been received for the current year, which leaves a balance of only £34 to be made up. For the two following years, there is only at present a guaranteed fund of £103 per annum.

THE work carried out up to the present has already cleared up many difficult points. Dr. Tarr has shown that European and American foul brood are two distinct diseases caused by different organisms. He has confirmed that American foul brood is due to a bacterium, *Bacillus larvae*, and that its incidence is independent of the strength of the colony. European foul brood, on the other hand, is a disease of weak stocks and is probably caused by *Bacillus pluton*, in association with other organisms. He has also shown that a third condition known as 'addled brood' is

very prevalent in Britain; it constituted about one third of the cases of so-called foul brood sent in for examination. It is liable to be mistaken for foul brood, but is really due to a defective condition in the queen, and once it is recognized can readily be cured by requeening. The work in the next three years will be concentrated on tests of control measures for both European and American foul brood and further work on the organisms causing European foul brood. It is to be hoped that further support will be forthcoming to supply the small amount still required for this year's work, and that as many contributors as possible will continue to subscribe for the three years.

Regional Planning in the United States

A broadsheet issued by PEP (Political and Economic Planning) describes some developments in regional planning in the six New England States of the U.S.A. which are of some interest in relation to the Special Areas Bill in Great Britain. The broadsheet is based on a report prepared by the Commission on Regional Planning for New England, issued last year by the National Resources Committee, a progress report, "State Planning, Vermont", issued by the State Planning Board of Vermont, and on general reports on "State Planning (Review of Activities and Progress)" and "Regional Factors in National Planning", both issued by the National Resources Board. While the population of the United States as a whole increased by more than 140 per cent between 1880 and 1930, that of New England increased by little more than 100 per cent and that of the State of Vermont by less than 10 per cent. Seventy-seven per cent of the New England population is now urban, and only 6 per cent remains on farms. Simultaneously, the occupied population has declined to 42 per cent (as against 47.2 per cent in England and Wales), the long established shrinkage of employment in agriculture, forestry and mining being accentuated by contraction of employment in manufacturing and mechanical industries. These contractions are balanced by expansion of employment in trade, transport, professional, public, clerical, domestic and personal services.

A significant feature is the large increase in part-time farmers, and about one third of the area is still in farms. Attempts are being made to classify farms in relation to their suitability for profitable agriculture. It is anticipated that expansion of milk production on the better farms, for example, would more than make good any loss through winding up uneconomic holdings. The problem of the hill districts is also being tackled by a programme of woodland development and especially in planning for recreation. In building up a recreation industry, whether in relation to preservation of scenery and amenities, alliance between recreation and forestry, sports, improved communications, New England developments have perhaps most to teach Great Britain, and especially in regard to planned instead of piecemeal development. The Planning Boards in the

six States only date from 1935 and the six chairmen with an independent chairman and two co-opted citizens, make up the New England Planning Commission, which is assisted by consultants, a small staff of technical assistants, and an advisory committee of 546 members distributed throughout New England and representing all types of activities—housing, transport, town planning, industry, etc. This Committee does not meet as a whole.

Future of Air-Conditioning

IN the July number of *Water Works and Sewerage* the editor makes some timely comments on the future of air-conditioning. Apparently water supply managers have little definite information as to the probable demands on local water supply facilities that will be made in the near future. Another important problem that has to be considered is the question of sewerage facilities capable of handling the increased loading to be imposed in the form of spent water discharged from the cooling equipment into sewers that have not been designed for this load. At the recent convention of the American Water Works Association some interesting data were given. During the year 1935-36, the air-conditioning capacity installed had increased 35½ per cent in Chicago. During the same period, the water sold to air-conditioned premises had increased 38 per cent. The figures also show that the peak demand for a district which is now only 16 per cent air-conditioned is 130 per cent above the daily average demand. In July and August also, the demands per 24 hours in the districts most densely air-conditioned reached 170 per cent of the annual average. The average over non-conditioned districts during the same two months was only 10 per cent. In a block of buildings containing theatres, hotels and restaurants all using air-conditioning the maximum per cent of the daily average was 250. Chicago is in the happy position that its major mains and pumping capacity seem sufficient for ten years more at this rate of growth. On the other hand, deficiencies of sewers will have to be made good, unless wasteful evaporative type cooling devices are installed in air-conditioning plant.

Earthing the Metal Sheathing of Electric Cables

A DIFFICULTY in connexion with electric supply when metal sheathing of electric wiring and apparatus is employed is how to connect this sheathing to earth in such a way that, in the event of it becoming electrified owing to a fault developing between the sheathing and a main, the faulty circuit may be disconnected at once and consequently the pressure between the sheathing and the earth cease to be dangerous. To secure this it is necessary that the sheathing be a continuous conductor of small resistance and that it is maintained in good electrical connexion with the earth. The Wiring Regulations of the Institution of Electrical Engineers stipulate that the electrical resistance of the metal sheathing or tubing must not exceed one ohm between any two points of its length. In practice this can easily be measured by testing. The connexion of this metal

sheathing to earth is more difficult to specify but in general it is stipulated that its resistance must not exceed one ohm. When it has this low resistance, the cut-out of the faulty main will act and so the sheathing and the metal in contact with it ceases to be dangerous. Where it is economically impracticable to obtain an earth having a resistance of not more than one ohm, earthing must be supplemented by an earth leakage 'trip-coil' so adjusted that it will operate at not more than 30 milliamperes. The resistance of an earth electrode depends very largely on the humidity and the character of the soil in which it is buried.

In many cases when the supply is taken from overhead mains and there is no water supply, compliance with the I.E.E. regulations is very difficult and practically impossible. In this case the neutral main of a four-wire system of supply gives an easy method of getting an approximate earth potential over the whole of the supply area. Where there are no parasitic currents from tramways, this system has many advantages. This system is used in some parts of Australia and New Zealand. The Electricity Commissioners and the Postmaster-General have given their special consent to its use in certain districts in Great Britain. When this system is adopted, no fuse must be inserted in any conductor connected with the neutral main. This leads to a simplification and consequent cheapening of electrical installation work. In Australia, the State Electricity Commission of Victoria has recently altered its wiring regulations. The provision of an automatic circuit breaker is made compulsory in all new installations. In addition, breakers have to be installed in all existing installations at the expense of the supply authority. It will be interesting to see how this works in practice.

The Enforcement of the Rules of the Road

SUGGESTIONS made by Dr. H. C. Dickinson, the chairman of the Highway Research Board of the U.S.A., are the subject of a recent report issued by Science Service. Traffic experts to-day are aiming at simplifying the traffic rules and reducing their number so far as possible. Dr. Dickinson has reduced them to four. The first is to keep to your own lane of traffic with only two thoughts in mind, namely, to watch the car ahead and to warn the car behind you whenever you do anything which changes your movement in your own traffic lane. Secondly, to realize that you have no right to cross or turn into another traffic lane. Thirdly, to give a clear signal, or indicate by the motion of your car, whenever you change from your own traffic lane. Finally, never exceed a speed at which the car cannot be stopped without interfering with other traffic in the lane. When an accident causes personal injury or damage to a car—other than fenders or bumpers—it should be obligatory for both parties to attend the action in court. In personal injury cases, the permits of all the drivers involved should be suspended pending the hearing, and the permit of innocent drivers, if any, could

then be restored. Dr. Dickinson makes the novel suggestion that when an accident has nearly occurred and has only been prevented by the quick-wittedness of one of the actors, regulations should be used which would enable 'enforcing' officers to issue 'tickets' to drivers endangering other drivers or pedestrians. The charge he suggests is that of 'creating a public danger', and the penalty a small fine or dismissal on probation. Repeated offences could be dealt with more severely. The object of the proposal is to make it very unpleasant for anyone who puts another person in jeopardy even although no harm results.

Zoological Types in India

THE series of "Indian Zoological Memoirs" has been enriched by an excellent monograph, illustrated by 85 text figures, on "Palæmon, the Indian River Prawn", by Dr. S. S. Patwardhan (Pp. xi+100. (Lucknow: Lucknow Publishing House, 1937.) 2 rupees). These monographs are intended to assist in the teaching of zoology in India by the selection of a number of readily obtainable types, which can be worked out fully by students in their own time and perhaps at their homes. A single animal studied closely in respect to its anatomy with the consequent consideration of the function of all its parts is bound to be of great help. To this is added, in the judicious selection of types here, the possibility for the student to study his forms in Nature. The illustrations are good black and white drawings in close proximity to the descriptions of the parts, and there are directions for the necessary dissections. If we are to make any suggestions, we would plead for a greater consideration of function, and references might be inserted freely, so that interested students may be induced to examine their types in a more intelligent manner. For example, in this prawn a consideration of the mode of action of the mouth appendages may be deemed essential to the study of their anatomy—and we find no references to the considerable bulk of recent work on this matter. Form and function are inseparable, and both are essential to the study of the living animal. For a young student, the author assumes a little too much, the monograph being more useful to his teacher.

Institution of Professional Civil Servants

THE eighteenth annual report of the Council of the Institution of Professional Civil Servants covers the year 1936 and refers to a large increase in membership, which was 50 per cent greater than in 1935; when the figure of 10,000 was reached for the first time. One of the outstanding achievements of the year was the successful prosecution of salary claims on behalf of architectural and civil engineering and mechanical and electrical drawing office staffs. The satisfactory settlements which were reached are attributed largely to the extensive research of the Committee, which proved that such staffs were underpaid in comparison with similar employees outside. The report again emphasizes the importance of the National Whitley Council to members of the Institution. The

Council has also been concerned with the completion of the application of the recommendations of the Carpenter report to scientific establishments, and in his presidential address at the annual meeting on April 29, Sir Richard Redmayne emphasized the necessity for the upgrading of the highest professional and scientific posts in the Civil Service, which, so far as remuneration is concerned, compare most unfavourably with posts carrying a similar responsibility outside the Service. A sub-committee is considering appropriate salaries for those professional posts outside the scope of arbitration with the view of making representations to the authorities. The Association is also dealing with the salaries of architects, engineers and surveyors in the Civil Service. Sir Richard criticized the Treasury for refusing to allow the reference to arbitration of the Institution's claim that women scientific officers should receive the same scales of pay as their male colleagues in the same grade, and stated that the Chancellor of the Exchequer had been asked to receive a deputation on this question.

Fruit Supplies in 1936

THE Intelligence Branch of the Imperial Economic Committee has issued a volume dealing with fruit supplies during 1936 (H.M. Stationery Office, pp. 106. 2s. 6d. net or 2s. 9d. post free). 55 per cent of the total import of fruit was of Empire origin. So high a proportion has never before been reached. There are, however, some very potent lessons for the home producer. The present report gives the convincing information that each apple tree yielded an average of 12.7 lb. of fruit in 1935, and 68.3 lb. in 1936. The "untimely and unusually severe frost" in May of 1935 is mentioned as the main cause of that season's low yield. It cannot be emphasized too strongly that the effects of frost are now largely within the control of the grower. The pioneer work of Mr. George Harrington, the investigations into general principles by various scientific workers, and the practical experiments by the technical staff of Messrs. Geo. Monro, Ltd., have made the practice of orchard heating a practical proposition without heavy finance. Total imports of raw fruit into the United Kingdom remain fairly steady around an average of nearly 28,000,000 cwt., and apple imports are not very variable around a mean of about 6,500,000 cwt. Imports of grapes, peaches, lemons, pineapples and plums from Empire sources were higher in 1936 than ever before, and more bananas were imported by Great Britain than in any previous year. Supplies of fruit from South Africa reached a new record. Totals for most fruit imports were, however, lighter than in 1935.

The Ross Institute

A MEETING of the Industrial Advisory Committee of the Ross Institute, which is now incorporated with the London School of Hygiene and Tropical Medicine, was held on May 28, at which the activities of the Institute were surveyed. Useful discussions also ensued upon the housing of African labour, the

risk of malaria when replanting rubber, the Indore process of disposal of night soil and town refuse and courses of instruction for laymen proceeding to the tropics. Information was also given of an investigation by Dr. Crowden at the School of Hygiene of experiments on air-conditioned cubicles for use in the tropics.

Fast Atlantic Crossing by Air

THE Empire flying-boat *Cambria* crossed the Atlantic on September 28 in the fastest time ever recorded. The distance of 2,000 miles from Newfoundland to Foynes, near Limerick, was covered in 10 hr. 36 min., giving an average speed of 190 miles an hour. According to the account in *The Times* of September 29, Captain G. J. Powell made tests of speed at various altitudes. During the first part of the flight he remained at 4,000–5,000 ft. and made speeds of 172.6–185 m.p.h. Later he climbed to 7,000 ft. and attained a speed of 195 m.p.h. Bad weather then forced him to 13,000 ft. when his speed fell to 167 m.p.h. Eventually, he reduced the height to 10,000 ft., where the most favourable wind for the easterly part of the journey was found.

The Night Sky in October

SUMMER Time ends on October 3 at 2^h U.T. The moon is new on October 4 at 12.0^h and full (the Hunter's Moon) on October 19 at 21.8^h. Conjunctions between the moon and the planets occur as follows: Venus on October 2 at 4^h; Mercury on October 3 at 6^h; Mars on October 11 at 18^h; Jupiter on October 12 at 17^h and Saturn on October 18 at 8^h. On October 29 at 17^h, Mars and Jupiter are in conjunction; the two planets passing within 1 $\frac{1}{2}^{\circ}$ of one another (heliocentric positions). On October 11 at 6^h, Venus is in conjunction with Neptune. On October 15, Uranus is near the sixth magnitude star α Arietis; the diameter of the planet is $3\frac{1}{4}''$. The satellites of Jupiter, which always offer an attractive field for observation, present a few special features this month. On October 5 at 2^h 24^m–27^m Satellite II will be partly eclipsed by Satellite I. On October 7 a similar eclipse of these two satellites takes place at 22^h 07^m–24^m, the magnitude of the eclipse being 0.4. On October 17, I is partially eclipsed by III at 3^h 27^m–36^m. Appulses between II and I occur on October 12^d 01.9^h and October 22^d 1.0^h, whilst a complete occultation of II by I will take place on October 25^d 17.9^m. On October 13, Jupiter will occult the seventh magnitude star *B.D.* $-22^{\circ} 5100 = C.D. 13939$, the emersion being visible in Great Britain at 18^h 34^m at position angle 276° from the north point of the planet's image ("B.A.A. Handbook, 1937", p. 19). The light variation of Algol (β Persei) may be observed about 1 $\frac{1}{2}$ hours before and after the following times: October 3^d 19.6^h; 18^d 03.7^h; 21^d 00.5^h and 23^d 21.3^h. The periodic comet, Enoke, which was re-discovered by Jeffers on September 3 at the Lick Observatory, passes from Triangulum to Andromeda during the month. The comet, which was of magnitude 18 at the time of discovery, is still very

faint, its anticipated magnitude at perihelion on December 27 being about 5.5. An ephemeris for this comet is given by Dr. A. C. D. Crommelin in "B.A.A. Handbook", p. 34; corrections to this ephemeris are given by L. E. Cunningham, using the positions obtained by Jeffers at re-discovery. The zodiacal light may be seen before dawn in the first part of the month when the moon is absent. In view of the present general high level of solar activity, the northern skies may also be scanned for the presence of auroral light.

Announcements

H.M. QUEEN MARY has once again shown the keen interest she takes in the higher education of women by promising to visit the Royal Holloway College (University of London) at Egham on October 12. H.R.H. Princess Alice is chairman of the governors of this women's College, which has about two hundred students, and she shows a highly practical interest in the College and in the careers of its students. It is worthy of mention that during the university year just closing a student of Royal Holloway College, Miss Gladys E. Muddle, gained the Sherbrooke Studentship and the Sir John William Lubbock Memorial Prize, open to all students of mathematics in the University of London.

SIR THOMAS HOLLAND, principal of the University of Edinburgh, and formerly director of the Geological Survey of India, has accepted the presidency of the Geographical Association for 1938.

THE Le Chatelier Memorial Lecture of the Chemical Society will be delivered on October 28 at 5.30 p.m. by Dr. O. H. Desch, superintendent of the Metallurgical Department, National Physical Laboratory.

THE Sex Education Society has issued a programme of seven lectures to be given at the Conway Hall, Red Lion Square, W.C.1, during the present session. The first will be delivered by the president, Dr. Norman Haire, at 8 p.m. on October 5. The full programme can be obtained from the Honorary Secretary, 27 Harley Street, W.1.

THE Annual Conference of Greenkeepers will be held at St. Ives Research Station, Bingley, Yorkshire, on October 19. During the morning, a tour of the Research Station will be made, and during the afternoon a series of short papers will be given. A course on scientific greenkeeping will be held on October 20-26. The course will include non-technical lectures by members of the staff of the Research Station, coupled with practical work and demonstrations on the experiment ground. Further information can be obtained from the Director, St. Ives Research Station, Bingley.

THE British Drug Houses, Ltd., Graham Street, London, N.1, have issued a new edition of their

booklet dealing with B.D.H. standard stains, and including also a full range of the various materials required by the microscopist; the booklet may be obtained free on application. Useful notes are appended upon the bacteriological, histological and pathological applications of the various stains and materials, most of which can be supplied in small quantities suited to the requirements of the individual worker.

DR. S. O. BLACKTIN writes to point out that an error occurs in the short article contributed by Dr. J. S. Owens to NATURE of August 21 upon his "Electrotor Smoke and Dust Meter". The article was based solely upon a paper by Dr. Blacktin in the *Journal of Industrial Hygiene and Toxicology*, and not upon an examination of the instrument itself. Referring to the insertion of a new record disk, the words were used "and the cap with its disk screwed into position". Dr. Blacktin points out that this was a misunderstanding of the statement made in his paper; for the record disk is *not* supported inside the cap of the instrument but on a table under it.

THE Academy of Sciences of Cuba has recently celebrated the seventy-fifth anniversary of its foundation.

A CHAIR of social medicine has recently been created in the University of Paris. Its incumbent will initiate fifth-year students into certain elements of preventive medicine such as sickness insurance.

DR. JOHN E. GORDON, field director of the International Health Division of the Rockefeller Foundation, New York, has been appointed professor of preventive medicine and epidemiology at Harvard University Medical School.

THE John and Mary R. Markle Foundation of New York has presented one hundred thousand dollars to the National Research Council for the support of research in endocrinology in the next three years. The fund will be administered by the Division of Medical Sciences.

As the result of years of agitation by social reformers, no marriage will be possible in the Argentine in future unless the bridegroom is able to present to the civil authorities a certificate that he is free from contagious diseases transmissible in wedlock. The law, which is to be enforced immediately, does not apply to women. Other clauses in the law provide for the compulsory hospitalization of refractory cases of contagious infection and the closing of houses of ill-fame.

ERRATUM. In the obituary notice of Prof. H. E. Armstrong in NATURE of July 24, on p. 140, col. 1, lines 17 and 18 from bottom, for "Sir George Grove" read "Sir William R. Grove".

Letters to the Editor

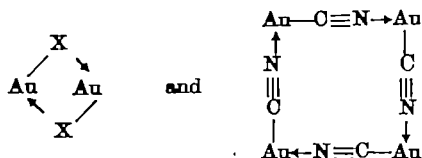
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 590.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

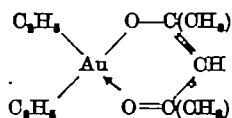
Constitution of Aurous Compounds: Gold Mirrors

THE volatile aurous compounds described by Dr. F. G. Mann and Dr. A. F. Wells¹ provide further examples of the fact that, in its aurous compounds, gold is always 2-covalent. Constitutionally analogous sulphur and nitrogen compounds are also known. It is significant that whenever gold is in solution in the aurous condition, the metal is always present in a complex ion. This is shown in the cases of such typical compounds as potassium aurocyanide, $\text{KAu}(\text{CN})_2$, and hydrobromoaurous acid, HAuBr_2 . Like the auric ion, the aurous ion appears to be incapable of existence, and some investigations² have shown that the probable constitutions of the aurous halides and of aurous cyanide are respectively:



Thus, even in its simplest compounds, aurous gold appears always to be 2-covalent, while auric gold is always 4-covalent and the four valencies are coplanar with the gold atom³.

The production of gold mirrors by the heat decomposition of gold compounds is, of course, not new. Faraday in 1856 showed that drops of "gold chloride" solution evaporated in watch glasses and heated over a spirit lamp produced films which exhibited by transmitted light the same colours as the gold-containing liquids (Chemistry Exhibit, 157, Science Museum). In 1930, brilliant mirrors or films of pure gold were produced by gently heating the volatile trivalent and 4-covalent gold compound, diethylgoldacetylacetonate⁴:



Some of the first pure gold films produced at ordinary temperatures by the process recently described⁵ can be seen in the gold exhibit in the South African Court of the Imperial Institute.

CHARLES S. GIBSON.

Chemistry Department,
Guy's Hospital Medical School,
London, S.E.1.
Sept. 20.

¹ NATURE, 140, 502 (Sept. 18, 1937).

² J. Chem. Soc., 800 (1934); 219, 1024 (1935).

³ Cox and Webster, J. Chem. Soc., 1635 (1936). Gibson and co-workers, forthcoming publication.

⁴ Gibson and Simonsen, J. Chem. Soc., 2532 (1930).

⁵ NATURE, 140, 279 (Aug. 14, 1937).

Structure of Organic Molecular Compounds

THREE general conceptions are current as to the nature of the valence forces responsible for the formation of organic molecular compounds, each of which may conceivably be true as the limiting case in certain classes of compound:

(a) The molecular compounds are merely lattice compounds, involving no genuine chemical bonding, but depending for their formation and composition upon considerations of packing. This probably applies to such compounds¹ as CHI_3 , 3S_8 .

(b) Combination occurs by the formation of true co-ordinate links, as in inorganic molecular compounds. This view has been developed, probably incorrectly, in connexion with the polynitrobenzene-hydrocarbon compounds².

(c) Union is effected by the forces of interaction between strongly polar groups and the highly anisotropic, polarizable aromatic systems³. The London forces thus involved are, in a sense, intermediate between van der Waals's attractions and true covalencies.

During the past few months, an X-ray examination has been made of the quinhydrone and related compounds, with the view of eliciting the evidence of crystal structure as to their constitution. A similar approach to the nitrobenzene-hydrocarbon compounds was made by Hertel⁴, without conclusive results. The full results of the present investigation will shortly be presented elsewhere, but the following morphotropic considerations appear to lead the problem nearer to a solution.

(1) The discrete existence of quinonoid and quinoloid units in the structure, necessitated by the revised quinhydrone structure of Palacios and Fox⁵, is confirmed.

(2) The identity of the a and b dimensions in ordinary quinhydrone and in α -naphthoquinone quinhydrone (see table) show that the quinone and quinol groupings lie essentially in the (001) plane, with the breadth of the molecules along c , as was advanced for quinhydrone⁶.

(3) For dimensional reasons, the quinone and quinol units can alternate only along the a and c directions, but not along b . The formation of quinhydrone by a species of infinite hydrogen bond polymerization⁷, which, from the orientation of the molecules, could only take place along b , is thereby excluded.

(4) In phenoquinone, $\text{C}_6\text{H}_4\text{O}_2 \cdot 2\text{C}_6\text{H}_5\text{OH}$, b and c are essentially unchanged, whereas a is exactly $3/2$ times the a dimension of quinhydrone. Clear evidence is thus afforded that the components alternate along a . In various p -substituted phenoquinones, a and c are also slightly modified (due to the bulk of the substituents and to the inclination of the molecules to (001)) while retaining the same essential characteristics.

(5) The relation of the remarkably stable compounds of chloranil and bromanil with hexamethyl benzene, etc.—for example, $C_6Br_4O_2.C_6(CH_3)_6$ —to the quinhydrones⁷ is confirmed. The same alternation of components along a is observed, with identical a spacing; this brings the planes of the bromanil and the hexamethylbenzene molecules practically into contact. In these compounds there can scarcely be any question either of hydrogen bonds or of the formation of co-ordinate links.

(6) The direction of maximum light absorption in the quinhydrones and both the maximum of light absorption and the slow vibrational direction in the even more strongly pleochroic bromanil-hexamethyl benzene compound coincide with a .

	a	b	c	β	n
Quinhydrone	7.70	6.04	21.8	90°	4
$C_6H_4O_2.C_6H_4(OH)_2$	7.70	6.16	27.4	Rhombic	4
$C_6Br_4O_2.C_6(CH_3)_6$	7.40	8.83	28.7	Rhombic	4
$C_6H_4O_2.2C_6H_5OH$	11.50	6.16	22.2	100°	4
$C_6H_4O_2.2CH_3C_6H_4OH$	11.83	6.2	24.6	97°	4
$C_6H_4O_2.2Br.C_6H_4OH$	12.16	6.16	24.3	96°	4
$C_6H_4O_2.2Cl.C_6H_4OH$	12.00	6.16	23.5	97°	4

Along this direction the aromatic molecules are stacked plane to plane at a perpendicular distance of the order of 3 Å. The trend of the evidence makes the conclusion inevitable that this represents also the direction of bonding, in which case the mechanism (c) is the most probable. The formation of hydrogen bonds in quinhydrone is not necessarily excluded, and their presence is now being sought by the elegant method of Robertson and Ubbelohde⁸.

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South Kensington, S.W.7.

¹ Bernal, *Trans. Faraday Soc.*, **23**, 211 (1926).

² Bennett and Wilks, *J. Chem. Soc.*, 255 (1929).

³ cf. Bragg, *J. phys. Chem.*, **B**, **35**, 63 (1934).

⁴ Hertz, *J. phys. Chem.*, **B**, **11**, 59, 77 (1930); **22**, 280 (1933).

⁵ *Anal. Fis. Quim.*, **30**, 421 (1932); **33**, 627 (1935).

⁶ cf. Chem. Soc., Annual Reports, **30**, 420 (1933).

⁷ Pfeiffer, *Ann.*, **404**, 1 (1914).

⁸ *Nature*, **139**, 504 (1937).

Duality of the Coproporphyrins in Bovine Congenital Porphyrinuria

Of the four theoretically possible isomeric types of porphyrins, only those belonging to Series I and III have so far been encountered in Nature. Haemoglobin, bilirubin, cytochrome, etc., are Series III derivatives. Series III has thus come to be regarded as the normal or 'physiological' type. Excretion of excessive amounts of porphyrins belonging to Series III does, however, occur in certain pathological states including lead poisoning (Grotepass¹, Mertens², Fischer and Duesberg³), pigment cirrhosis of the liver (Dobriners⁴), hepatic tumours (Dobriners⁴) and after administration of salvarsan (Sohreus⁵). The uroporphyrin excreted in acute idiopathic porphyrinuria has been shown to be uroporphyrin III (Waldenström⁶, Mertens⁷), whilst Dobriners⁴ has detected the simultaneous presence of coproporphyrins I and III in the stool from one such case.

The pigments formed in excessive amount by congenital porphyrinurias were until recently thought to

belong exclusively to Series I, but Fischer and Hofmann^{8,9}, working with material from the human case 'Petty', and Rimington^{11,12} studying congenital porphyrinuria bovines, have shown that small quantities of uroporphyrin III accompany uroporphyrin I in this disease.

We have now been able to isolate coproporphyrin III from the urinary and faecal coproporphyrin mixture of the same bovines, thus extending the duality also to the coproporphyrins. Evidence strongly suggestive of the presence of coproporphyrin III in small amounts in the bile porphyrins of a previous bovine case had already been obtained chromatographically by Rimington¹¹, but the quantities available were insufficient to allow of crystallization.

In the present instance, the total coproporphyrin fraction (faeces or urine) group was esterified and the more soluble coproporphyrin III methyl ester extracted by stirring with cold methyl alcohol (compare Dobriners⁴; we are indebted to Dr. E. Mertens for privately suggesting this technique). After several repetitions of this procedure, the Series III ester was dissolved in a few drops of dioxane, a little methyl alcohol added and then sufficient water, drop by drop, to render the mixture slightly opalescent. On standing in the ice-chest, the porphyrin was deposited in micro-crystalline form, m.p. 138/172° (Fig. 1). Synthetic coproporphyrin III methyl ester (the gift of Prof. H. Fischer, whom we wish to thank), crystallized in the same way, had m.p. 140°. Mixed m.p. 138°. Spectrum of ester in ether: 625.3; 599.3; 587.5–566.7; 531.6; 498.7. Three different preparations were made.

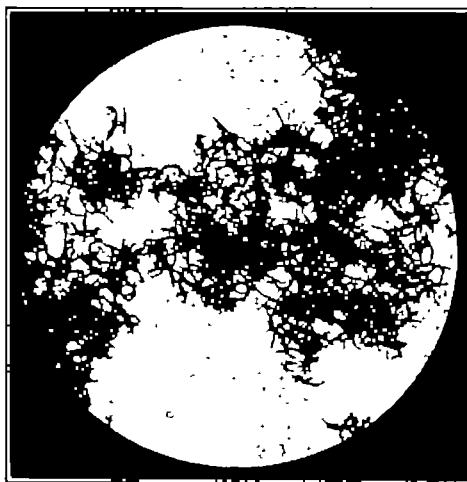


Fig. 1.

COPROPORPHYRIN III FROM URINE: BOVINE CONGENITAL PORPHYRINURIA. $\times$ ABOUT 100.

The occurrence of Series III porphyrins together with those of Series I in congenital porphyrinuria may be traceable to a secondary toxic effect (Fischer and Hofmann¹⁰), but is equally readily explicable on the basis of the scheme put forward by Rimington^{11,12} picturing a catalysed synthetic mechanism in the hamatopoietic tissue.

We have also encountered another pigment in these urines which we believe to be a hitherto

undescribed porphyrin. The methyl ester crystallizes in rectangular or rhomboidal prisms, resembling protoporphyrin ester, has m.p. 233–38° and a spectrum closely similar to that of coproporphyrin. The quantity obtained is as yet insufficient for analysis.

CLAUDE RIMINGTON.
G. C. S. ROBERTS.

Onderstepoort Veterinary Research Laboratory,
Pretoria, S. Africa.
Aug. 22.

- ¹ Grotepau, *Z. physiol. Chem.*, **205**, 193 (1932).
² Martens, *Klin. Woch.*, **15**, 61 (1937).
³ Fischer and Duesberg, *Archiv. exp. Path. Pharm.*, **100**, 95 (1932).
⁴ Dobriner, *J. Biol. Chem.*, **113**, 1 (1936).
⁵ Schreus, *Klin. Woch.*, **14**, 1717 (1935).
⁶ Waldenstrom, *Deut. Archiv. Klin. Med.*, **178**, 38 (1935).
⁷ Martens, *Z. physiol. Chem.*, **228**, 1 (1936).
⁸ Dobriner, *Proc. Soc. Expt. Biol. Med.*, **35**, 175 (1936).
⁹ Fischer and Libowitzky, *Z. physiol. Chem.*, **241**, 230 (1936).
¹⁰ Fischer and Hofmann, *Z. physiol. Chem.*, **245**, 15 (1937).
¹¹ Rimington, *Onderstepoort J. Vet. Sci.*, **7**, 567 (1936).
¹² Rimington, *NATURE*, **140**, 165 (1937).
¹³ Rimington, forthcoming publication in *Comptes Rendus Trav. Lab. Carlsberg*: Sørensen Festschrift.

Disintegration Processes by Cosmic Rays with the Simultaneous Emission of Several Heavy Particles

On photographic plates which had been exposed to cosmic radiation on the Hafelekarr (2,300 m. above sea-level) near Innsbruck for five months, we found, apart from the very long tracks (up to 1,200 cm. in length) which have been reported recently in a note in the Wiener Akademie-Berichte, evidence of several processes described below.

From a single point within the emulsion several tracks, some of them having a considerable length, take their departure. We observed four cases with three particles, four with four and 'stars' with six, seven, eight and nine particles, one of each kind.

The longest track corresponded to a range in air (15°, 760 mm. Hg) of 176 cm. The ionization produced by the particles is different in the different cases. Most of the tracks show much larger mean grain-distances than α -particles and slow protons.

In Fig. 1 a 'star' with eight tracks is reproduced. On account of the rather steep angles at which some of the particles cross the emulsion-layer (approximately 70 μ thick) it is not possible to have all the tracks of a 'star' in focus simultaneously. Fig. 2 shows a sketch of the same 'star'. Measurement of the tracks gives the results in the accompanying table.

Track	Length in cm. of air (15°, 760 mm.)	Number of grains	Position of the end of the track
A	30.0 "	113	Within the emulsion
B	11.0 "	15	" " "
C	44.0 "	71	Glass " "
D	6.2 "	11	" " "
E	7.0 "	23	" " "
F	1.2 "	5	Within the emulsion
G	13.6 "	67	Surface of the emulsion
H	23.9 "	58	Glass

Centre of the 'star' 25 μ under the surface of the emulsion.

We believe that the process in question is a disintegration of an atom in the emulsion (probably Ag or Br) by a cosmic ray. The striking feature

about it is the simultaneous emission of so many heavy particles with such long ranges, which excludes any confusion with 'stars' due to radioactive contamination. A similar configuration of tracks by chance is equally out of question. Brode and others¹

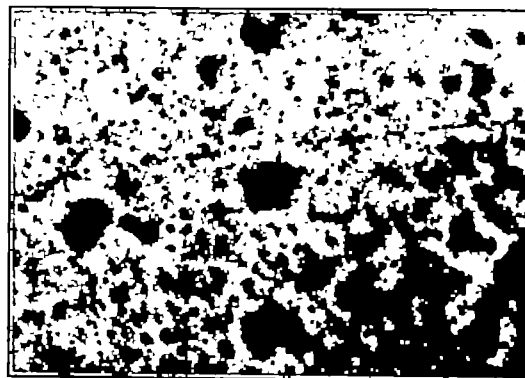


FIG. 1.

observed a single case of a disintegration with three heavy particles in a Wilson cloud chamber. The phenomenon which Wilkins believes was a shower of protons is perhaps a similar process, but he did not observe a centre².

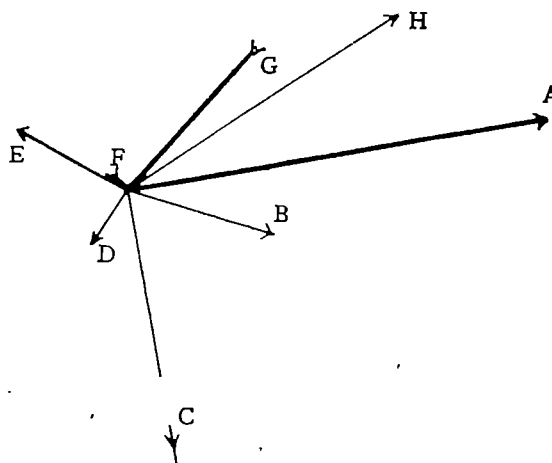


FIG. 2.

THICK LINES INDICATE A COMPARATIVELY LARGE NUMBER OF GRAINS PER UNIT OF LENGTH OF THE TRACK. AN INTERRUPTED LINE MEANS THAT THE TRACK IS TOO LONG TO BE REPRODUCED ON THE SAME SCALE. THE ARROWS INDICATE THE DIRECTION FROM THE SURFACE OF THE EMULSION TO THE GLASS.

The total energy involved in the process cannot as yet be calculated as most of the particles do not end in the emulsion.

We hope to give further details before long in the Wiener Akademie-Berichte.

M. BLAU.
H. WAMBACHER.

Radium Institut
u. 2 Physik. Institut,
Wien.
Aug. 25.

- ¹ Brode, R. L., and others, *Phys. Rev.*, **50**, 581 (October, 1936).
² Wilkins, *Nat. Geog. Soc., Stratosphere Series*, No. 2, 37 (1936).

Polarization of the Solar Corona

DURING the eclipse of June 19, 1936, at the observation station near the village of Kalenoe on the banks of the Ural River (U.S.S.R.), an investigation of the polarization of the solar corona was carried out by the expedition from Abastumani Observatory. The observations were made under perfect atmospheric conditions. A polarigraph with a reflecting analyser was used. The polarization was studied in two regions of the spectrum, corresponding to photographic and visual rays. In each series three plates were obtained with planes of polarization making angles of 60° . This enabled us to determine the degree and the direction of polarization at each point. On the plates the zone from $10'$ to $40'$ from the limb was found to be suitable for accurate photometric measurements. The effect of polarization is obvious.

From the study of the distribution of the degree and direction of the polarization, we can draw the following preliminary conclusions:

(1) The degree of polarization is different for different regions of the spectrum.

(2) The change of the polarization with increasing distance from the moon's limb is different for different heliographic latitudes, and depends on the structure of the corona. At places with a sharp radial structure (in corona streams) the polarization changes little, while between the streams it diminishes with the distance from the moon's limb.

(3) The direction of the polarization, while remaining approximately radial close to the solar poles and between streams, undergoes a strong but regular perturbation in the streams themselves.

The distribution of the direction of polarization in the outer corona (considering it as a vector) shows a certain analogy to the field of force.

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Aug. 28.

Anomalous Dielectric Constant of Artificial Ionosphere

SINCE the earliest experiments of Barton and Kilby¹ in 1913 on the dielectric properties of ionized air, there have been many attempts by investigators to record experimentally the depression of the dielectric constant of an artificial ionosphere (as the ionized air in a discharge tube may more properly be called) to a value less than unity. It has, however, been found by almost every investigator that the reduced value of the dielectric constant could be obtained only under very special experimental conditions such as low value of ionization in the experimental discharge tube or ultra-high frequency of the exciting wave; while, more often than not, the value of the dielectric constant recorded was greater than unity. This latter result is usually believed to be contradictory to the theory, and various explanations have been put forward to explain the apparent anomaly.

The purpose of this note is to show from a consideration of the ionospheric dispersion formula that the so-called anomaly is not an anomaly at all, since the formula itself yields values of the dielectric constant greater than, equal to, or less than unity, depending upon the experimental conditions of the discharge tube such as the degree of ionization, the

pressure (that is, collisional frequency) and the exciting wave frequency.

The complete dispersion formula is given by

$$\left(\mu - \frac{i\alpha}{p}\right)^2 = 1 + \frac{1}{\alpha + i\beta} \quad \dots (1)$$

Where $\alpha = -\frac{p^2 m}{4\pi N e^2}$ and $\beta = \frac{m p \nu}{4\pi N e^2}$.

The symbols have their usual significance.

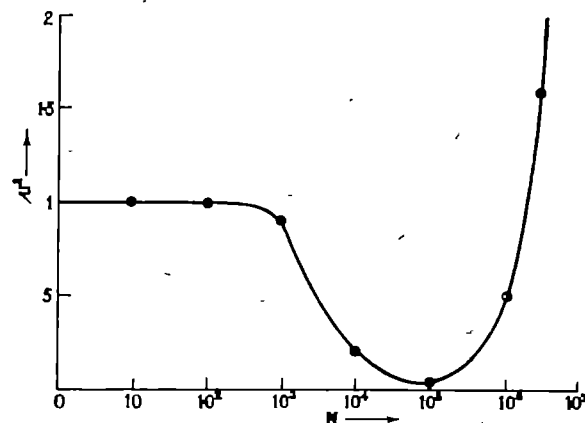


Fig. 1.

Separating the real and the imaginary parts, we have²

$$2\mu^2 = \sqrt{1 + \frac{2\alpha + 1}{\alpha^2 + \beta^2}} + \frac{\alpha}{\alpha^2 + \beta^2} + 1 \quad \dots (2)$$

$$\frac{2\alpha^2 \kappa^2}{p^2} = \sqrt{1 + \frac{2\alpha + 1}{\alpha^2 + \beta^2}} - \frac{\alpha}{\alpha^2 + \beta^2} - 1 \quad \dots (3)$$

It is easily seen from expressions (2) and (3) that μ^2 is greater than, equal to, or less than, unity, according as

$$\frac{|\alpha|}{\alpha^2 + \beta^2} \begin{cases} < \\ > \end{cases} \frac{\alpha^2 \kappa^2}{p^2}$$

If $\alpha > \beta$, expression (2), reduces to

$$\mu^2 = 1 - \frac{4\pi N e^2}{m(p^2 + \nu^2)} \quad \dots (4)$$

The approximate formula (4), which apparently suggests that μ^2 cannot attain a value greater than unity, has been responsible for the widespread belief "that the theoretical expression for the dielectric constant of an ionized medium does not permit values greater than unity, whatever the ionic concentration may be". Calculation of values of μ^2 from the complete dispersion formula shows, however, that the theoretical expression for the dielectric constant does permit values both greater, and less than, unity.

Figs. 1 and 2 are plots of equation (2). In Fig. 1, the dielectric constant is plotted against the ionic density N , all other quantities remaining constant. It is seen that only within a limited range of N can values of μ^2 less than unity be recorded. If N is increased beyond this range, the value of the dielectric constant increases and becomes greater than unity.

Fig. 2 is drawn for values of ν , N and p as were obtained in an actual experiment by Mitra and Banerjee⁴. The broken line prolongation of the left-hand portion of the curve is obtained by using the approximate formula (4). Mitra and Banerjee had explained the upward swing of the curve to the right

by assuming the effect of conductivity in their experiment. It is now seen that the existence of this portion of the curve is implied in the complete dispersion formula (2). The expression under the square root contains terms which take into account the

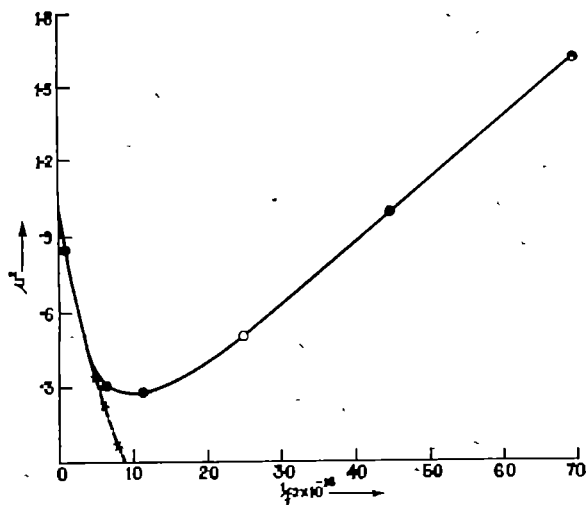


Fig. 2.

effect of conductivity. The fact that the experimental curve of Mitra and Banerjee, though similar in nature to Fig. 2, does not agree closely with it, shows that the disposition of the experimental apparatus had possibly some influence.

S. K. MITRA.

K. K. ROY.

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Calcutta.
Aug. 16.

- ¹ Barton, H. H., and Kilby, W. B., *Phil. Mag.*, **26**, 567 (1913).
² White, F. W. G., "Electro-magnetic Waves" (Methuen and Co., 1934), p. 58.
³ Appleton, E. V., and Chapman, F. W., *Proc. Phys. Soc.*, **44**, 253 (1932). (The remark quoted is for the case of no external magnetic field.)
⁴ Mitra, S. K., and Banerjee, S. S., *NATURE*, **136**, 512 (1935).

Effect of Near Lightning Discharges on a Magnetometer

DURING two thunderstorms at the beginning of the present monsoon, the recorded curves of the Copenhagen declination magnetograph recently installed at Alibag showed some characteristic features which on examination appear to be due to the effect of the magnetic field of the lightning discharge currents on the magnetometer. The magnetograms are reproduced in Fig. 1. The variations occurred between 2 hr. and 4 hr. and between 18 hr. and 22 hr. I.S.T. The storm was most intense in the second of the two intervals at about 20 hr. The magnetometer needle experienced a number of sudden kinks, and the subsequent oscillations gradually died down in 2-3 minutes. The maximum first deflection was about 1.5 mm.

It is easy to make a rough estimate of the deflection of the magnetometer needle that may be expected due to the magnetic field of a near lightning discharge. For impulsive discharges the total duration of which is small compared with the periods of the magnetometer, the instrument will behave as a ballistic galvanometer, the relation between the discharge current, its

duration, the constants of the suspended needle and the field in which it is suspended being given by the usual formula:

$$\int i dt = q = \frac{HT}{\pi G} \sin \frac{\theta}{2} \left(1 + \frac{\lambda}{2}\right),$$

if the magnetic field due to the current is perpendicular to H . In the present instance, T was 3.95 sec. and H was $\frac{0.876}{4.9}$ gauss. The effective magnetic field was smaller in the ratio 1:4.9 because, in order to increase the sensitiveness of the magnetometer, the north pole of the needle had been made to face south by applying torsion to the suspending quartz fibre

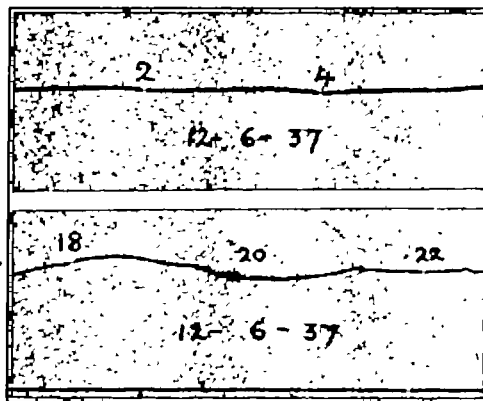


Fig. 1.

RECORDS OF A D. LA COUR DECLINATION MAGNETOGRAPH OBTAINED ON MAY 12, 1937, AT ALIBAG, NEAR BOMBAY, SHOWING THE EFFECT OF NEAR LIGHTNING DISCHARGES. THE TIMES ARE IN HOURS (INDIAN STANDARD TIME).

in the manner recommended by Dr. D. La Cour. Now G , the field at the needle (supposed short) due to unit current in the discharge circuit is given by

$$G = \frac{l \sin \theta}{r^2},$$

where l is the length of the discharge current, r its distance and θ the angle between r and the discharge path. The direction of the field is perpendicular to the plane containing l and the centre of the needle. Assuming $\sin \theta = 1$, $l = 2$ km. and $r = 2$ km., then $G = 5 \times 10^{-4}$. A probable value for q is 20 coulombs (see C. T. R. Wilson's article on Atmospheric Electricity in the "Dictionary of Applied Physics"). From these data the deflection of the needle can be easily calculated. It comes out to be $1/4820$ radian when the lightning discharge is most favourably oriented. The corresponding deflection on the chart when the distance of the photographic paper from the mirror of the magnetometer is 165 cm. is $2 \times 165/4820$ cm. or 0.7 mm. The observed and expected deflections are of similar magnitudes.

Attempts are being made to design a simple magnetometer with a Helmholtz compensating coil for the purpose of measuring the discharges of individual lightning flashes.

K. R. RAMANATHAN.

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Aug. 6.

Sensitization of the Skin of Mice to Light by Carcinogenic Agents

WHITE mice painted twice a week for three weeks with benzpyrene in benzene are found to be sensitized to light. The mouse is painted and exposed to direct sunlight for a half to one hour; during the exposure the skin of the painted area becomes red and markedly oedematous. There is no latent period to this reaction; within a few minutes of the exposure the mouse becomes ill at ease, scratches the painted region and tries to hide it from the sun. The next day, the area shows a definite dermatitis.

Unpainted white mice having the hair closely clipped over the same region showed no reaction after three hours' exposure or at any subsequent time; unpainted areas in the experimental mice gave no reaction, nor did mice painted with the solvent.

Exposures to infra-red radiations and to ultra-violet radiations did not give rise to these reactions. By dividing the visible spectrum into three with Kodak gelatine filters, it was found that only the blue-violet light was effective: this corresponds with the absorption spectrum of benzpyrene.

Similar reactions have been obtained with tar and with di-benzanthracene, but which part of the spectrum is responsible has not yet been ascertained.

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J. C. MOTTRAM.

Sept. 14.

Gonadotropic Activity of Amphibian Anterior Pituitary

PREVIOUS attempts, using infantile mice or rats as test animals, to demonstrate the presence of a gonadotropic substance in the anterior pituitary of frogs have been entirely negative¹. Since implantation of frog's pituitary into frogs causes ovulation, Zondek comes to the conclusion that the frog's pituitary contains a gonadotropic substance which is inactive in warm-blooded animals. The negative results obtained by Lipschutz and Paetz and Zondek were probably due to the fact that the amount of pituitary tissue implanted was too small. Adams and Tukey, however, injected saline suspensions of from 16 to 96 frogs' pituitaries into each infantile mouse and still obtained negative results.

In view of the interest of this work from the point of view of comparative endocrinology, similar experiments were performed using *Xenopus laevis*, the South African clawed frog, as donor. Littermate female white mice 19-22 days old were used as recipients. In each experimental series one or two animals received a subcutaneous implant of frog anterior pituitary tissue; two to four mice received control implants of one of the following frog organs: brain, kidney, muscle, spleen, liver, ovary; one to three animals served as normal untreated controls. 72 hours later the mice were examined for opening of the vagina. They were then killed and the ovaries and uteri removed. The ovaries were dissected away from their oviducts and capsules. Fat and loose connective tissue were carefully removed from the uteri. All organs were immediately weighed on a torsion balance.

Implantation of 3.5 mgm. of anterior pituitary caused opening of the vagina but had no effect on the weights of either ovaries or uterus. Implantation of 8-20 mgm. caused opening of the vagina in all but two of twelve animals, also an increase in the weight of the ovaries and a two- to fourfold increase in uterine weight. In two mice hemorrhagic follicles (*bluepunkts*) were present in both ovaries; the uteri

weighed 31.0 mgm. and 32.5 mgm. (controls, 8 mgm.) and the ovaries 4 mgm. and 5 mgm. (controls, 2 mgm.). In seven animals uterine weights of 17-23 mgm. were obtained. All control implants gave negative results. A few of the enlarged ovaries were sectioned and showed definite follicular growth.

The ovarian, uterine and vaginal responses obtained in these experiments provide definite evidence that the gonadotropic substance of amphibian anterior pituitary can activate the mammalian reproductive apparatus.

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Cape Town.

H. ZWARENSTEIN.

Aug. 24.

¹ Lipschutz, A., and Paetz, B., *Comp. rend. Soc. Biol.*, 90, 603 (1923). Zondek, B., *Arch. Gynaek.*, 144, 123 (1930). Adams, A. B., and Tukey, G. B., *Anat. Rec.*, 67, Supp. 2 (1937).

Vitamin P

ACCORDING to Bentsáth and Szent-Györgyi¹, their experiments on the influence of vitamin P on the course of development of experimental scurvy² have been repeated at their request in several laboratories with the result that their observations were partly corroborated and partly not confirmed. This, they assert, is due to the fact that vitamin P requires for its activity the presence of traces of ascorbic acid.

In view of the fact that I repeated the above work independently, it is of interest to compare my results³ with the above. I was unable to record any vitamin P activity with daily doses of 1 mgm. of either 'citrim', hesperidin or a mixture of hesperidin and eriodictyol. When, however, sub-optimal preventive doses (0.1 mgm. and 0.2 mgm. of L-ascorbic acid a day) were administered alone to the experimental animals, a clinical and pathological condition was produced which resembled that obtained by Szent-Györgyi and his collaborators after the administration of vitamin P. This condition has always been known to occur when antiscorbutic doses lower than the minimum prophylactic dose have been offered to guinea pigs on well-balanced scorbutic diets, including the Sherman - La Mer - Campbell diet, which Bentsáth, St. Ruzsnyák and Szent-Györgyi used in their original investigation.

According to Bentsáth and Szent-Györgyi's latest view¹, one is driven to the conclusion that the basal diet I used (bran, barley meal, middlings, fish meal, crushed oats and autoclaved milk) contained no traces of ascorbic acid, which is undoubtedly true, but contained the hypothetical vitamin P, whilst the Sherman - La Mer - Campbell diet as used by them contained traces of ascorbic acid, although this is not evident from their negative control experiment⁴, but no vitamin P; alternatively, the biological action observed by them was due to the contamination of their 'citrim', etc., with traces of ascorbic acid. The object of this note is to record the bearing of my results on the modified view of Szent-Györgyi and his collaborator, which was advanced since the appearance of my paper, in the hope that it will help in the solution of this elusive subject.

S. S. ZILVA.

Lister Institute of Preventive Medicine,
London, S.W.1.

Sept. 7.

¹ Bentsáth, A., and Szent-Györgyi, A., *NATURE*, 140, 425 (Sept. 4, 1937).

² Bentsáth, A., St. Ruzsnyák and Szent-Györgyi, A., *NATURE*, 128, 796 (1936).

³ Zilva, S. S., *Biochem. J.*, 31, 915 (1937).

Meteorites: the Number of Pultusk Stones and the Spelling of "Widmanstätten Figures"

IN criticizing others in *NATURE* of September 18 (p. 504), Prof. F. A. Paneth lays himself open to criticism. His calculation of the number of Pultusk stones is a remarkable example of what can be done with mathematics when all the factors are not taken into account. In 1868, Krantz supplied for the British Museum collection Pultusk stones weighing 3,545, 845, 793, 256 (half a stone), 139½ gm., and twelve others weighing together 243 gm. Towards the end of such a series it is the common practice to weigh the smaller stones together in one lot; and evidently the 212 (not 210) stones with an aggregate weight of 1 kgm. formed the tail-end of Krantz's stock. In 1908, Krantz was still offering Pultusk stones weighing 565, 492, 382 gm., and numerous others of less than 100 gm. While it is perfectly true that the best museums strive to acquire and preserve the best specimens, it is scarcely a balanced argument to quote, to the exclusion of these, a small private collection in Moravia, in which fragments of all the meteorites represented amounted to only 2 kgm.

In the British Museum collection there are 72 Pultusk stones with a total weight of 18,188 gm., the largest 9,095 gm. and the smallest 6 gm. (that is, less than the average in the Moravian collection); 264 in the Paris collection weigh 31,387 gm.; 175 in Chicago 14,291 gm.; 62 in Bonn 19,742 gm.; and 41 in Vienna 15,843 gm. These 614 stones account for half the total weight recovered. Individual stones of more than 1 kgm. in different collections (in addition to those in the British Museum) are 9,521, 8,070, 7,938, 7,150, 3,770, 2,500, 1,702, 1,040 and 1,025 gm. While it is not at all impossible or improbable that as many as 100,000 stones fell in this shower, the facts now available do not supply data for this to be proved mathematically.

In my paper in the *Mineralogical Magazine* in 1933 I collected fourteen variations in the spelling of "Widmanstätten figures" in the literature dating from 1813. Since then I have collected a few more. In the best books of reference the name of the discoverer is given as Widmanstetter (or Bech-Widmanstetter). Prof. Paneth quotes the Austrian Biographical Lexicon, giving (from E. Cohen) the date and page, but not the volume (Theil 55), which suggests that he did not himself actually consult the original. Here the entry is under "Widmanstetter", and the same also in J. C. Poggendorff's "Biographisch-literarisches Handwörterbuch" (1898, vol. 3). In the British Museum "Catalogue of Printed Books" a later member of the family, writing between 1870 and 1896, is catalogued under "Beckh-Widmanstetter" (Leopold von), with a cross-reference from Widmanstetter.

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Sept. 21.

Spiriform Morphology of some Lead Crystal Growths in Silica Gel

It has been well known since A. L. Simon's description of the phenomenon¹, that fern-like crystal growths of lead can be obtained in silicic acid gels containing lead acetate solution. Whereas Simon used zinc to promote the electrochemical liberation of metallic lead in the gel, the use of tin for the same

purpose leads to the formation of crystals of a strikingly different morphology and lustre.

Under conditions recently studied in detail, which are characteristically critical as regards the concentrations of the reactants (particularly the lead acetate) a spiriform type of growth has been observed, to which no previous reference can be found in the literature. These growths arise electrochemically in a way entirely different from those helical and spiral precipitates of lead iodide, lead chromate and calcium phosphate described in the published work of Hatschek and his pupils², neither do they resemble the silver chromate spiral precipitates described in Hedges's "Liesegang Phenomena", nor the spiral crystals of M. Copisarow³. These spiriform lead growths often take a form resembling somewhat a very deeply cut screw having a minute barrel diameter, and with a very serrated edge to the pitch; sometimes the growths are like a thin ribbon of lead, twisted into a spiriform strip. The accompanying photograph

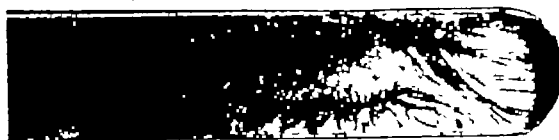


Fig. 1.

(Fig. 1), for which I have to thank Mr. E. Rowell of the Kodak Research Laboratories, Harrow, reproduces a six by one inch test-tube containing two such spiriform specimens. Whilst a non-stereoscopic view of them cannot adequately indicate the full screw-like features, a cinematic record reveals on rotating the tube that the two spirals in it are respectively right- and left-handed. At the points where they touch the glass walls, the spirals flatten out into serrated strips and these curl strikingly in opposite senses.

In collaboration with Mr. A. King of the Chemistry Department of this College, with whom work on these phenomena is being continued, it has been found that those gels, which are 0.02 normal with respect to the lead acetate concentration, can be made to reproduce spiriform growths, whilst identical gels containing a slightly different concentration of lead will produce many other strikingly different growths; the use of metals other than zinc or tin will also promote further modifications in their morphology.

NORMAN STUART.

Royal College of Science,
South Kensington, S.W.7.
Aug. 23.

¹ *Koll.-Z.*, 12, 171 (1913).

² *Koll.-Z.*, 27, 235 (1920); *Biochem. J.*, 14, 418 (1920).

³ *Koll.-Z.*, 47, 60 (1922).

Judgment by Hypothesis

PROF. J. B. S. HALDANE (see *NATURE*, Sept. 4, p. 428), in comparing my attitude towards Prof. E. A. Milne's cosmology with that of Lysenko towards the Russian geneticists, draws an analogy which seems to me little short of fantastic. According to *NATURE* of August 21, Lysenko treats Darwin's words as dogmas by which to judge and condemn, without examination, the work of modern experimenters. I accused Prof. Milne of imitating the practice of the Aristotelians who treated Aristotle's

words as dogmas by which to judge and condemn, without examination, the work of their contemporary experimenters. If there is any analogy to be drawn, it is surely between Lyenko and the Aristotelians (ancient or modern).

However, I am less concerned with that than with the possible implication that I wish forcibly to restrict Prof. Milne's work. On the contrary, I would place freedom of thought and expression second only to complete dedication to truth (or truthfulness, for those who think they can dispense with the shorter word) in the list of essential conditions for research. While I wish with all my heart that Prof. Milne would stop inventing systems and telling us what God cannot do, and would return to those problems in astrophysics which he is so peculiarly gifted to solve, I would fight to the last ditch for his right to waste his talents if he so wishes. My complaint is that he does not satisfy the first condition. He deduces systems from pure fancy, but instead of consistently calling them products of the imagination and presenting them as works of art, he tacitly identifies them with the world of experience and calls them scientific. Mathematics, according to the phrase which has been repeated and disregarded *ad nauseam*, is a subject in which we do not know what we are talking about. If Prof. Milne would eliminate such words as time, nebula, universe . . . from his

papers, and substitute x , y , z throughout, I would no more seek to restrain his activities than I would those of the surrealists.

HERBERT DINGLE.

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Sept. 16.

Tritium or Triterium?

I HOPE it is not too late to protest against the use of the name 'triterium' for the isotope of hydrogen of mass 3. The name appears in the very interesting article by Lord Rutherford in *NATURE* of p. 303, and has apparently been used elsewhere, to judge by the quotations in that article.

The word 'deuterium' is correctly formed from the Greek δευτερος (*deuteros*), 'second', but the Greek for 'third' is τρίτος (*tritos*), not *triteros*. The name which corresponds properly with 'deuterium' is clearly 'tritium', and this word is already in use; for example, papers dealing with this isotope are indexed under 'tritium', and not 'triterium', in the indexes to the British Chemical Abstracts for 1935 and 1936.

Trinity College,
Dublin.
Sept. 1.

KENNETH C. BAILEY.

Points from Foregoing Letters

COMMENTING on a recent remark by Mann and Wells on the production of gold films by heat decomposition of volatile gold compounds, Prof. O. S. Gibson refers to previous experiments of the same type. Also, he points out that in aurous compounds gold is always 2-covalent and that aurous ions, like auric ions, are apparently incapable of existence.

A table with details of the structure of quinhydrone and related compounds, as determined by X-ray analysis, is given by Dr. J. S. Anderson. The position of the quinone and quinol groupings, the relation of compounds of chloranil and bromanil to hexamethylbenzene and other structural characteristics are discussed.

A photomicrograph of coproporphyrin III, obtained from a bovine suffering from congenital porphyrinuria, is submitted by Dr. C. Rimington and G. C. S. Roets, showing that, as in the case of the related uroporphyrins, compounds belonging to both isomeric types (series I and series III) occur in certain pathological states.

Long-range ionization tracks, starting from a common focus in the emulsion of a photographic plate which had been exposed to cosmic radiation for five months at an altitude of 2,300 m., are considered by M. Blau and H. Wambscher to have been produced by disintegration of an atom in the emulsion by a cosmic ray.

Photographs of the solar corona, taken during the total solar eclipse of 1936 by means of a polarigraph with reflecting analyser, show, according to K. G. Zakharin, that the degree of polarization varies in different parts of the corona and also with the wavelength, and that the direction of polarization undergoes a change in the 'streams'.

Prof. S. K. Mitra and K. K. Roy point out that the complete formula for ionospheric dispersion yields

values for the dielectric constant which are greater than, equal to or less than unity, depending on degree of ionization, pressure and the exciting wave-length. The use of a simplified approximate formula had wrongly led to the opinion that theoretical considerations preclude values greater than unity, but such values were found experimentally.

Some characteristic fluctuations noticed in the declination magnetograms obtained at Alibag, near Bombay, are explained by Dr. K. R. Ramanathan as being due to the magnetic field of near lightning discharges. He points out that the magnetometer behaves as the needle of a ballistic galvanometer for these impulsive discharges, and suggests that this may be made the basis of an instrument for measuring the discharges of individual lightning flashes.

Implantations of the anterior pituitary of the frog into immature female white mice are found by Dr. H. Zwarenstein to activate the reproductive apparatus (opening the vagina, increase in weight of ovaries and uterus, and follicular growth).

Dr. S. S. Zilva observed no vitamin P activity on administering a daily dose of either 'citrin', hesperidin or a mixture of hesperidin and eriodictyol to guinea pigs on a scorbutic diet. He obtained, however, a biological response similar to that observed by Prof. A. Szent-Györgyi on administering sub-optimal doses of ascorbic acid. The bearing of these observations on Benteath and Szent-Györgyi's latest view concerning the action of vitamin P is pointed out.

ERRATUM.—In the note in *NATURE* of September 18, p. 509, referring to Dr. A. L. Reimann's communication, the statement: "the linear rate of decay of the phosphorescence of zinc-blende" should read: "the linear rate of decay of the *inverse of the square root* ($p^{-1/2}$) of the phosphorescence of zinc-blende".

Research Items

Eastern Himalayan Blood-Groups

IN view of the high percentage of Group *AB* found among Tibetans at Gyantse, Miss Eileen W. E. Macfarlane has obtained samples from Tibetans, Nepalis and Lepchas (*Man*, No. 159, August). The Tibetans were hospital patients and others at Kalimpong, North Bengal. The subjects either called themselves Bhutias or were Bhutanese. There are Bhutias in Sikkim State, who resemble the Tibetans physically and wear similar dress and ornaments. The Bhutanese were nearly all from Ha, Bhutan, and also belong to the Tibetan race. The sample in all numbered fifty-six. The proportion of the blood-groups differs considerably from the blood-groups observed by Tennant at Gyantse. The percentage of *B* is of the same order, and considerably lower than in the neighbourhood of Nepal. The percentage of *O* is much higher and of *A* lower than at Gyantse, the latter possibly being due to inbreeding, while the high proportion of *AB* may be a result of the Chinese garrison stationed there from the beginning of the century until 1912. The proportions found at Kalimpong suggest either that blood-group relationships differ markedly in different parts of Tibet, or that conditions in Gyantse are exceptional. One eighth of the Bhutias belong to Group *B*, more than a third to Group *A*, and almost one half to Group *O*, *AB* being rare. The preponderance of *O*, the characteristic group among American Indians, recalls the fact that the physical resemblances and similarities of artistic design between Tibetans and American Indians, especially the Navajos, has been noted as striking. The nearest Mongoloid neighbours of Tibet in China and Nepal are fairly high in *B* and it is remarkable that the Tibetans have absorbed relatively little of this group. They have evidently been isolated from the main stream of Mongolian migration since very early times.

Early Chinese Bronzes

AMONG a number of early Chinese bronzes from the Eumorfopoulos Collection, now in the British Museum (Bloomsbury), which are figured and described in the *Brit. Mus. Quarterly*, 11, 3, by Mr. R. S. Jenyns, is the famous ram-handled *tsun* which belongs either to the Shang-Yin, or early Chou Dynasty. This piece should convince sceptics that the Chinese bronzes of the classic period are equal, if not superior, to those of any other civilization. It is modelled in the form of two rams standing back to back, and is supported on four legs represented by their forefeet. From between their heads rises the funnel, which forms the mouth. The body is covered with scales, which may, or may not, have been engraved after casting. The conquest of Shang-Yin by the Chou princes about 1100 B.C. does not seem to have altered the Shang-Yin style. This *tsun* shows only one of the four innovations regarded by Karlgren as making their appearance at that period. It must, therefore, be very closely related to the Shang-Yin bronzes. It is difficult to account for the sudden appearance of the Shang-Yin culture, which produced highly complicated and distinctive bronzes without apparent effort. The mastery of technique and the conventionalized motives argue a long process of

evolution, and their inscriptions are far from primitive. Yet there is an enormous hiatus of time to be accounted for between the neolithic pottery from Western Kansu and Honan and these highly sophisticated vessels. The immediate ancestors of these are lacking. The Hsia culture, in which bronze casting and early forms of bronze must have made their appearance, remains a mystery. Even if it be admitted that bronze casting was introduced from the West in its finished form immediately before the Shang-Yin, the existence in Shang-Yin of forms evidently of great antiquity, which betray no affinity to known Western forms, is difficult to explain, without admitting a long process of internal evolution. We are compelled to believe that Shang-Yin culture had its roots in a distant past, but why almost no traces of that past have survived is a puzzle for which archaeology has yet to supply a happy solution.

Passerine Birds of Ethiopia and Kenya

DURING the months of its sojourn in Africa in 1911 and 1912, the Frick Expedition collected about 5,200 birds, besides a number of eggs and nests, and copious field observations, all due to the energy and collecting ability of the late Dr. Edgar Alexander Mearns. The description of the passerine birds by Herbert Friedmann adds to the faunal knowledge of an area remarkable for the wide range of its conditions, from desert to tropical rain-forest, from a rainfall of 0-11 inches to 70-80 inches, and from sea-level to 15,000 feet (*U.S. Nat. Mus., Bull.* 153, 479; 1937). Among the general features described is the marked tendency of far more lowland birds to range high up the mountain slopes in Ethiopia (to an altitude of 7,000-8,000 feet) than reach to about half that altitude (4,500 feet) in more equatorial portions of the continent. The authors regard the birds of these regions as having been derived from the steppes of south-eastern Asia by way of Asia Minor and Arabia during Pliocene times. In the course of this extensive movement many birds moved southwards through the area, such as the ancestors of *Francolinus ophana*, *F. africanus*, *Streptopelia capicola*, *Lophoceros melanoleucus*; others remained and formed a centre in which new species developed, and from which westward migration probably contributed to the fauna of the western savannahs the ancestors of such forms as the ground hornbill (*Buceros abyssinicus*), the parakeet (*Psittacula krameri*), the roller (*Coracias abyssinicus*) and the chat (*Oenanthe bottae*).

Self-fertilization in Japanese Slugs

THAT a pulmonate mollusc may possess the power of laying fertile eggs when kept in strict isolation has been known since Oken's experiments on *Lymnaea auricularis* more than a century ago. A number of other species have since been shown to behave in similar manner. K. Ikeda (*J. Sci. Hiroshima University*, March 1937) has conducted extensive and carefully controlled investigations into this phenomenon in the slug, *Philomysus bilineatus*. The young hatched in spring do not become mature until autumn, so need not be isolated until then; they mate in autumn but the eggs are not laid until after awaking

from hibernation in spring. The discovery of albino forms allowed a certain amount of genetical analysis. The fertility of the egg results from self-fertilization and not from parthenogenesis, and the power of self-fertility does not diminish with age. The individual spermatozoa descend the genital duct to attain fertilizing power in the receptaculum seminis, and the varying degrees of self-fertility exhibited by different species possibly result from differences in the ability of the spermatozoa to migrate through the duct.

Larvæ of Indian Coleoptera

IN *Indian Forest Records*, 11, No. 9, Mr. J. C. M. Gardner, of the Forest Research Institute, Dehra Dun, continues his series of articles on the immature stages of Indian Coleoptera. The present contribution deals with various Carabids, or ground beetles, and includes descriptions of the larvæ of species belonging to eighteen genera of these insects. As a number of these genera are European, and the structural characters of their larvæ are figured, the paper is of interest to workers other than those studying the Indian fauna. Very little has been published previously on larvæ of the Indian members of the family, and the present article, it is hoped, will be followed by others of a like character.

Aquatic and Marsh Plants of India and Burma

MR. K. P. BISWAS described some aquatic and marsh plants of India and Burma in a paper read before Section K (Botany) at the meeting of the British Association on September 7. India and Burma contain an enormous stock of aquatic and marsh plants in their many stationary and flowing waters. The hill streams in the Himalayas have their beds often covered with *Batrachospermum* and *Sirodotia* sp. The coastline, both the Malabar and the Coromandal, harbour large quantities of different species of marine algae. But there is still a vast field for the investigation of the marine flora of the coastline of India and Burma. The Andaman Islands, the Mergui Archipelago have also a rich vegetation of marine algae, chiefly composed of *Caulerpa*, *Sargassum* and *Halimeda*. The estuarine areas are marked by dense mangrove vegetation exposed to tidal action. On the west coast *Ceriops Roxburghiana*, *Avicinnia alba* are predominant. In the east, *A. officinalis*, *A. alba*, *Bruguiera gymnorhiza*, *Rhizophora mucronata*, *Acanthus ilicifolius*, *Agave majus*, *Ceriops Roxburghiana* are dominant species. In the Sundribun down to Mergui Archipelago and farther south the two palms, *Phœnix paludosa* and *Nipa fruticans* form quite a striking feature along the shore and deltaic areas. The larger rivers do not as a rule support much aquatic vegetation; but during hot months some portions of the beds of the rivers partially dry up, forming shallow pools separated from the main body of water. These pools form good culture beds of algae. Stationary water in the form of natural or artificial lakes, jhils, bils, tanks, pools, puddles and swampy areas (ricefield swamps) occupy a considerable area of the lower plains of the two countries. These, due to favourable edaphic and climatic conditions, are full of aquatic and marsh vegetation. In this mass of crowded vegetation, four zones can be distinguished: (1) the bottom layer, which may be called the zone of the vital layer; (2) the zone of rooted aquatics; (3) the zone of suspended vegetation, and (4) the zone of surface vegetation.

The inland brackish water plants are interesting, too. Such plants are often found in the plains of the cities near the sea, such as Bombay, Calcutta and Madras. The salt lakes of Calcutta retain a mixture of salt-water and freshwater vegetation in their swamps.

Polyporaceous Fungi

THE behaviour of nuclei in the developing basidium of the higher fungi has only been studied intensively during comparatively recent years. It has been generally established for one or two agaricaceous fungi that two nuclei fuse in the young basidium; the fusion nucleus divides, first by reduction division, and later by ordinary mitosis, to form the basidiospores. Dr. S. R. Bose adds welcome confirmation to this view, by showing that the Polyporaceæ possess a similar mechanism (*J. Ind. Bot. Soc.*, 16, No. 3, 119-128; 1937). Eleven species of Polyporaceæ have been studied, and results are given in detail for each species. Basidia are very small in the pore-bearing fungi, but a sufficient number of stages has been found to establish similarity of behaviour with other previously described Basidiomycetes. The mechanism of nuclear division is essentially similar to that of higher plants, though the chromosomes are too small to be counted satisfactorily. Dr. Bose has recently published a paper on "Polyporaceæ from Lokra Hills (Assam)" (*Ann. Mycologici*, 35, No. 2, 1937), in which he describes a number of species from an elevation of 5,000-10,000 feet. Many cosmopolitan fungi are included, and the accounts show that several polypores of temperate Europe and North America are found at this elevation in Assam, but are absent from the plains of Bengal. *Fomes fomentarius* is a typical example of such distribution.

A Dune Drainage System

MR. V. J. CHAPMAN has described an investigation made in 1933 to determine the nature of the water-table movements in the salt marshes of Scolt Head Island on the Norfolk coast (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, Session 1936-37). The area selected was especially convenient for the experiment as there is a small artificial pond near the centre, and it was the rise and fall of the water in this pond that prompted the investigation. The information obtained showed that while the diurnal tidal movements did not sensibly affect the level of the pond, it rose appreciably and rapidly about 48 hours after every maximum spring tide which reached a height of 27 ft. above Hull datum and then fell slowly. Particulars were also obtained showing the direction of the drainage flow. These water-table movements have a profound bearing on the plants which grow in the dunes and which, in order to tap the supply of fresh water known to float on top of the salt water, develop long roots. Without these periodic fluctuations of the water-table many of the dune plants would not be able to exist in summer when their need of water is great. To this extent, it is suggested, the flora of dune hollows may be associated with and dependent upon the subterranean water supply, assisted possibly by some capillary action in the sand. The conclusions reached as a result of this short investigation agree with those of earlier research carried out at Blakeney Point, and are therefore thought to be representative of the conditions in dunes in this part of Norfolk. These are that no flow takes place until the high spring tide reaches a

certain minimum level, that then a rapid rise takes place after a lag of 48 hours and that, except at these very high tides, the water drains out along the line of least resistance following a shingle path to the shore.

Meteorological Connexions between Greenland and Europe

At a meeting of the Royal Meteorological Society held on June 16, Dr. F. Loewe read a paper entitled "A Period of Warm Winters in Western Greenland and the Temperature See-Saw between Western Greenland and Central Europe". He referred to the studies of Grosse, Wagner and Scherhag on the marked change that has taken place in the climate of Greenland since about the beginning of the present century in the direction of milder winters and slightly warmer summers, resulting in a decrease of the mean annual range and therefore in a more oceanic climate. For example, the average difference between the extreme seasons from 1923-34 at Jakobshavn was 19.5°C . compared with 24°C . for the period 1876-1934. A striking individual instance of winter warmth is that of the period January-March 1929 when Jakobshavn temperature was 12.7°C . above the 1876-1935 mean, and the coldness of the same period in northern Germany (it was the coldest winter probably since 1830 and certainly since 1838) illustrates the see-saw of temperature with which the second part of the paper deals. This see-saw effect was pointed out by Hann so long ago as 1890, who observed that in the winter months the anomalies of temperature at Vienna and Jakobshavn were of opposite sign, but Dr. Loewe finds that the contrast with west Greenland is greater for the region around the Baltic than for Vienna. He gives a table of temperature anomalies for the nine warmest and nine coldest winters at each of the three stations, Jakobshavn, Breslau and Uppsala, for the period 1876-1930, and the corresponding anomalies at the other two stations, which illustrates the effect very well. The 54 sets of figures contain only two years, 1916 and 1930, with big simultaneous positive anomalies on both sides of the North Atlantic. The main reason for the see-saw is clearly to be found in pressure conditions between Greenland and Norway, high pressure tending to bring polar air down to the Baltic and tropical air up to West Greenland, and low pressure in the same area a reversed exchange of tropical and polar air.

Fluoroform

A MINUTE amount of a substance which was probably fluoroform, CHF_3 , was obtained by Mehlans in 1894 by the interaction of iodoform and silver fluoride. It was prepared in a pure state by Ruff in 1936 by the interaction of iodoform with a mixture of mercurous and calcium fluorides. A. L. Henne (*J. Amer. Chem. Soc.*, **59**, 1200; 1937) has now described a method suitable for larger scale preparation. In this, bromoform is heated in a closed steel vessel with antimony fluoride (SbF_5) and some bromine. This gives the substance CHF_3Br , b.p. -14.5° . This is carefully purified and is then treated with mercuric fluoride in a similar apparatus, with special temperature control. The gaseous CHF_3 evolved is collected over water, condensed by liquid air and distilled through a condenser cooled at -80° ; CHF_3 (b.p. -88.2°) passes on. The substance is very inert chemically and physiologically. Alkalis and acids are unaffected by it, bromine does not react in

bright sunlight, but fluorine reacts vigorously with formation of CF_4 and HF . The atomic distance between the carbon and fluorine atoms (as measured by L. O. Brockway) is 1.35 Å. By the action of chlorine in bright sunlight, hydrogen is replaced and CClF_3 formed. This boils at -81.1° and, as CHF_3 , boils at -82.2° , it is seen that in these compounds a replacement of hydrogen by chlorine has caused a rise in boiling point of only 1° .

Effect of Pressure on Phosphors

It is well known that powdering a phosphor results in a diminution of the intensity of the light emitted, but that uniform pressure produces no change in the intensity. Smekal's theory gives a satisfactory explanation of the effect of powdering. A comprehensive investigation of the effect has now been made (N. Riehl and H. Ortmann, *Ann. Physik.*, [v], **29**, 556; 1937). It was first shown that powdering does not affect the specific gravity of either zinc sulphide or alkaline earth sulphide phosphors. An attempt was then made to determine the percentage of active centres which are rendered inactive by the effect of pressure, the work being confined to the zinc, calcium and strontium sulphide phosphors. The opinion is expressed that the absolute effect of pressure was widely overstated in the earlier work, the reason being that the transparency of the phosphorescent layer was greatly decreased by powdering. For a medium-powdered phosphor it is estimated that the effect is only to reduce the intensity of the emission by 10 per cent, and this is near the limit of accuracy of the experiment. For an extremely finely powdered phosphor the diminution was only about 36 per cent. A rough estimation of the number of centres which come to the surface on account of the powdering agrees well with the experimentally determined decrease in intensity.

Spectrum of Nova Herculis

A LARGE number of papers on the spectrum of Nova Herculis has appeared since the discovery of this star in 1934, but one of the most complete and detailed accounts is that published recently by D. B. McLaughlin (*Pub. Obs. of Univ. of Michigan*, **6**, No. 12). The method of presenting the observational material is worthy of note, since the author discards "that most deadly of methods of discussion: the day-to-day journal of observations" and divides the history of the nova into typical stages, with separate treatment of each stage as a unit. Day-to-day changes of more important characters are, however, to be found in the numerous tables or diagrams. Wave-lengths, identifications, intensities and radial velocities are given for each group of absorption or emission lines which occurred in the various stages considered, together with critical accounts of the main features typifying each stage. It is impossible to summarize the many interesting results obtained, but special mention might be made of the anomalous behaviour of the Mg II line at 4481 Å., which showed radial velocity changes at variance with those of all the other absorption lines. It is described as "one of the most remarkable enigmas of the Nova spectrum". Some correlations are found between spectral changes and luminosity, and a tentative hypothesis is offered in which an interesting variant of the expanding shells hypothesis appears to give a satisfactory physical interpretation of the principal features observed.

The Relation of Growth Substances to Horticultural Practice*

By Dr. M. A. H. Tincker, Royal Horticultural Society, Wisley

MUCH of our recent knowledge of plant hormones we owe to the Utrecht botanists, whose investigations led to the recognition of the nature and function of these substances. Earlier experiments carried out with seedling oats showed that the shoot apex produced substances capable of regulating growth. When cut off and placed on gelatin, quantities exuded from the tips of the active substances proportional to the number of seedlings used for a fixed period of exudation. These substances could be transferred to other seedlings. A wide search was made for a ready source of these compounds, found to be present in small quantity in grain, pollen and leaves. Higher concentrations are available in urine.

At the Leicester meeting of the British Association Prof. F. Kogl described the isolation and chemical recognition of auxin *a* and *b*. Their structure is complicated; but with these two compounds a third active compound, hetero-auxin, was found. It is a simpler chemical, β -indolyl acetic acid, previously well known to chemists.

Small quantities (5 mgm.) of indolyl acetic acid when applied in lanolin, a convenient solvent, to the young stems of tomato plants growing vigorously, cause within 24 hours twisting and bending of the petioles and stems, as unequal growth takes place on the two sides. This is a quick ready means of testing closely related and other chemicals. In a few days, roots appear from the stem, root initials also develop inside, clearly seen by cutting the stem longitudinally. Similarly, the production of roots may be induced in severed portions of plants, and this is the practical point, for vegetative reproduction is thus facilitated.

The paste method has been largely superseded by dilute solutions. Herbaceous or woody cuttings are taken with expanded leaves, their basal ends placed in the solution to a depth of an inch; owing to the loss of water in transpiration from the leaves, sufficient solution is taken up to induce subsequent root production when the cuttings are placed, after washing in water, in sand in propagating frames.

The list of active chemicals includes the related indolyl butyric and indolyl propionic acids. The organic salts or esters of these acids are active, so are some of their metallic salts such as sodium indolyl-acetate. Scatole has recently been proved active. Alpha and beta naphthalene acetic acid are very highly active, phenyl acetic and anthracene acetic acid are less active.

Although fairly closely related, iso-indolinone is inactive. The substitution of sulphur for the nitrogen and hydrogen group in indolyl acetic acid very greatly reduces the activity. Although closely related to indolyl propionic acid, tryptophan is inactive; it may be a stage in the formation of the growth substance in Nature.

The treatment causes: (a) more cuttings to form roots; (b) more roots to be formed on each cutting;

(c) the active process (including *a* and *b*) to be accelerated.

Amongst herbaceous plants, cuttings of lupins, delphiniums, pelargoniums, violas and alpine phlox have shown accelerated rooting by treatment with pastes in lanolin and with very weak solutions. There is a tendency to damage delicate tissue by the use of solutions of too high a concentration; 1 part in 30,000 or 40,000 parts of water is recommended for such cuttings.

With holly, taken at the end of June and treated with indolyl acetic acid, 1 part in 10,000 of water for 24 hours, half the cuttings rooted in 6 weeks whilst none of the controls, placed in water for 24 hours, rooted in this time. With *Viburnum Carlesii*, cuttings taken at the end of July and treated with alpha naphthalene acetic and others with indolyl acetic, 1 part in 10,000 of water for 24 hours, rooting took place rapidly. In ten days, the active growth taking place inside the stem split the outer layers. Cuttings of *Oeanothus dentatus* taken in late November produced roots in January, and *Myrtus communis* cuttings taken in January rooted in a month. Stimulation may occur at a season of normal quiescence.

Species and varieties of heather (*Erica*) responded quickly to alpha naphthalene acetic acid, *Pieris formosa* taken in late August and *Gaultheria procumbens* have given favourable results. With *Rhododendron rubiginosum*, 85 per cent of the cuttings treated in alpha naphthalene acetic acid and indolyl acetic acid, 1 in 20,000 for 48 hours, rooted in three months, whilst only 5 per cent of the controls form roots. Other plants tested include species of *Buddleia*, *Camellia*, *Deutzia*, *Escallonia*, *Hydrangea*, *Pernettya*, all of which showed favourable results by these methods. Even with the more recalcitrant genera and species some encouraging results have already been obtained. Further results are reported in tests made by horticultural and chemical firms, and at other research stations and laboratories. These greatly extend the list of species in which root formation has been accelerated. Certain species may yet prove quite unresponsive but the indications are to the contrary, provided the time of year and concentration of solution can be correctly selected.

The concentrations are surprisingly low, for frequently 1 in 40,000 of water is effective. It appears from certain *ad hoc* tests that there is a critical concentration below which little or no activity is induced. Twice the length of time for uptake from a solution half as concentrated may not be so effective as a stronger solution used for the given time.

Pouring solution on to the sand before inserting cuttings is not recommended, as bacteria interfere. Freshly made solutions should be used as moulds and bacteria may contaminate them if kept. Since the solutions are not stable in light, storage in coloured and opaque vessels at higher concentration is recommended.

The success obtained has been quickly appreciated

* Substance of a lecture to Section K (Botany) of the British Association, delivered at Nottingham on September 3.

by chemical manufacturers and by horticulturalists. There are now a number of solutions readily available on the market in many countries.

Thus it is seen that investigations, primarily of botanical interest, dealing with fundamental problems

of plant development, have quickly led to results of much interest and value to the practical man; showing once more the relationship of science and its discoveries to everyday life, to industry and to recreational pursuits.

The Teaching of Geology in Schools

JUST over two years ago, at the Norwich meeting of the British Association, Section C (Geology) appointed a committee to report on questions affecting the teaching of geology in schools. A short report was presented at the 1936 meeting of the Association, and, at the suggestion of members of Section L (Education), an extended report giving detailed proposals was prepared for the Nottingham meeting. These reports were discussed in a joint meeting of Sections C and L, at which Mr. H. G. Wells presided, on September 7.

The views of the geologists were explained by Prof. A. E. Trueman, who opened the discussion, Prof. G. Hickling, Prof. W. W. Watts, Prof. L. J. Wills, Sir Lewis Fermor and Prof. P. G. H. Boswell. It was pointed out that, while geology has never figured very prominently in school curricula, many pupils were formerly introduced to it, for example, on field excursions, by teachers who had received some training in the subject, but that few intending teachers at present are encouraged to include it in their university or college courses. While appreciating something of the difficulties of the overcrowded curriculum, it was felt that geology should be more widely included in school courses. The Committee did not press its claims in competition with any other subject; in general, while it wished to secure the inclusion of some outlines of geological knowledge in all science courses in secondary schools (for example, as a part of schemes of 'general science'), it only asked, in addition, that geology should be included as an optional subject at more advanced stages. The inclusion of some geology in the scheme of informative education outlined by Mr. Wells in his address to the Education Section was noted with keen satisfaction.

Both the cultural and utilitarian aspects of geology were emphasized. It is one of the richest of cultures, stimulating a broader interest in the outside world and increasing the appreciation of scenery. On the other hand, it is an eminently useful science with numerous and obvious applications in mining, engineering and agriculture. It was suggested that geology should form an essential part of the school curriculum in mining and industrial areas, partly on account of its economic importance, partly for the wider interest it would give to later life.

The syllabuses proposed by the Committee are intended only as suggestions, and great elasticity of treatment appears to be desirable in the case of geology even more than in other sciences, the bias and the arrangement of the various topics depending largely on the location of the school.

In the senior elementary schools there is more opportunity for variety of treatment, and a rather practical bias is suggested. Dr. W. K. Spencer described some of the work carried out in such schools.

The lack of any courses in geology in most schools was held responsible for the present dearth of trained

geologists; Prof. Hickling and Prof. Watts pointed out that while the supply is thus restricted the demand for geologists is increasing. It was emphasized that there are attractive careers in this field for a number of men of ability and good physique.

Two teachers who took part in the discussion expressed rather different points of view. First, Mr. James Davies, one of the few teachers who are actually teaching geology in secondary schools, indicated the nature of his courses. In pleading for a wider adoption of geology he spoke of the attractiveness of the subject and said that there is nothing more inspiring than leading a party of young people over hill and dale (his school is in South Wales). As an example of the chance of a beginner in geology making new discoveries, he mentioned the first recognition of a marine band in the Coal Measures by one of his pupils. In his school, both geology and geography appear in the curriculum. On the other hand, Mr. V. C. Spary, speaking as a teacher of geography, expressed fears that the introduction of geology into the time-table could only mean the displacement of geography. He agreed, however, that a well-balanced course of geography must include many lessons of a geological nature, for "geography teachers must borrow a great deal", and he thought it a great advantage for teachers of that subject to have some geological training.

Mr. Wells agreed with Mr. Spary that the teaching of geology as a specific subject is not highly desirable until an advanced stage in education is reached, but thought that reference would nevertheless be made at earlier stages to the geological record when teaching biology, and to physiography in teaching geography. He went on to inquire what constitutes geological training when the biological and physio-graphical sides are taken away. In reply to these questions it was insisted that palaeontology and physiography are branches of geology, and while it may be convenient to treat them in relation to other subjects in the curriculum, it is desirable that the pupils should know that they are then learning geology. Anxious as they are to see their subject taught in schools, geologists would much prefer to have it taught under its own name.

In the course of the discussion, there was no real criticism of the view that geology should be taught in schools; there was, however, this difference of opinion as to whether it should appear as a separate subject except at more advanced stages (for example, at the Higher School Certificate stage). The inclusion of the subject as a part of a course in 'general science' would possibly be the most satisfactory solution in many schools, up to the stage of the School Certificate, as the Committee had recommended.

In connexion with the discussion, Prof. H. H. Swinnerton arranged an interesting exhibit to show a course of simple experimental work in geology suitable for schools.

Fossil Man in Minnesota*

IT is probable that there is no skeleton of ancient man of which the circumstances and conditions of discovery have been more carefully documented than that of the skeleton found in the ancient glacial lake deposits, now known as "Lake Pelican", beneath Minnesota Highway No. 30, near Pelican Rapids, on June 18, 1931 (see NATURE, Feb. 27, p. 385). Prof. A. E. Jenks, in his detailed account of the skeleton, has been careful to secure statements from all who were concerned in the discovery of this skeleton; and the facts were further checked by a re-excavation on the site, in which the circumstances received further confirmation by the occurrence of more fragments of the skeleton.

The skeleton was unearthed at a depth of some twelve feet in the course of repairs to a recently made road, when a mechanical excavator was noticed by the workmen to have crushed a clam shell. A closer examination revealed the existence of a skeleton, which on removal proved to be virtually complete. One tooth, lost after discovery, is missing, as are the nasal and some of the smaller bones, such as those of one hand and the feet.

Minnesota is the centre of an area of some thousand miles in extent which, as a zone of terminal moraines and a 'driftless area,' would have been peculiarly favourable for the existence of glacial man. The ancient glacial lake system to which belong the deposits in which the skeletal remains were found is of late Pleistocene date. This area would have been readily accessible to early man entering America by either the Arctic coast or the Yukon valley, and thence coming south-eastward along the Mackenzie River and on the east of the Rocky Mountains, and thereafter in a generally eastward direction along the Missouri River. Hence access could readily be gained to the various centres in America in which forms of aboriginal culture developed later.

The skeleton as a whole, as already mentioned, is very complete. It is that of a sub-adult female of about fifteen years. The bones are mineralized, and little affected by the silt in which they lay. There can be no question of a modern burial, and the supposition is that the young woman was drowned in glacial Lake Pelican about half a mile from the foot of the glacier, possibly having fallen through the ice.

The characteristics of the cranium are not distinctively primitive in type, except in the backward extension of the skull and the 'houseboat' shape, which is also characteristic of the Australian and Eskimo. The cephalic index, 77.09, distinctly mesocephalic, and therefore higher than in the Mousterian and Aurignacian types, and the head-height indices are not very distinctive of race, falling in the median categories, which may be found in all the great groupings of mankind. The cranial vault shows a number of primitive characters, of which the more noteworthy are the prominent glabella, the absolutely and relatively long temporal margin of the parietal bone, the low index of the squamous portion of the temporal bone, the high position of theinion above

the Frankfort plane, and the flatness of the nuchal area. A number of unique or unusual features are shown, such as the U-shaped grooves of the occiput and the columnar form of the bases of the pterygoid processes.

The face as a whole shows an important primitive characteristic in the marked alveolar prognathism combined with mid-facial orthognathism. In this it most closely resembles neanthropic palaeolithic Europeans. In other measurements and indices the resemblance is nearest to the Mongoloid and White groups. As contrasting with certain Amerindian groups, it is both higher and narrower; yet it is within the group means of Algonkians, and in breadth within the range of the Siouan group. In orbital index the specimen falls with the Mongoloids; while the interorbital breadth and index are Mongoloid. The nasal index is closest to the White, yet certain of the Mongoloid groups have similar indices. The forward thrust of the maxilla is Mongoloid; while the mandibular index is closer to that of the Australians than of any other living race.

The teeth exhibit important primitive characters. They are absolutely large in every respect. In the relative length of the lower molars the third is the greatest, which gives them a unique formula. The cusps of none of the molars show any reduction in number, and they retain the primitive crown patterns. The shovel-shaped upper incisors, though characteristic of the modern Mongoloids, seem to be a primitive character.

The stature as computed from the long bones is 1,582 mm. (Manouvrier) or 1,540 mm. (Pearson). This, on Manouvrier's method, is slightly above the average for females generally, which is 1,530-1,539 (Martin). The figure is above the Mongoloid average, which is generally lower than European and Negro.

Artefacts were found with the remains. The clam shell crushed by the grader has been identified as *Lampsilis siliquoides*. As this lay above the frontal bone it may have been part of the headdress. An antler dagger, broken at the time of discovery, lay to the right of the right humerus, and has been identified as part of the time on the main beam of an elk antler. It is 196 mm. in length and had been fashioned by a coarse cutting implement. Its butt end is perforated. A conch shell pendant was found among the ribs and vertebrae in the abdominal area. At the second re-digging of the site sixty fragments of turtle carapace were recovered, also fragments of antler, metatarsal of a loon, toe bones of a bird's foot, a wolf's tooth, and the calcaneum of a rodent. The whole possibly was a 'medicine' outfit.

The general deductions are that the skeleton named 'Minnesota man' has been found geologically documented in undisturbed sediment of late Pleistocene origin in the area immediately east of the Big Stone Moraine of the Wisconsin glacier; and that the measured and observed morphological characters of this skeleton proclaim it to be a primitive *Homo sapiens* of an early type of evolving Mongoloid, already prophetically suggesting American aborigines, especially the Eskimo, more than the present Asian Mongoloids, and living in west central Minnesota about twenty thousand years ago in late Pleistocene times.

* Pleistocene Man in Minnesota: a Fossil *Homo Sapiens*. By Dr. Albert Ernest Jenks. With a Chapter on the Pleistocene Geology of the Prairie Lake Region, by Dr. George A. Thiel. Pp. xiv+197. (Minneapolis, Minn.: University of Minnesota Press; London: Oxford University Press, 1936.) 34s. net.

Naval Architecture and Engineering

A SAILING yacht, being designed to attain the highest speed without the usual restrictive commercial considerations, provides an opportunity for the development of the ideal form of hull. If this is nicely balanced, the yacht keeps her course when heeled over, whereas if, on heeling, she tends to change course, she becomes a difficult boat to steer and can be described as unbalanced. In "A Law of Hydrostatics and its Influence on the Shapes of Sailing Yachts"—a paper read at the spring meeting of the Institution of Naval Architects held in March—Engineer Rear-Admiral Alfred Turner dealt with this question of balance. On heeling, the hull displaces an unsymmetrical volume of water, and may be considered as resting on the line of centres of buoyancy described as the metacentric shelf. This line does not form a plane curve; it may be very irregular, and from its irregularities there may arise a variable tendency to alter course according to angle of heel. The author investigates this by poising transparent paper patterns of a set of cross-sections and, after setting out Bouguer's law of balance with slight modifications, explains, by reference to the characteristics of some thirty-six vessels of which diagrams are given, the rules he has formulated.

In another paper, "The Development of the Two-stroke Cycle Oil Engine", read at this session, Mr. W. S. Burn, treating the subject from the marine point of view, explained its advantages over the four-stroke type in offering a cheaper, smaller, lighter and more efficient unit. The feature of first importance in its design is the evolution of a satisfactory method of scavenging, a process which has to be completed during the small movement of the piston and the small interval of time in which the exhaust ports are open. By means of a set of diagrams illustrating successful systems in use, the author explained their merits and classified them as uniflow or double-flow types. Scavenging being satisfactorily provided for, the two-stroke engine is shown to present, in other respects, a simpler problem for the designer owing to the greater freedom in arranging the combustion chamber, the cylinder head and piston crown, on each of which useful comment was made.

Marine steam boilers have, in the past, been regarded as immune from what is known as 'caustic embrittlement', but as in recent years a few cases have occurred in which the shells were found to be seriously affected and were condemned as unfit for further service, the problem has demanded the attention of marine engineers. The term is more picturesque than accurate, but the nature of the attack is characteristic and well defined, taking the form of intercrystalline fracture due to chemical action occurring only at the seams where two surfaces are in contact, and when the water is strongly alkaline and low in sulphates. The cracks follow the grain boundaries and are not transcrystalline as in the case of fatigue fractures. These points were illustrated by photomicrographs in a paper entitled "Note on the Chemical Intercrystalline Fracture of Riveted Joints in Boilers" read by Dr. S. F. Dorey, in which also he showed how the cracks in several joints examined were found to extend along the lines of rivet holes and along radial lines from these holes, invariably on the faces in contact.

While these results have always occurred in cases in which caustic soda was present, recent investigations suggest that the actual cause is the presence of sodium silicate in the soda or other chemicals used in the boilers. As soda was used in boilers long before caustic embrittlement was spoken of, the author thinks that possibly some difference in the method of manufacture of soda during the last thirty years may account for it and suggests that particulars of the analysis of the earlier supplies of soda may give some hint. He advises that care should be taken that nothing containing sodium silicate should be used in the treatment of boiler water and that, where soda is necessary, no more should be used than will maintain a neutral condition.

Science News a Century Ago

The Morse Recording Electric Telegraph

ON October 3, 1837, Samuel Finley Breece Morse, of the American artist and professor of the "Arts of Design" at the New York City University, filed in the United States Patent Office a "Caveat" comprising: "1st, a system of signs by which numbers and consequently words and sentences are signified; 2nd, a set of type adapted to regulate and communicate the signs, with cases for convenient keeping of the type, and rules in which to set up the type; 3rd, an apparatus called a port-rule for regulating the movement of the type-rules, which rules by means of the type in their turn regulate the times and intervals of the passage of electricity; 4th, a register which records the signs permanently; 5th, a dictionary or vocabulary of words numbered and adapted to this system of telegraph; 6th, modes of laying the conductors to preserve them from injury."

Morse was born in 1791. He was the eldest son of Jedidiah Morse (1761-1826), "the first American geographer". Educated at Yale College, he determined to be a painter, and at the Royal Academy in London in 1813 exhibited his picture "The Dying Hercules". During 1829-32 he paid his second visit to Europe, studying art in France and Italy, and it was on his passage home in the sailing ship *Sully* that, after a conversation on the possibility of sending electric currents along wires, he conceived the "Morse code". He had little scientific knowledge, but at the New York City University was assisted by Leonard W. Gale, professor of chemistry, who was acquainted with the work of Henry.

On September 4, 1837, with an apparatus made by Morse, a continuous dispatch was effected in the form of V-shaped lines inscribed on a paper fillet, consisting of the numbers "215-36-2-58-112-04-01837" which, interpreted by a numbered vocabulary, made the phrase "successful experiment with electric telegraph, September 4, 1837". Early in 1838, Morse discarded the numerals and employed an alphabet of 'dots and dashes'.

The Thermo-electric Light

IN the *London and Edinburgh Philosophical Magazine* of October 1837 is a communication from Francis Watkins, a partner in the firm of Watkins and Hill, opticians and philosophical instrument makers, of 5 Charing Cross, in which he says: "I

hope you will allow me to make known in your forthcoming publication a fact in thermo-electricity which I have observed since my last communication to you, and which I believe has not been noticed in print in this or any other country.

"With a pair of metallic elements, consisting of one bismuth and one antimony, weighing each five grains and measuring 0.5 of an inch long and 0.12 diameter, when their extremities were unevenly heated, I have obtained with a Henry's flat ribbon coil, a very perceptible and brilliant spark.

"I have had the pleasure of showing the experiment to MM. De la Rive, Plateau and Netschayef, and I need not add that these distinguished philosophers were much delighted on seeing the thermo-electric light developed by a single pair of metallic elements."

Medical Mission to China

THE following announcement is contained in the *British and Foreign Medical Review* of October, 1837: "The London Missionary Society is desirous of finding medical men adapted to execute its benevolent designs for the improvement of the vast and interesting population of China. To candidates properly qualified such an undertaking must be highly attractive. In a scientific point of view China presents a field of observation of great variety and extent. With slight exceptions the state of medical knowledge is extremely low and defective, and notwithstanding their inordinate national vanity, many of the inhabitants are beginning to recognize the superiority of Europeans in this as in many other departments. A competent endowment of medical science and more especially a talent for operative and ophthalmic surgery, would be a sure passport of popularity and reputation under such circumstances; and we can hardly imagine a situation more calculated to excite and gratify the honourable ambition and philanthropic feelings of generous and adventurous work."

The Medical Literature of Norway.

THE following extract is taken from a paper in the *British and Foreign Medical Review* of October, 1837, by Prof. Frederik Holst, professor of medicine at the Royal Frederik's University at Christiania: "The medical literature of Norway is but of small extent, and will probably always continue such in proportion to the population; as the latter is not great, the medical practitioners are but few, and the language of the country is understood by very few out of Scandinavia. Consequently, neither the medical man who might feel inclined to come forward as an author, nor the bookseller who is able to undertake the cost of printing the work, has the same encouragement as in other countries. It would therefore be unjust to consider the paucity of literary productions in that country as a proof of the incompetence of its medical men. The facilities of communication with other countries makes them pretty soon acquainted with foreign publications on subjects in their department; and in Norway there is no well-informed practitioner who does not take one or more of the best foreign medical journals, and procure the more important works by foreign medical writers. The medical works that have appeared in Norway have, in almost every instance, been called forth by particular occasions, or possess merely a private or local interest."

Societies and Academies

Paris

Academy of Sciences, July 26 (*C.R.*, 205, 265-300).

NIKOLA OBERRECHT: The solutions of a system of linear finite difference equations of the first order with constant coefficients.

JEAN LEBRAY: Discussion of the problem of Dirichlet. FOLKE ODQVIST: Complete equations of equilibrium of thin elastic skew layers.

GEORGES CARPANI: The dissociation constants of d-glucosascorbic acid and of its product of oxidation by iodine. The absorption ultra-violet spectra of d-glucosascorbic acid.

HENRI MOURNU, MICHEL MAGAT and GEORGES WETROFF: The Raman spectra of the two forms of phosphorus pentachloride. From the study of the Raman spectra of phosphorus pentachloride in the solid and liquid states, it is found that this substance has two distinct molecular forms, changing from one to the other on fusion. The partially fused substance shows the two spectra superposed. In liquid form the molecule possesses the symmetry of a trigonal bipyramid; the Raman spectrum of the solid form can be interpreted in more than one way. The Langmuir formula $(PCl_4) + Cl$ is consistent with the results.

MOISE NEUMANN and PAUL TOUTAKIN: The dissociation of peroxides and the cold flames of hydrocarbons. Experiments confirming the theory of Alivazov and Neumann on the formation of cold flames during the oxidation of hydrocarbons, the intermediate oxidation product being a peroxide.

MILLE. ALICE LACOURT: The volumetric micro-estimation of oxygen (ter Meulen method).

FÉLIX FRANÇOIS and MILLE. MARIE LOUISE DELWAULLE: The isothermal decomposition of the nickel peroxides.

DINAH ABRAGAM and YVES DUBOIS: The fixation of hypochlorous acid on phenylbutadiene and the isomerization of the corresponding epoxide into phenylcrotonaldehyde.

MIGUEL POCTIVAS and MILLE. BIANCA TCHOUBAR: The action of C_2H_5MgBr and of $MgBr$, on the oxide of dimethylstyrolene.

EDOUARD ROCH: The Oligo-Miocene of the southern slope of the Moroccan Haut-Atlas.

RUNÉ ABRAH and EDGAR AUBERT DE LA RÔLE: The presence of the Pliocene at the island of Malekula (New Hebrides).

DANIEL AUGER: Complex pulsations of the action current produced in *Nitella* by the action of certain buffer substances.

ROBERT ECHOUVIN and ARTHUR BRUNEL: Ureides and free urea, the degradation of the purins in *Soja hispida*.

YVES LE GRAND and EUGÈNE GIBLIEWICZ: Fluttering in lateral vision.

ERNEST FOURNIEAU, M. and MME. JACQUES TRÉFOUIL, FÉDÉRICQ NITTI and DANIEL BOVET: The chemiotherapy of pneumococcus infection by di(p-acetylaminophenyl) sulphone (1399F).

Calcutta

National Institute of Sciences of India, August 27-28.

R. N. CHOPRA: Therapeutics of antimalarial drugs.

A. C. BANERJEE: Urban malaria in the United Provinces.

R. B. LAL: Methods of forecasting malarial epidemics.

FROILANO DE MELLO: Malaria in Portuguese India.
R. SENIOR WHITE: Physical factors in mosquito ecology.

W. O. SWENY: Irrigation and malaria.
T. A. CURRY: Flood and flush schemes in Bengal.
F. O. GRIFFIN: Surface and subsoil drainage.
S. G. MASILLAMANI: Irrigation and malaria in the Madras Presidency.

M. O. T. IYENGAR: Topography of land in relation to malaria.

P. SEN: *Anopheles ludlowii* survey in and around Calcutta.

G. C. CHATTERJEE: Malaria and its relation to agriculture in India.

M. K. AFRIIDI: Antimalarial operations in Delhi.
B. A. RAO: Control of anopheline breeding in irrigation channels by Paris green.

J. D. SINHA: Drug prophylaxis in malaria by the use of quinine and plasmoquine in the field.

K. V. KRISHNAN: The spleen and resistance to malaria and hæmoglobinuria.

K. L. CHOWDHURY: Mosquito control in Calcutta.

G. C. CHATTERJEE: Larvivorous fish.

S. L. HORA: Larvicidal fish.

R. N. CHOPRA: Experimental studies on ape malaria with reference to its use in therapy for nervous conditions.

B. B. DIKSHIT: Pharmacology of plasmochin with special reference to its action in pregnancy.

K. V. KRISHNAN: Biochemical changes in the blood of monkeys developing malarial hæmoglobinuria and their significance in the etiology and treatment of blackwater fever in man.

B. M. DAS GUPTA: Transmission of *P. vivax* to man.

M. O. T. IYENGAR: Natural parasites of mosquitoes in India.

S. L. HORA and K. K. NAIR: Observations on the nutrition of *Panchar panchar*.

A. G. FRASER: Observations on the bionomics of *Panchar panchar*.

H. N. RAY: The development of bird malaria parasites in endothelial cells.

D. N. ROY: Salt water *rossi* as a malaria carrier.

M. N. DE: The pathology of malarial spleen.

Moscow

Academy of Sciences (*O.R.*, 15, No. 6-7; 1937).

I. M. VINOGRADOV: Representation of an odd number as a sum of three primes.

D. MENŠOV: The series of orthogonal functions limited in their totality.

A. A. IVANOV: The most probable orbit of the small planet (122) Gerda, from observations at thirty-four oppositions from 1872 to 1934.

M. KURNEKIJ: Fundamental formulae for the calculation of elements of a trajectory of the centre of gravity of a projectile.

V. FURDUJEV: A method of acoustical design of rooms equipped with loud speakers.

S. LIFSHITZ: Experimental investigations of reverberation optimum for different frequencies.

W. W. SHOULSKIN: The principles of the monsoon theory.

L. A. TUMERMANN and V. ŠYMANOVSKIJ: A fluorometer based on the effect of Debye and Sears.

K. S. LVALIKOV: Experimental verification of the Thomson formula.

N. S. KURNAKOV, G. B. BOXIJ and I. N. LEPEŠKOV: Kainite and polyhalite in salt deposits of the Soviet Union.

V. I. NIKOLAJEV, O. K. JANATJEVA and V. D. POLJAKOV: The potassium deposits on the right side of the Volga and in Kalmykia.

I. I. ČERNIAJEV and V. I. GOREMYKIN: (1) Hydroxylamine-pyridine compounds of bivalent platinum. (2) Oxidation of hydroxylamine compounds of platinum.

F. M. ŠEMIČKIN: The reactions of rare earths and allied elements with pyrogallol, gallic acid and morphine (5).

A. I. ZUSTIN: Influence of temperature contrasts on the frequency of lethal mutations in *Drosophila melanogaster*.

A. M. GROSSMAN: The elimination of super-numerary chromosomes in *Zea mays*.

I. SOKOLOV: The chromosomes in the spermatogenesis of the domestic ass.

V. I. TOVARNITSKIJ and T. L. RIVKIND: Hormonization of seeds. Treatment of seeds with a solution of equine urine, known to contain substances of hormone nature, resulted in an increase in the yield of grain up to 60 per cent.

B. S. ZAKHAROV: The problem of vernalization of *Perilla*.

T. T. DEMIDENKO and N. P. MARTYNOV: The effect of the osmotic pressure of soil solution on the yield and composition of sugar-beet.

T. T. DEMIDENKO and V. P. GOLLE: The influence of light on the inflow of nutrient substances in plants.

N. V. NASSONOV: The effect of the subcutaneous insertion of epithelial, osseous and muscular tissues on the surrounding tissues in axolotls.

L. V. POLESKAEV: The determination of a regenerating extremity in axolotl.

A. M. VASJUTOČKIN: Some derivatives of the epithelial framework of the thymus gland of an amphibian.

A. A. VOTKHEVIČ: Morphogenetic activity of different parts of the hypophysis. (3) The influence of different zones of the anterior lobes of hypophysis on the thyroid gland of Amphibia. (4) Inhibition of metamorphosis of tadpoles by the substance of the "eosinophilous zone" of the anterior lobes of the hypophysis.

S. M. ANDRONOV: *Gigantella* Sars and its stratigraphic importance in the Lower Carboniferous deposits of the middle course of the Ishim River.

Rome

National Academy of the Lincei (*Atti*, 25, 149-196; 1793).

E. BOMPIANI: Construction of surface elements starting from curvilinear elements.

G. GIORGI: A method for calculating distortion effects in telegraph and telephone wires.

W. BLASCHKE: Invariants of complexes.

E. BOBTOLOTTI: Moutard's quadratics and the canonic bundle.

R. CALABRO: Some surfaces of the third and fourth order.

W. DOMBLIN: Continuous case of chain probabilities.

G. ARRIGHI: Observations on the Newtonian motion of any two masses.

L. MARTINELLI: Luminosity of the images which appear in a telescope.

G. OCCHIALINI: Gamma radiations of polonium-beryllium.

A. BARONI: Non-existence of bismuthous bromide, BiBr₃.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT WATER ENGINEER in the County Borough of Croydon—Town Clerk, application forms from Borough Engineer (October 5).
JUNIOR ASSISTANT in the Development Department, British Non-Ferrous Metals Research Association, Regent Buildings, Huston Street, N.W.1.—Secretary (October 8).

LECTURER IN BACTERIOLOGY in the Faculty of Medicine, University of Birmingham.—Secretary (October 9).

LECTURER IN CIVIL ENGINEERING at University College, Nottingham.—Registrar (October 15).

BROOKS ASSISTANT ENGINEER to the Rivers Mersey and Irwell Catchment Board—Engineer to the Board, Carrington Lane, Sale, Cheshire (October 16).

ASSISTANT (biology) in the Museum and Art Galleries, Paisley—The Clerk to the Committee, Young, Martin and Sayers, 4 St. Mirren Street, Paisley (October 20).

ASSISTANT DIRECTOR OF FISHERIES in the Straits Settlements—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, S.W.1 (October 31).

SIR HENRY ROYCE RESEARCH FELLOWSHIP for work on the common cold or on influenza—Registrar, The University, Manchester, 18 (October 31).

PROFESSOR OF SOCIAL SCIENCE in the University of Liverpool—The Registrar (November 15).

JUNIOR LECTURER and a **LECTURER IN ZOOLOGY** in the University of Cape Town—Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.O.2 (November 15).

TWO RESEARCH FELLOWSHIPS relative to the causation and pathology of rheumatic disease—Secretary, Empire Rheumatism Council, 1 Mire Court Buildings, Temple, M.O.4 (November 15).

TWO SENIOR ELECTRICAL ENGINEERS (temporary) at the Headquarters of the Air Ministry, Adastral House, Kingsway, W.O.2—Secretary (W.9).

ELECTRICAL ENGINEERS (temporary) in the Directorate of Works, Air Ministry, Adastral House, Kingsway, W.O.2—Secretary (W.9).

ASSISTANT MECHANICAL ENGINEER in the Locomotive, Carriage and Wagon Workshops of the South Indian Railway Co., Ltd.—Messrs Robert White and Partners, 3 Victoria Street, S.W.1.

Official Publications Received

Great Britain and Ireland

Seachtú Mheán: Roinn Talmhaíochta (Department of Agriculture): *Brannse Iascaigh (Fisheries Branch). Statistics of Salmon, Sea Trout and Eels captured during the Years 1936, 1935, 1934, 1933 and 1932.* (P. No. 2637.) Pp. 16. (Dublin: Stationery Office.) 3d. [109]
Britain's New Forests. Pp. 12. (London: Forestry Commission.) [109]

Chelsea Polytechnic. Prospectus, Session 1937-38. Pp. 61. Chelsea School of Art: Prospectus, Session 1937-38. Pp. 16. Chelsea College of Physical Education: Session 1937-38. Pp. 14. Chelsea School of Pharmacy: Prospectus, Session 1937-38. Pp. 19. Chelsea School of Cookery, Housecraft, Dressmaking and Millinery: Prospectus, Session 1937-38. Pp. 10. Chelsea School of Chiropractic: Prospectus, Session 1937-38. Pp. 14. Chelsea School of Metallurgy: Prospectus, Session 1937-38. Pp. 18. (London: Chelsea Polytechnic.) [109]

British Film Institute. Science Teaching Films: a Report presented to the Governing Body of the British Film Institute by the Science Committee of the Education Panel. Pp. 44. (London: British Film Institute.) 6d. [159]

Queen Mary College (University of London). Calendar, Session 1937-1938. Pp. 238. (London: Queen Mary College.) [159]

Amgueddfa Genedlaethol Cymru: National Museum of Wales Humphrey Llwyd's Maps of England and of Wales. By Dr. F. J. North. Pp. 59+5 plates. (Cardiff: National Museum of Wales.) 1s. [159]

Medical Research Council. Seventeenth Annual Report of the Industrial Health Research Board to 30th June 1937. Pp. iii+80. (London: H.M. Stationery Office.) 6d. net. [159]

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig Keeping. Pp. 62. (London: Bacon Development Board.) 2s. [159]

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 1, No. 5: Metamorphic Correlation in the Polymetamorphic Rocks of the Val de Rhodan, Unst, Shetland Islands. By Dr. H. H. Read. Pp. 196+221+3 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4s [159]

Vitamin D in Cacao Shell (Commercial Cacao Bean Shell): Reports on Recent Researches, including Investigations into its Use as an Accessory Food. Reprinted from various publications and edited by A. W. Knap. (Technical Series, No. 23.) Pp. 64. (Bournemouth: Publication Department.) 1s. [179]

Technical Publications of the International Tin Research and Development Council. Series B, No. 5: Fusible Alloys containing Tin. By H. J. Daniels. Pp. 24. (London: International Tin Research and Development Council.) Free. [179]

Royal Technical College, Glasgow. Calendar for the One Hundred and Forty-second Session, 1937-1938. Pp. 522. (Glasgow: Royal Technical College.) [189]

Other Countries

Instituto Nacional de Tecnologia. Estudos sobre conforto termico no Brasil: O termometro resultante de Mismard. Pelo Paulo Sá. Pp. 24. *Estudos sobre o conforto termico e o conforto visual no Brasil.* Pelo Paulo Sá. Pp. 43. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [89]

British East African Meteorological Service. Annual Report for the Year 1936. Pp. 8+4+2+2. (Nairobi: B.E.A. Meteorological Service.) [89]

Expédition Antarctique Belge. Résultats du voyage de la Belgique en 1897-99. Rapports scientifiques. Zoologie—Ornithologie. By D. Dhuyssens. Pp. 11. (Anvers: J.-B. Bouschmann.) [109]

Ceylon. Part 4. Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1936. By A. H. Malpas. Pp. vi+9. 20 cents. Part 4: Education, Science and Art (G). Administration Report of the Marine Biologist for the Year 1936. By A. H. Malpas. Pp. vi+2. 15 cents. (Colombo: Government Record Office.) [109]

Scientific Publications of the Cleveland Museum of Natural History. Vol. 7: The Birds and Mammals of the Western Slope of the Asuero Peninsula (Republic of Panama). By John Warren Aldrich and Benjamin Patterson Bole, Jr. Pp. 196. (Cleveland, Ohio: Cleveland Museum of Natural History.) [159]

U.S. Department of the Interior. Office of Education. Bulletin, 1937, No. 5: Insurance and Annuity Plans for College Staffs. By Sherman H. Flanagan. Pp. vi+83. (Washington, D.C.: Government Printing Office.) 10 cents. [159]

Cornell University: Agricultural Experiment Station. Bulletin 665: A Study of Price Differences in Retail Grocery Stores in New York State. By Lella Doman. Pp. 52. Bulletin 666: Body of Cultured Cream. By E. S. Guthrie. Pp. 12. Bulletin 667: Soils in relation to Fruit Growing in New York. Part 10: Susceptibility of various New York Orchard Soils in reduction upon Water-logging. By Michael Peck and Damon Boynton. Pp. 20. Bulletin 668: An Economic Study of Land Utilization in Genesee County, New York. By J. N. Heferson. Pp. 42. Bulletin 669: Marketing Apples in the Champlain Valley. By G. P. Scoville. Pp. 41. Bulletin 670: An Economic Study of Grape Farms in Schuyler and Yates Counties, Crop Year 1935. By H. G. Mener. Pp. 27. Bulletin 671: Economic Studies of Vegetable Farming in New York. 1: Market-Garden Farms with Greenhouses, Rochester Area. By G. A. M. Baptist and H. G. Mener. Pp. 51. Bulletin 672: Soils in relation to Fruit Growing in New York. Part 11. The Organic-matter Content of New York Orchard Soils in relation to Orchard Performance. By Ralph W. Cummings. Pp. 26. (Ithaca, N.Y.: Cornell University.) [159]

University of California Publications in American Archaeology and Ethnology. Vol. 37, No. 4: Culture Element Distributions. 4: Pomo. By R. W. Gifford and A. L. Kroeber. Pp. 117-254. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1.50 dollars. [159]

Department of Agriculture: New South Wales. Science Bulletin No. 55: Plant Breeding in New South Wales—Tenth Year of Progress, 1935-36. Pp. 56. (Sydney: Government Printer.) [159]

Commonwealth of Australia. Council for Scientific and Industrial Research. Bulletin No. 107: A Soil Survey of the Coomera, Wentworth (Cudswa), and Pomona Irrigation Settlements, N.S.W. By T. J. Marshall and Dr. Allan Walkley. Pp. 43+3 plates. Pamphlet No. 70: Further Observations on Soil Erosion and Sand Drift, with Special Reference to South-Western Queensland. By F. N. Ratcliffe. Pp. 28+6 plates. (Melbourne: Government Printer.) [159]

The Carlsberg Foundation's Oceanographical Expedition round the World, 1928-30, and previous Deep-Sea Expeditions. Deep-Sea No. 9: Contributions to the Life Histories of the Deep Sea Fish, *Synbranchius*, by Anton F. Brumm; Deep-Sea No. 10: Les poissons abyssaux du genre *Ophichthys* Günther (Anatomie, embryologie, biologie), par Dr. Léon Bertin; Deep-Sea Report No. 11: Les octopodes de la croisière du Deep, 1931-32, par Prof. Louis Joubin. (Published by the Carlsberg Foundation.) Pp. 33+30+50. (Copenhagen: O. A. Reitzels Forlag; London: Oxford University Press.) 12.50 kr.; 11s. [159]

The Rockefeller Foundation. Annual Report, 1936. Pp. iv+461. (New York: The Rockefeller Foundation.) [159]

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, No. 52: Scientific Irrigation Management; a Review of Investigations on Plant and Water Relations, the Waialua Irrigation Investigations, the Administration of Plantation Irrigation Water. By H. B. Shaw and J. A. Sweeney. Pp. 199-279. (Honolulu: Hawaiian Sugar Planters' Association.) [159]

U.S. Department of Agriculture. Farmer's Bulletin No. 1777: Diseases of Fur Animals. By J. H. Shillinger. Pp. ii+22. 5 cents. Miscellaneous Publication No. 258: Annotated List of the Insects and Mites associated with Stored Grain and Cereal Products, and of their Arthropod Parasites and Predators. By R. T. Cotton and N. H. Good. Pp. 81. 10 cents. (Washington, D.C.: Government Printing Office.) [179]

Malta. Annual Report on the Working of the Museum Department during 1936-37. Pp. xxvi. (Malta: Government Printing Office.) [179]

Rutgers University Bulletin. Vol. 14, No. 2A (Studies in Education, No. 11): Educational, Psychological and Personality Tests of 1936; including a Bibliography and Book Review Digest of Measurement Books and Monographs of 1933-36. By Oscar K. Buras. Pp. 141. (New Brunswick, N.J.: Rutgers University.) 75 cents. [189]

Smithsonian Institution: Bureau of American Ethnology. Bulletin 115: Journal of Rudolph Frederick Kins; an Account of his Experiences among Fur Traders and American Indians on the Mississippi and the Upper Missouri Rivers during the Years 1846 to 1853. Translated by Myrtle Jarrell. Edited by J. N. B. Hewitt. Pp. ix+328+48 plates. (Washington, D.C.: Government Printing Office.) 60 cents. [189]

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SATURDAY, OCTOBER 9, 1937

Vol. 140

State Intervention and Agriculture

STATE intervention in a particular industry is one of those subjects which most probably would have been rejected by the Council of the British Association had it not happily decided to include within its ambit the interactions of science and the life of the people. It is true that this development tends to bring the sciences into closer touch with economics and politics, but one day economics may be established as a fully inductive science, and knowledge obtained by impartial scientific inquiry will be the basis of political action.

State intervention is increasing everywhere, and for reasons which are not far to seek. Industrial and social relations generally have multiplied so greatly and become so exceedingly complex that only a supreme authority can co-ordinate them. An industrial system based upon the law of the jungle is no longer regarded either as ethical or efficient. Morality has not kept pace with material progress, and the basest uses are being made of some of the fruits of science and invention. The view that the functions of the State should be restricted to protecting its citizens against external aggression and maintaining justice between them is still valid if we accept a wider connotation of the word 'justice'. Probably most of us now consider it right that the State should control the conditions of industrial competition; that it should abolish privilege as a right to which no corresponding function is attached; that it should so far as possible give equal opportunity to all; and many think that it should secure to every worthy citizen a sufficiency of the basic necessities of life—wholesome food, clothing, shelter and facilities for re-creating mind and body.

Opposed to this growing recognition of the need for extended State action is the inborn longing

for individual freedom, and one of the major problems of civilization is how to reconcile the freedom required for individual development and self-expression with the restraints which the State must impose to save itself from anarchy and disruption, and to give every citizen a fair deal. No one with any faith in the future believes that these two ideals are fundamentally incompatible. Science, art and industry provide the knowledge and the means for attaining a full, free and happy life; and yet it eludes us—probably because the necessary emotional stimulus is lacking. The older religions no longer seem able to impart this stimulus. Can devotion to high ideals of conduct and attainment take their place? Man began by being a slave to his environment; he acquired the elements of freedom when he learned to adapt himself to it, and to co-operate with his fellows; his freedom grew as science taught him how, in a measure, to control his environment; it will grow still more as he learns to control himself and develop a social conscience. *Laissez-faire* is on its death-bed; State intervention, regulative, controlling or dominating is taking its place. To many it is a necessary evil, but it will persist so long as individuals and communities play a lone or selfish hand. The ecclesiastics who demand a 'change of heart' are right: "The solid ground of nature"—like patriotism—is not enough.

The incongruity of State regulation or control and personal freedom, in relation to agriculture, was well brought out by Mr. J. M. Caine in his presidential address to Section M (Agriculture) of the British Association. As assistant secretary to the Department of Agriculture for Scotland, his pronouncements were necessarily guarded, but it was clear that, although he recognizes the

inevitability of State intervention in existing circumstances, he deploras its extension, believing with the fourteenth century poet, Barbour, that "Freedom is ane noble thing". Liberation, if only partial, waits on the return of economic prosperity, and the road thereto lies in securing for farmers a fair share of the home market, and in inducing them to eat of the fruits of education and research. The personal factor, he is convinced, is still extremely important, and the progressive farmer is usually the last to seek aid from the State.

The trouble here is that it has always been found difficult to induce farmers, as a class, to adopt the innovations indicated by scientific research (Australian farmers took to the use of superphosphate twenty-five years after its value had been demonstrated). Great Britain possesses some research institutions of the highest class and a goodly number of well-equipped agricultural colleges and farm institutes, yet farmers fail to take full advantage of them. We have some of the best farmers in the world, but, according to high authorities, our general standard of farming is relatively low. In recent years farmers have had to contend with very low prices for their produce, and many of them have not been able to afford the purchase of new equipment; but prices are now better, and the time now appears opportune for making an organized effort to 'put over' to the rank and file of farmers the practical results of recent research. Farm-equipment, seed-dressing, grassland management, fertilizers and composts, ensilage, grass-drying, and farm accountancy are all subjects in which progress has been made and to which the farmers' attention should be directed. This question is of very wide import and might well be discussed at a future meeting of Section M.

No one will deny that the Ministry of Agriculture has been alive to the hardships and responsive to the importunities of farmers; with its aid the production of sugar-beet has increased from 102,000 tons in 1923 to 3½ million tons in 1936-7, and that of wheat by 44 per cent since 1932. It is now extending its protection to growers of barley and oats, and—what is more important—is coming to grips with the fundamental problems of maintaining the fertility of the soil, by paying half the delivered cost of lime and one quarter that of basic slag; and improving the health of livestock, by instituting a vastly extended veterinary service. Less directly, the Government has assisted agriculture by fathering the establishment of marketing boards for milk, potatoes, hops and bacon, and of

a commission for fat cattle. These boards have, in the main, succeeded in enabling producers to get better prices, in mitigating the effects of violent price fluctuations, and in controlling the quality of certain marketed produce. On the other hand, some of the schemes are exceedingly complicated and require an army of officials and employees to work them, whilst the criticism is often heard that consumers' interests have not been adequately safeguarded; for example, the price of milk for liquid consumption is held to be excessive. In Germany the cost of distributing milk is stated to be only about one half of what it is in Great Britain, so that by adopting a system of State control from cow to consumer similar to the German, we might save £10,000,000 a year on this item alone. Nothing appears to have been done to reduce the lamentable 'spread' between producers' and consumers' prices, and the conviction is growing that the Government must be driven to tackle the general problem of distribution and consumption, and to institute a census forthwith.

So far governmental efforts have appeared to concentrate on symptoms and palliatives rather than on radical cures, and legislation has been too piecemeal. Desperate diseases require desperate remedies, and that no doubt is one reason why Sir Daniel Hall, in the inter-sectional discussion at Nottingham on "Planning the Land of Britain", advocated the nationalization of the land, and why Prof. R. G. Stapledon has come reluctantly to the same conclusion in regard to the improvement of our upland pastures. Another urgent problem the solution of which is defying the efforts of the Government, is how to reconcile the demands of home farmers with those of producers in the self-governing Dominions; and no solution to the problem of increasing our supplies of home-grown food to make us secure in time of emergency is yet forthcoming.

These and other problems confronting agriculture and the community are of such magnitude and complexity that no one expects them to be resolved overnight. They transcend the ability of individuals and are therefore rightly passed on to the State. Many of them are of international moment, and most of them bear direct relation to the riddle of how to raise the purchasing power of the masses so as to give them a higher standard of life. The important thing is to rule out drift. Social change, like all change, is ineluctable, but it can be controlled and directed towards social betterment.

Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions

By

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FOR some months we have been recording daily the equivalent heights and reflection coefficients of the F_2 region of the ionosphere, for radio frequencies near to the critical penetration frequency of the region. Under these conditions, the

hours Eastern Australian Standard Time, is reproduced in Fig. 1. For reasons of lack of space, only the most marked period of the disturbance, between 0932 and 0955 is shown in the figure. The heights and intensities are recorded for

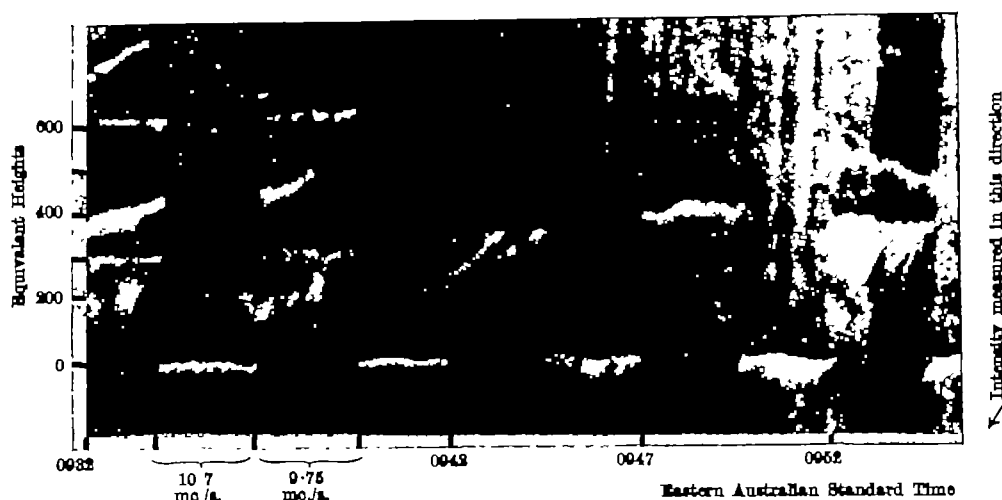


Fig. 1.

EFFECT OF BRIGHT HYDROGEN ERUPTION ON EQUIVALENT HEIGHTS AND ECHO INTENSITIES FROM F_2 REGION OF IONOSPHERE. VISUAL OBSERVATIONS WITH SPECTROHELIOSCOPE IN H_α SHOWED BRIGHT SPOT BETWEEN 0922 AND 0940 HOURS E.A.S.T.

recorded quantities are exceptionally sensitive to small changes in the electron density of the F_2 region.

Examination of our results reveals the frequent occurrence of a type of disturbance which has the following definite features:

(a) the equivalent height rises sharply in a period of a few minutes;

(b) the intensities of the reflected echoes decrease at the same time as (a);

(c) after some minutes the heights decrease and the intensities return to normal;

(d) although the disturbance may now be said to have ended, the F_2 region is left higher than before, although the F_2 electron density has returned to its original value, as evidenced by the separation of the ordinary and extraordinary magneto-ionic components, and other tests.

The record of a typical disturbance, which occurred on May 15, 1937, between 0920 and 1005

periods of 2½ minutes each successively, on frequencies of 9.75 and 10.7 mc./sec. The ground wave appears along the lower edge of the diagram, its intensity being measured by the breadth of the trace downwards and to the left, according to a technique as yet unpublished. It is seen that the ground wave is very weak for the lower frequency, while at 0945 and 0950 the ground wave on the higher frequency appears specially strong. The latter circumstance is due to the observer increasing the sensitivity of the receiver in an unavailing attempt to record echoes at this frequency. At 0932 are seen strong echoes from the F_2 region at equivalent heights of 400 and 295 km. These are respectively the ordinary and extraordinary components into which the wave is split by magnetic double refraction in this region. The doubly reflected echoes are seen above. The intensities of these echoes are indicated in the manner described above for the ground wave.

It is seen that the equivalent heights rise steadily until 0948, when the ordinary wave has penetrated the region while the extraordinary echo is of much reduced intensity. At 0955 the intensity of the extraordinary component is almost normal, but the equivalent height is now 365 km., which is much greater than obtained before the disturbance commenced. The intensity of the ordinary component returned to its normal value at 0957, and the heights returned to normal at 1005. On three occasions, namely, at 1250–1330 April 24, 1140–1220 May 25, and 1200–1300 June 11, the disturbances, while exhibiting all the characteristic features described above, were so pronounced that echoes practically disappeared. On each of these occasions, reference to the La Perouse receiving station of Amalgamated Wireless Australasia, Ltd., revealed that a fade-out of all signals from short-wave transmitting stations throughout Australia had occurred, while only a few overseas transmitters were heard, with greatly reduced intensity.

It is clear, therefore, that so-called 'fade-outs' are due to particularly strong ionospheric disturbances of the type described above.

The non-return of echoes from the ionosphere can be due to (α) a reduction of the electron density in the reflecting region, or to (β) an increase of ionization in an absorbing region. It is clear from the above that (α) does not occur in the F_2 region. For example, the disappearance of echoes on the higher frequency in Fig. 1 must be due to this cause. Calculation by well-established methods¹, of the reduction of the reflection coefficient before penetration occurs, reveals, however, that the observed reduction of ionization in F_2 is not by itself sufficient to account for the observed reduction of echo intensity.

We have obtained further information on this point from records showing equivalent height-frequency curves, which have been obtained automatically at half-hourly intervals with equipment formerly described². On some occasions, when a disturbance has been observed in progress, the operation of this apparatus has been quickened, so that it measured the ionization densities of the various reflecting regions E_1 , E_2 , F_1 , F_2 at five-minute intervals. From the auxiliary data obtained in this way it has been found that almost simultaneously with the reduction of ionization in the F_2 region, there occurs an increase in the ionization of the absorbing D region below 100 km. This is clearly shown by the weakening, and occasional complete disappearance of the E (and F) echoes obtained on low frequencies, although these echoes may be received almost unimpaired on higher frequencies.

It has been shown by Dellinger³ and others that fade-outs sometimes occur almost simultaneously

with bright hydrogen eruptions on the solar disk, although only a small fraction of observed eruptions appear to be effective in this connexion. We find strong evidence that *every* solar eruption observed at the Commonwealth Solar Observatory occurs almost simultaneously with an ionospheric disturbance of the type described above, although only a fraction of these disturbances are large enough to cause a complete 'fade-out'. Thus of forty-four eruptions observed during March–June 1937, forty-one were observed or estimated to begin within ten minutes of the beginning of an ionospheric disturbance, while only three eruptions produced no observable disturbance. It is further to be observed that, in the latter three cases, the eruptions followed closely after the occurrence of an earlier eruption which did produce an ionospheric disturbance. It appears likely, therefore, that in each of these three instances the ionosphere had not recovered from the effects of the earlier disturbance sufficiently to respond to the second eruption.

It is clear that all these effects must be due to sudden bursts of ultra-violet radiation from the eruptive area on the solar disk. In many cases the results show that the normal D region ionization is more than doubled during an eruption, although the eruptive area may be less than $1/2,000$ of the solar disk. It is clear, therefore, that the effective ultra-violet radiation from the eruptive area increases by a factor of some thousands during an eruption. Observations with the spectrohelioscope during eruptions show that the intensity of the first emission line of the Balmer series of hydrogen (H_α) increases by a factor of about ten in the eruptive area, but similar observations in the ultra-violet are, of course, unobtainable owing to atmospheric absorption.

We find very strong evidence that the major effects produced in the ionosphere during an eruption are due to solar emission of the Lyman resonance line L_α (1215.6 Å.) of hydrogen, which must be emitted in great intensity from the eruptive area.

No hydrogen radiation other than L_α is capable of penetrating the earth's atmosphere to the depth of the D region, but Hopfield⁴ has shown that air has just the necessary transparency over a limited spectral region around the wave-length of L_α . Moreover, no solar radiation capable of directly ionizing oxygen or nitrogen is capable of penetrating to the D region. Chapman and Price⁵ have pointed out, however, that the oxygen atom in the ^1S state resonates to L_α radiation (if a few angstroms wide) and is raised to the ^1P state. If a collision occurs in this state, it can lose an electron and 0.75 electron volts, thus reverting to the normal

state of ionized atomic oxygen. For this to happen it is obviously necessary that the life-time of the atom in the ^1P state must be comparable with, or greater than, the mean time interval between collisions. This condition is satisfied in the D region, where the electron collision frequency is approximately 5×10^7 per second. It is not likely to be satisfied in the E or higher regions, so that we should not expect increased ionization in these regions due to L_a radiation. The abundance of oxygen atoms in these regions is beyond doubt.

The decrease of ionization density in the F_1 region during an eruption is also explained by the great increase in L_a radiation. The radio data show conclusively that the region, and the atmosphere below to some yet undetermined level, is considerably heated and expanded during an eruption. This is evidenced by the pronounced rise in the real height of the F_1 region during an eruption, by the reduction of the density of the ionization in this region, by the comparatively rapid recovery of the F_1 ionization due to rapid cooling of the very hot F_1 region, and by the slower recovery of F_1 height due to the slower cooling of the less hot regions below. The work of G. H. Godfrey and W. L. Price, which is in course of publication, shows that in the absence of water vapour these regions would reach an equilibrium temperature of $3,200^\circ \text{K.}$ due to the absorption by oxygen of solar ultra-violet radiation of wave-lengths about $1450 \text{ \AA.}$ It is the presence of water vapour, in concentration of about one part in ten thousand by volume, which keeps the temperature down to the values between $1,000^\circ \text{K.}$ and $2,000 \text{ K.}$ which are found experimentally by Martyn and Pulley* in the F_1 region.

It has been recently shown by Rathenau† that water vapour shows strong absorption bands at the wave-length of L_a , such absorption leading to dissociation of the H_2O molecule into H and OH^* .

It is clear, therefore, that the strong L_a solar radiation during an eruption must dissociate much of the water vapour present in the upper atmosphere, so leading to higher equilibrium temperatures in the ionosphere. The application of Godfrey and Price's calculations shows that these temperatures are attained in a few minutes, and leads to a detailed explanation of the observed phenomena in the F_1 region during an eruption.

The origin of the numerous ionized levels of the ionosphere is still unknown, progress having been impeded by lack of knowledge of the solar radiation in the ultra-violet. The assumption of black body radiation in this region only increases the difficulties of interpretation by providing an infinite variety of ionizing radiation. It is a fortunate circumstance that the increased radiation during an eruption is confined to relatively few wave-lengths, with L_a almost certainly predominant. We believe that the study of the behaviour of the ionosphere while the sun is providing increased energy at these relatively few wave-lengths must greatly increase our knowledge of the normal structure of the ionosphere, and of the normal solar ultra-violet radiation. With this object in view we are now studying the effects of solar eruptions on the E_1 , E_2 , F_1 and G regions, in all of which smaller but appreciable changes occur.

This work is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research, and of the director of the Commonwealth Solar Observatory.

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Geographical and Cultural Regions

A JOINT discussion between members of Section E (Geography) and Section H (Anthropology) was held at the British Association meeting at Nottingham on the subject of geographical and cultural regions. The primary object was to clarify the concepts of regional divisions of the earth's surface from various points of view.

A large measure of agreement on the fundamental principles of regional division from the point of view of the geographer was revealed. Its essential object is to distinguish different environments, and there was no divergence from the view that the most permanent contrasts, and those most

important in relation to human life, are determined by natural factors (position, physical features, structure, climate, soils and vegetation). The total complex of conditions characterizing the personality of any such 'environment region' is, however, in practically every case profoundly modified by man, who must himself be included as one of the creative factors. Entirely 'natural' regions are now comparatively rare; for example, it was pointed out that very little of the tropical forest of Africa is in a true sense primitive. Subject to this qualification, the concept of major natural regions, as worked out at the beginning of the century by

Prof. Herbertson of Oxford, is of great and lasting value.

It is important, however, to distinguish two aspects of regional division. Regional schemes such as that of Herbertson are *generic* in character. A type is defined, based on fundamental criteria of climate and other factors, and its distribution over the earth's surface examined. All the representatives of the type broadly resemble each other in these particular respects and their 'intrinsic conditions' are comparable. But generic classifications of this kind cannot take into account the factor of geographical orientation, which in its influence on the evolution of human societies and the moulding of the *genre de vie* is often quite as important as the intrinsic conditions. The Sahara and the Atacama in Herbertson's scheme both belong to the category of hot deserts; but the geographical position of the Sahara between the Mediterranean lands and tropical Africa has profoundly influenced the evolution of its trading societies and differentiated its human life from that of the Atacama. So, too, while there is a 'Mediterranean' type of climate, vegetation and production, which is found in five or six widely separated parts of the world, the Mediterranean region of the Old World in the sum total of its conditions and in its geographical setting has no real parallel elsewhere.

Thus, apart from generic classifications, the attempt is made by geographers to distinguish what may be termed *specific* regions with a particular location and a combination of conditions found nowhere else. There are different 'orders' of such regions, ranging from the *pays* of France (Beauce, Brie, etc.) to such large concepts as 'Western Europe'. When over wide areas there is found a particular set of intrinsic conditions in combination with a very definite geographical orientation, we have distinctive theatres of human life which are characterized by a series of closely linked physical and human phenomena. Examples of such large 'human provinces', if the phrase may be allowed, are North China (north of the great climatic, vegetational and economic divide of the Tsin-ling shan), the Lower Yang-tze Basin (below the Gorges) and South-East China (south and east of the Nan-ling and its continuations). In such attempts to define large specific regions it is often necessary to recognize transitional zones and to admit that human agency, as in the case of the North German Lowlands in recent times, may change considerably not only the intrinsic conditions but also the value of the geographical orientation.

The discussion at Nottingham on the concept of cultural regions and their relationship to geographical divisions of the earth's surface was mainly negative. On the ground that race,

religion and language are all unsatisfactory and dangerous as criteria, several of the anthropologists present were unwilling to admit the validity of the concept of cultural regions, except in respect of limited areas defined in terms of material culture-traits such as those which Mr. Clark Wissler has determined for aboriginal North America. Owing to its isolation and comparative immunity from new waves of cultural influence, Pre-Columbian North America presented a more favourable field than Asia or Africa for the establishment of relatively stable culture-complexes broadly corresponding to natural 'food-regions'. But even these passed through many phases and interacted in complex ways before the final disintegration caused by the advent of the white man.

Admitting the force of these contentions, the question remains whether it is not still legitimate and indeed important to distinguish regional types of civilization. A notable passage in Mr. R. F. Hudson's scholarly work on "Europe and China" is worth recalling:

"There is a hierarchy and ranking of nationalities in accordance with degrees of community or separateness in cultural inheritance. There is the supreme nationality which is mankind. Within this greatest whole are the few great unities formed by continuous dominant traditions of original civilisation, and within these again are the many lesser groups, determined mainly by present spoken language, which are the only 'nations' known in ordinary speech.

"Europe and China are nations of the first division of mankind: they are great continuities of historical development which may embrace many distinct languages and political units. . . . The real unity in each case has been one of cultural tradition. Europeans are all peoples and states deriving their dominant cultural form directly or indirectly from Hellenism, Chinese those deriving it from the 'Chinese' empire of the Hwang-ho basin in the first millennium B.C."

Is it denied that, in spite of the complexities and new ideologies of the modern world, there are still certain "great unities formed by continuous dominant traditions of original civilisation"? Is it no longer valid to make the distinction between the European and the Chinese type of civilization? Has not the real unity of China been in a broad sense 'cultural'? Or, if 'culture' must be used in a more restricted sense, what other term should be employed to express a unity that has been immensely powerful and yet has been neither national nor political? These questions may be asked with full consciousness of the intricacy of modern civilization and the possibility of rapid change in cultural affinities such as seems to be illustrated by the Turkish national State since the Great War.

P. M. ROXBY.

Chemistry of Building Materials

AT the meeting on September 7 of Section B (Chemistry) of the British Association, there was a symposium on "The Chemistry of Building Materials". After an introduction by Dr. B. E. Stradling (director of the Building Research Station), papers were presented by Dr. F. M. Lee (Building Research Station) on "Some Problems in the Study of Hydraulic Cements", Dr. J. S. Dunn (Imperial Chemical Industries, Ltd.) on "Calcium Sulphate Plasters; Setting, Retarders and Accelerators", Mr. F. H. Clews, Mr. H. H. Macey and Dr. G. R. Rigby (British Refractories Research Association) on "Some Important Properties of Clay", and Dr. D. G. R. Bonnell (Building Research Station) on "Some Problems connected with Porous Building Materials".

Building presents an excellent example of a traditional industry in the stage of transition to an applied science. It is an industry founded originally on craft and based on rules of experience which have become enshrined in traditional methods. To the older building materials such as timber, stone, burnt clay and lime, there has been added in modern times a host of new products, whilst the demand for speed and economy in building has resulted in numerous changes in methods. These changes have often been in the nature of extensions and modifications of traditional processes, but they have been made without that full knowledge of the reasons for the success of the traditional methods which is necessary if development is to have a sure basis and to be other than the slow and costly traditional method of trial and error. Modern conditions have necessitated, therefore, not only the examination of the newer materials and processes, but also the study of the traditional materials and of the reasons for the success of the traditional methods.

This is well exemplified in the craft of the plasterer. The production of lime was formerly a local industry, and the craft by long experience had become adapted to the properties of the local materials. The modern development of large-scale production has led to the wide distribution of materials which, though outwardly similar, differ in properties from those to which the craftsman was accustomed. Calcium sulphate plasters have been added as an additional plastering medium, but materials of this class, differing widely in properties, and in the methods necessary for their successful handling, are distributed under trade names giving no clue as to the type to which they belong. The substitution of Portland cement mortar for lime mortar in rendering and stucco,

again without adequate appreciation of the very different properties given to the finished product, has been a very common cause of trouble.

As was pointed out by Dr. Stradling, the craftsman in lime and plaster controls a chemical reaction of which he knows nothing. While working with materials in which he had long experience, the craftsman could produce excellent work; with materials of different physical properties and rates of reaction, however good these materials might be, there entered factors to which he was unaccustomed, and of which he had no warning, and his craft suffered in consequence.

The problems in building to-day are, however, not only due to insufficient knowledge of the fundamental properties of its materials of construction, but also, and in considerable degree, to insufficient dissemination of the existing knowledge among architects, builders, engineers and craftsmen. Whilst research on materials is now proceeding at a rapid rate in many countries, the need for further education in the building industry is only too clear.

The discussion at the meeting of Section B could inevitably only cover a small part of the field indicated by its title, but it sufficed to bring forward many interesting problems.

Apart from the metals and igneous rocks, all building materials are porous and capable of absorbing water to some extent. Changes in moisture content, not only on first drying, but also in subsequent use, produce accompanying changes in volume and in other physical properties such as strength and elasticity, while the movement of water, carrying soluble salts in solution, gives rise to surface efflorescence and to decay of masonry and brickwork. The change in volume is responsible for much of the cracking found in buildings. In practice it is relieved to some extent by the ability of materials to creep, or undergo plastic deformation under load. Though much work has been done on shrinkage and creep, there is still need for further study of moisture movements under conditions of restraint, such as normally occur in building. The general phenomenon of volume change in porous solids has as yet interested chemists relatively little though it offers a promising field for research. The work of Meehan and Bangham on the expansion of charcoal by sorption of gases and vapours is suggestive in this connexion.

Calcium sulphate plasters can be grouped generally into the hemihydrate and the anhydrite types, the latter being produced by the burning of gypsum

at relatively high temperatures or from the natural mineral. The system calcium sulphate-water is of the simplest binary type, but despite much work since Lavoisier's original contribution in 1765, the problem of the dehydration products of gypsum has never appeared fully solved. It has usually been considered that the partial dehydration of gypsum results in the formation of the hemihydrate, $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$, but Dr. Dunn reported that the crystal form of this compound remains unaffected, with but minor changes in the lattice constants, with water contents ranging from 0 to 0.65 molecules of water. It is considered probable, therefore, that there is a zeolitic series with $3\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and CaSO_4 as end members. Plasters containing the so-called hemihydrate usually require to be retarded as otherwise their rate of set is too rapid for normal use in building. Two types of retarder can be distinguished, one reducing the rate of nucleus formation and the other acting similarly, but, in addition, modifying the habit of the gypsum crystals, giving a relatively slower rate of growth along the *c* axis. The rate of set of anhydrite plasters is very slow and, in practice, an addition of an accelerator is required. In general the hydration is accelerated by sulphates of the alkali and other metals, but the most effective catalysts are those combining an alkali metal sulphate with the sulphate of another metal such as zinc, the effect being more than additive and an optimum ratio existing for the two sulphates. The alkali metals accelerate the growth of gypsum crystals most at right angles to the *c* axis, while zinc sulphate is more specific for growth parallel to that axis. This observation takes the explanation of the action of a two-component catalyst one stage forward, but the problem of how each catalyst stimulates crystal growth still remains.

Though the most obvious property required in a cement is that of developing strength, in practice this presents few problems compared with those arising from volume change and physical and chemical decay. The heat of hydration of Portland cement, which may amount to a hundred calories per gram, is a source of considerable trouble in concrete structures of large mass. The internal temperature in concrete dams, for example, may rise as much as 50°C . above the original temperature of the materials, and the thermal contraction which takes place during subsequent cooling is the main cause of cracking in such structures. The production of cements with a reduced heat of hydration, and their utilization in recent work, such as Boulder Dam on the Colorado River, U.S.A., can be traced back to the much increased knowledge of the constitution of Portland cement which has resulted from phase equilibrium studies on many of the oxide systems involved.

The relative properties of vitreous and crystalline phases of the same gross composition is a matter of much interest in cement technology at the present time. During the burning of Portland cement, some 20-30 per cent of the mass passes into the liquid condition, but the extent to which this liquid crystallizes on cooling, or supercools to form a glass, probably varies considerably. There is evidence that unexplained differences in properties of cements of similar composition and fineness may have their origin in variations of this kind.

Clay is amongst the oldest of the raw materials of building and it has been successfully moulded, burnt and used for some thousands of years without any scientific knowledge of its chemical constitution or physical properties. A certain degree of control was, however, formerly exercised by Acts of Parliament. In 1477, in the reign of Edward IV, an Act required that the clay should be dug before November 1, turned over before February 1 and not used before March 1. Even so late as the reign of George III, there came an added requirement that the clay should be turned between February 1 and the time of moulding of the bricks. The reduction or, in some cases, entire elimination of the time of weathering of the raw clay, together with the speeding-up of drying and other processes, have created many new technical problems. The large-scale production of burnt clay products demands, therefore, if it is to be conducted on economic lines, a degree of control both of materials and processes which was quite foreign to the older small-scale industry.

The mineralogy of raw clay has made striking advances in recent years, but the chemical changes which occur on burning are still a matter of controversy. Plasticity, that physical property by which clays are characterized, remains a much confused subject. In many of the experimental methods used for its determination in the clay industry, properties other than plasticity enter, and a return to methods which are fundamentally simple, such as the measurement of deformation in torsion or tension, appears necessary. Problems of drying play a large part in manufacture, and most manufacturers use unnecessarily long drying periods as an insurance against losses by cracking. This could be avoided by the application of adequate knowledge of the properties of a clay. The temperature of drying is important, there being a temperature at which the safe rate of drying is a maximum; the tendency to crack is greater above and below this temperature. It appears that the decrease in viscosity of water with rise in temperature is offset at the higher temperatures by the decrease in the tensile strength of the clay.

F. M. L.

The British Association and the Indian Science Congress

A Scientific Delegation to India

ARRANGEMENTS for a scientific delegation from Great Britain to India this winter are nearing completion. The Indian Science Congress Association, which holds annual meetings in different parts of India of individual scientific workers and others, and functions much on the lines of the British Association for the Advancement of Science, is approaching the celebration of its jubilee (twenty-fifth) session at the meeting to be held in Calcutta in January next. The Association invited the co-operation of the British Association in forming a representative visiting delegation from this country and others, and the General Committee of the British Association eagerly accepted the invitation, which was, in effect, to make a new use of the mechanism of the Association, and one which is felt to suggest far-reaching implications. It is common knowledge that the British Association has sometimes held its own annual meetings overseas, at the invitation of Dominion Governments and institutions. But it has never before been asked to co-operate in organizing a scientific delegation apart from its own annual meetings—and if this can be done for India, why not for other parts of the Empire in which conditions would not permit of a meeting of the Association on ordinary lines? But this is to anticipate: the present notice is concerned with the Indian meeting.

It was arranged with the Indian Science Congress Association that invitations should be extended, through and by the British Association, to a large number of eminent scientific workers in Great Britain, in part on nominations received from India, and for the rest on representative standing in the British Association. The Indian Association itself has invited certain representatives from foreign countries, and also from Great Britain in a few departments of work which find more prominent places in the Indian Association than in our own. Lord Rutherford accepted the Indian Association's request to preside over the joint congress, to the immense satisfaction of both British and Indian colleagues. The total number of the party, including delegates and persons accompanying them, is 94 at the moment of writing; but this is subject to some addition—not, it is to be hoped, to subtraction.

The programme in India is being arranged by the Indian Science Congress Association, and the presidents of the sections for the meeting are all residents in India; but the visiting delegates may

be expected to take an active part in the proceedings. The meeting in Calcutta will run from January 3 until January 9, and will be preceded and followed by tours through India, during which visits will be paid to various university and other centres of scientific interest, and it is understood that some of the visiting delegates will be invited to lecture.

The great majority of the visiting party will sail on the P. and O. steamer *Cathay* on November 28 (or will overtake her at Marseilles by leaving London on December 2) and are due at Bombay on December 16. Two days will be devoted there to reception and sight-seeing, and the party will then leave in a special train or trains in which they will live, strenuously no doubt but in the best of comfort which the Indian railways can provide, for the next twelve days. In the course of this journey they will visit Hyderabad (by the special invitation of the Nizam's Government), Agra, Delhi, Dehra Dun, and Benares, besides intermediate points of interest, where scientific and university institutions in particular will be inspected. There will be some opportunity for short journeys from Calcutta before the meeting of the Congress, including field excursions to the coalfields, Tatanagar, Darjeeling, ancient 'Gaur', the Sundarbans and the Assam oilfields, and after the meeting a further tour is planned to include Madras and Bangalore. Many of the delegation, however, having special interests and contacts in India, will substitute for this second tour individual visits to various places, and full facilities will be given to them to do so. Nor will the whole party be gathered together for the homeward voyage, though a substantial proportion of it will return from Bombay on the S.S. *Strathaird*, which will bring passengers to England on February 3, or a few days earlier by the overland journey from Marseilles.

The fund necessary in connexion with this occasion has been raised partly by the Indian Association, partly by the British Association from interested firms and individuals at home, and partly by means of a contribution from the funds of the British Association itself, which last is additional evidence, if any were needed, of the full appreciation of the importance of the occasion by the Council and General Committee of the senior body, as well as of the high compliment paid to it by the Indian Association in inviting its co-operation.

Obituary Notices

Prof. V. L. Kellogg

IN the death of Vernon Lyman Kellogg, which took place at Hartford sanatorium (Conn.) on August 8 last, the United States loses an eminent citizen and one who was a leading figure in the scientific life of that country. Born at Emporia, Kansas, in 1867, he graduated at the University of Kansas in 1889 and at Cornell University in 1891. His academic training was primarily as a zoologist and was continued in Paris and in Leipzig.

Although a man of broad zoological interests, Kellogg's scientific papers were almost entirely concerned with entomology. For a few years he taught that branch of the subject at Kansas University and afterwards he became professor of entomology and lecturer in bionomics at Stanford University. In 1908 he married Miss Charlotte Hoffman of Oakland, California. During his long period of tenure at Stanford, he was closely associated with the late David Starr Jordan, in collaboration with whom he wrote several books on diverse aspects of general zoology.

Kellogg's career at Stanford University virtually came to an end with the advent of the Great War. It was through the influence of Herbert Hoover that Kellogg was seconded for work in connexion with the American Relief Commission in Europe. Here his organizing capacity found scope, and he rapidly came into prominence owing to the leading part he performed in the Commission's activities. From 1917 until 1919 he was director in Brussels of this Commission for Belgium. His labours, on behalf of the benevolent efforts made by the United States, took him also to Poland and to Russia. The services which he rendered in organizing relief and other measures, during and after the War, received recognition by the bestowal upon him of decorations by France, Belgium and Poland.

On returning to the United States, Kellogg resigned his position at Stanford University, which he had held from 1894 until 1920. He had lately become permanent secretary of the National Research Council, an office which he administered until he retired from the post at the end of 1931. Kellogg's main interests were no longer in academic work, and he embarked upon what had been described as his period of greatest influence and accomplishment. In his capacity as secretary he played a major part in organizing the National Research Council. Being also a member of the National Academy of Sciences, a trustee of the Rockefeller Foundation and a member of its executive committee, and of other bodies, he was able to do much towards moulding the trend of scientific activities in America. Prof. R. A. Millikan, writing in *Science* of September 3, recounts that about 1930 Kellogg found himself to be the victim of an incurable malady known as Parkinson's disease (paralysis agitans). The fortitude with which he

faced this sentence, with unimpaired mind and failing body, won the admiration of personal friends. He only missed by a few months attaining his seventieth birthday.

Kellogg's contributions to entomology were in taxonomy and anatomy. For a number of years he was the leading authority on bird parasites or Mallophaga. His other papers were chiefly concerned with the structure of Diptera, and he also made a special study of the family Blepharoceridae and their larvae. His monograph on this group, and also that on the Mallophaga, formed parts of the "Genera Insectorum". His writings also include anatomical and other articles on Lepidoptera. Most of his papers were short, but they usually brought to light new or interesting features. His books were of a more general character and included "American Insects", 1904; "Evolution and Animal Life" (with D. S. Jordan), 1907; "Darwinism To-day", 1907; "Economic Zoology and Entomology" (with R. W. Doane), 1915; "Mind and Heredity", 1923; "Evolution", 1924, and several others.

During the War years, and shortly afterwards, Kellogg wrote various books of a different character—they were incidental to that upheaval in Europe and had particular reference to its political and economic outcome. These writings made his name familiar among his countrymen as that of a notable exponent of those times.

A. D. IMMS.

Mr. F. C. Thompson

FREDERICK CHARLES THOMPSON, lecturer in the Leather Industries Department and research assistant in the Procter International Research Laboratory of the University of Leeds, died on September 4 at the age of forty-six years. He received his early education in a Leeds secondary school and then followed the honours course in pure chemistry at the University of Leeds, graduating in 1911. Two years later he obtained an honours degree in the chemistry of leather manufacture, and in the same year was appointed to the staff of the Leather Industries Department as assistant lecturer and demonstrator under the late Prof. H. R. Procter.

In 1913, Mr. Thompson became research assistant in the Procter International Laboratory and in 1923 was made a lecturer in the Leather Industries Department. He carried out a great variety of investigations on subjects connected with the applications of protein chemistry to leather manufacture independently and in association with Prof. H. R. Procter, Prof. D. McCandlish and Mr. W. R. Atkin, a fellow lecturer in the Department. Recently, in collaboration with Mr. Atkin, he re-wrote Procter's "Leather Chemists Pocket Book", and this revised enlarged edition is generally regarded as the standard analytical text-book for the leather chemist.

Mr. Thompson was an authority on the application to problems of the leather trade, of electrometric and colorimetric titration of reactions and was frequently consulted by workers in other branches of applied science. In recent years he collaborated with Dr. J. Gordon of the Leeds Medical School in research work upon the complex subject of immunity, where Mr. Thompson's knowledge of protein chemistry proved useful, and several joint papers have been published by them in the *British Journal of Experimental Pathology*.

Mr. Thompson enjoyed the complete confidence of his colleagues in the International Society of Leather Trades' Chemists—an organization with branches in almost every civilized country in the world. After occupying many responsible positions as chairman of commissions, he became president of the Society in 1932 and held the office for two years. One notable contribution to the work of the Society which has earned the lasting gratitude of leather chemists was made jointly with his colleague Mr. W. R. Atkin. For many years difficulty had been experienced in securing uniform supplies of hide powder, an essential material for the quantitative estimation of tannin in tanning materials used commercially. By their joint research, Thompson and Atkin established the cause of this variation and showed how it might be readily overcome. As a result of this work, far greater concordance of results is now secured in quantitative tannin analysis than was previously possible.

Mr. Thompson was a tutor of the University of Leeds, and for several years had been a member of the local committee of the Association of University Teachers. He had many interests outside university life—chief amongst them being welfare work amongst boys. He holds the record for longest continuous service with the Boys' Brigade in Leeds. Under his captaincy his Company won all the trophies open to competition, and held the battalion ambulance cup continuously for twenty-three years. For many years he was superintendent of the Burley Methodist Church Sunday School. He was interested in music and his ability as a violinist resulted in his association with several amateur orchestras. In 1919 he married Miss M. Hampshire, and she survives him.

D. McC.

Prof. A. W. Gibb

PROF. A. W. GIBB, first Kilgour professor of geology in the University of Aberdeen, died on July 12 at the age of seventy-three years.

Alfred William Gibb was born and educated in Aberdeen. After taking the degree of master of arts at the University of Aberdeen, he spent some years in teaching and in business before resuming his studies. He was one of the first to graduate at Aberdeen with the newly established degree of bachelor of science, and soon after he became assistant to the professor of natural history. In Aberdeen at this time, 1896, the teaching of geology and zoology was carried on in the one department. Fortunately, the interests of the professor, Henry Alwyn Nicholson, were keenly palaeontological and his enthusiasm and care in developing the geological side of his teaching

were shared by his assistant. When the late Sir J. Arthur Thomson succeeded Nicholson, he left the geology teaching entirely to Gibb. In 1908, a lectureship independent of the Natural History Department was established, and in 1922, the Kilgour chair of geology was founded. To each, in turn, Gibb was appointed, and he was responsible for the planning and development of the Department of Geology in Marischal College.

Instruction in the mineralogical and petrological aspects of geology was Prof. Gibb's personal responsibility. To this end, he spent his spare time studying with Miers and Judd, and in Heidelberg with Rosenbusch. In 1908 he was awarded a doctorate in science for a thesis describing the rocks of the basic complex of Balhelvie, and he communicated several papers on diverse aspects of local geology to the Geological Society of Edinburgh.

Prof. Gibb's main interest was his 'ordinary' class, the first-year class for arts and science students. His lectures were extraordinarily popular, vying with those of his colleague, J. Arthur Thomson, and infecting generations of students with a vital interest in the subject which he expounded with such fascination. He had been teaching for forty years when he was forced by ill-health to retire in 1936, and the news of his death will be received with the regret that he was unable to enjoy fully the peace of his retirement.

Prof. A. Heim, For. Mem. R.S.

A CORRESPONDENT writes:

"Though his name will always be associated with his studies on Alpine structure, the part of Prof. Albert Heim as the founder of the Swiss Seismological Commission deserves to be remembered. In 1878, the first year of its existence, the Commission consisted of seven members, with Prof. A. Forster of Bern as president and Heim as secretary. To Heim was also assigned the task of collecting observations from Zurich, Uri and other cantons. Though its work was taken over in 1913 by the Swiss Meteorological Office, the Commission, re-named as the Swiss Earthquake Service, may claim to be the oldest, and by no means the least useful, of all existing committees for the study of earthquakes."

We regret to announce the following deaths:

Major B. F. S. Baden-Powell, known for his pioneer work in aeronautics, formerly president of the Royal Aeronautical Society, on October 3, aged seventy-seven years.

Mr. Richard Inwards, a former president of the Royal Meteorological Society, on September 30, aged ninety-seven years.

Mr. Arthur Kitson, who was early associated with electric lighting and the telephone, and invented the Kitson light, among numerous other devices, aged seventy-eight years.

Prof. W. St. Clair Symmers, emeritus professor of pathology in the Queen's University, Belfast, on October 4, aged seventy-four years.

News and Views

Biometry at University College, London

FROM the beginning of the present session, Prof. J. B. S. Haldane changes his duties by taking on those of the first Weldon professor of biometry, and he is the first holder of a chair in the subject at any British university. The post was founded by a bequest left last year by Mrs. F. J. Weldon in memory of her husband, Prof. W. F. R. Weldon, who was one of the original editors of *Biometrika*. Prof. Haldane will give the first of a course of ten lectures on biometry at 5 p.m. on October 12. In 1895 Karl Pearson gave his first course on the mathematical theory of statistics at University College, when he was professor of applied mathematics and mechanics. The Biometric Laboratory originated at this time. In 1907 he took over the Eugenics Laboratory from Sir Francis Galton. On his death two years later, the latter left the residue of his estate for the founding of a professorship and Laboratory of National Eugenics and Karl Pearson became the first Galton professor. For the next twenty years, research and teaching in eugenics, statistics and biometry were carried out in the same Department, known as that of Applied Statistics. On the retirement of the director in 1933, separate departments for the first two of these subjects were instituted, and there are now chairs for all three at the College where they first obtained academic recognition.

Ionospheric Disturbances and Solar Eruptions

DR. D. F. MARTYN, Messrs. G. H. Munro and A. J. Higgs, and Dr. S. E. Williams, in a communication which appears on page 603, show evidence that a type of ionospheric disturbance accompanies every bright hydrogen solar eruption. The main features of the disturbance are an increase of ionization in the *D* region and a heating effect in and below the *F*₂ region. When the disturbances are large they cause 'fade-outs' in short-wave communication. It is concluded that these effects are due to a greatly increased emission of the hydrogen resonance line *L*_α from the eruptive area. This causes ionization of atomic oxygen in the *D* region, and dissociates the water vapour in the *F*₂ region, thus raising the equilibrium temperature. Further evidence of a connexion between solar activity and short-wave radio 'fade-outs' is given in the note entitled "An Active Sunspot" on page 616 of this issue.

A New Permanent Water-Repellant for Textiles

A NEW compound of exceptional interest to both chemists and textile manufacturers is the subject of an exhibition housed at Dorland House, S.W.1, on October 5-8. This preparation, which has been given the name "Velan", has been developed during the past three years at the Manchester laboratories of Imperial Chemical Industries, Ltd., as a universal water-proofing agent for textile goods. Information

concerning the chemical composition of Velan is not yet available, but it would appear to be a complex organic substance which reacts with both hydroxyl and amino groups and on that account is able to combine with both animal and vegetable fibres. For the impregnation of textiles, Velan is used in the form of aqueous dispersions, which are readily preparable from the substance without the aid of supplementary agents. The impregnated fabrics are dried, and combination between the reagent and the textile fibres is afterwards effected by heating at a temperature of 100°-150° C. It is the last stage of the process which gives permanence to the proofing.

VELAN is claimed to be the first water-repellant for textiles which will remain permanent during repeated washing, laundering and dry-cleaning processes. Further, the compound is said to be unique among proofing agents in that it imparts softness and suppleness to fabrics. Unlike rubber or cellulose lacquer waterproofings, Velan does not affect the interstices of textiles and render them impermeable to air. The proofing process has proved satisfactory with cotton, wool, natural and artificial silk, straw, etc., though cotton seems to be somewhat more satisfactory than other textiles from the point of view of the permanence of the proofing. In view of these advantages, and the fact that processing does not add greatly to the cost of manufacture, Velan should find a wide range of applications in the textile industries.

Aid for Intellectual Unemployed in France

INTELLECTUAL workers, including men of science, writers, artists and others, have suffered no less than industrial workers during the recent years of economic unrest. In 1934 an organization was established in France with the object of providing socially useful work for the unemployed professional men and women. A list of work to be done was prepared and private donations were obtained to support the enterprise in order to see whether the idea had a practical value. Thus, in 1934 and 1935 a considerable number of unemployed were engaged in preparing a complete list of benevolent associations existing in France since 1901. The "Confédération des travailleurs intellectuels", consisting of more than 200,000 workers from various professional groups, also had the problem of intellectual unemployment under consideration. "L'Entr'aide des Travailleurs Intellectuels" (E.T.I.) was organized in order to examine the situation and to find ways and means of giving efficient assistance. The poor financial state of France excluded all possibility of help from the Government, and it was impossible to rely upon private donations. A campaign was therefore begun to obtain from the authorities permission to issue special stamps of different values, with a small surcharge, the surcharge being destined for the intellectual unemployed. The

campaign succeeded in obtaining a resolution published in the *Journal Officiel* on May 27, 1936, by which the issue of special stamps was confirmed, and the E.T.I. was entrusted with the receipt and distribution of the funds collected, under conditions drawn up by the council of the E.T.I., the Minister of National Education and the Postmaster-General.

It was considered more useful to spend the money on work in science, literature and art, than in distributing doles, the work being carried on so long as the funds permitted under approved conditions. The work thus provided may not, of course, be adapted to the special qualifications of every unemployed person, but they are engaged for six months to do some socially useful work, unless they find employment in their own field. Up to January 1, 1937, the French Post Office paid over to the E.T.I. about a million francs under this scheme. This sum is due mainly to philatelists and stamp-dealers; for the success of the scheme, it is necessary that the public generally should take part in this social and humane work. At present the following stamps have been issued:



Fig. 1.

Letters abroad:

1 fr. 50 c. surcharge 50 c. (see Fig. 1)

Post-cards abroad:

90 c. " 10 c.

Internal correspondence:

50 c. " 10 c. and 20 c.
(three kinds of stamp)
30 c. " 10 c.

These special stamps are available at any post office in France and at the E.T.I. (12 rue Henner, Paris IX), where they can be supplied in any quantity required.

Ancient Monuments in France

At the close of September the Commission des Monuments Historiques of France completed a hundred years of its existence. Although at one time subjected to no little criticism, instructed and otherwise, since the War, when it has included among its members the most distinguished of French archaeologists, its activities, both in the preservation and protection of buildings of historic interest and in its care for the antiquities of France generally, have deserved the highest praise. Notwithstanding limitations, of which the members of the Commission are even more fully conscious than expert opinion among the outside public, its control, advice and assistance in bringing to light, preserving and making

accessible the evidence from the prehistoric sites of France, which is now a world-wide possession of archaeological science, has earned the gratitude of every student of antiquity. Even better known to the travelling public, however, are the efforts which have preserved from decay and no less from vandalism the structures of the Middle Ages and of the Roman period. Among the latter the wonderful series of monuments of Roman culture, such as those at Orange, at Nîmes and at Arles, can never be forgotten by anyone who has passed through Provence. Among the latest achievements of the Commission is the excavation of the Roman theatre of Vienne, south of Lyons, which is not an amphitheatre of the more usual type, but is cut out of the side of the hill and necessitated an excavation more than sixty feet deep to bring to light the lowest tier of seats. The completion of the excavation is to be celebrated by a number of theatrical performances to be given on the stage next year similar to those now given annually in the amphitheatre at Orange.

'Shiva's Temple', Arizona

DR. HAROLD ANTHONY, leader of the Patterson-American Museum Grand Canyon Expedition, on his return to New York, gave a preliminary account of the results obtained during his four days' stay on September 16-20 on the summit of Shiva's Temple in the Grand Canyon, Arizona (see NATURE, Sept. 25, p. 537). Some seventy-five specimens, it is stated in the report in *The Times* of September 30, were shot or trapped, and will be forwarded to New York for examination. They include chipmunks, three or four species of mice, cottontail rabbits, rock squirrels, which resemble the common grey squirrel, and pack rats, of which one species may be peculiar to Shiva's Temple. As regards the problem whether isolation has produced any marked changes in appearance and habits, Dr. Anthony is of opinion that the colour of the specimens as a whole is lighter than that of those on the north and south rims of the Canyon, respectively one and a half miles and eight miles away in a straight line; but confirmation by detailed comparison is awaited. The vegetation, consisting of pines, junipers, shrubs, and cactus, is described as "more arid" than that of the mainland, and the heat as greater. The plateau, it is stated, is evidently visited in winter by cougar, or mountain lion, and coyote. As the report refers to the discovery of many Indian remains in the shape of mounds, ovens and tools, presumably the members of the expedition were not the only visitors to reach the summit since its isolation from the mainland, as was claimed originally, and the expectation of evidence bearing on the high antiquity of man in this region seems doomed to disappointment. Nevertheless, it is to be concluded that the remains are 'early', and any material which affords evidence of cultural or racial succession in the south-western States is of importance, especially in the present state of knowledge. It may be hoped that an opportunity will be found to submit the material *in situ* to careful and expert examination.

Broadcasting in India

AN outline of the policy and plans of the broadcasting organization known as All India Radio for the erection of broadcasting stations in India was given in a recent issue of the *Indian Listener*. The two main features of the problem of providing a broadcasting service in India are the relatively large area of country to be covered, and the intense atmospheric interference. It is considered to be desirable to provide as quickly as possible some sort of broadcasting service for the whole area of India, and with this object in view five short-wave transmitting equipments have been ordered and will be located at Delhi (two stations), Bombay, Calcutta and Madras. At the same time, five medium-wave stations have been ordered to provide a first-grade broadcasting service for the towns of Lahore, Lucknow, Trichinopoly, Dacca and Madras. These will supplement the existing medium-wave stations at Delhi, Bombay, Calcutta and Peshawar, so that shortly All-India Radio will have in operation five short-wave and nine medium-wave stations, the aerial power ratings of these varying from 0.25 to 10 kw. Bearing in mind that, in contrast with the practice in other countries, the short-wave stations have to provide an internal service in India, the operating wave-lengths will probably be between 30 and 50 metres for daytime and between 60 and 90 metres for night working. It is considered unlikely that there will be any interference between these stations working an internal service in India, and European and other short-wave stations operating an international service. The new medium-wave stations will operate on wave-lengths between 200 and 400 metres and will have large frequency separation so as to facilitate the provision of simple cheap receivers.

At the present time the position with regard to broadcasting receivers in India is unsatisfactory owing to their high cost. It is considered that with the development of transmitting stations now being undertaken, there will shortly be room for three types of receiver. The first is a cheap, popular receiver suitable for local reception from the medium-wave stations. Next comes the "All-India" receiver suitable for receiving all the stations now in contemplation, and thus capable of covering the short-wave band of 30-100 metres as well as the normal medium-wave band of 200-550 metres. The third type of receiver is in the "all-wave" class generally available at the present time in Great Britain, except that it should cover wave-lengths from 13 to 100 metres without a gap. In addition, there is a demand in India for wireless receivers suitable for community reception in villages, and the Research Department of All-India Radio has already developed a special set for this purpose. No external controls are provided on this receiver, which is left tuned to the local station and is operated by a clockwork time-switch, which turns the receiver on and off at the correct time for the "village hour". The only attention required by these receivers is a visit once every three weeks to change the accumulator battery and re-wind the clock.

Origins of Clerk Maxwell's Electric Ideas

A book entitled "Origins of Clerk Maxwell's Electric Ideas as described in Familiar Letters to William Thomson" has been published by the Cambridge University Press (price 3s. 6d.). These letters cover the period 1854-79 and illustrate clearly the genesis and rapid progress of Clerk Maxwell's ideas as he groped his way towards a structural theory of the electric and magnetic field. Some of the questions he asks Thomson are by no means easy to answer. In his first letter (Feb. 1854) he asks: "Suppose a man to have a popular knowledge of electrical show experiments and a little antipathy to Murphy's Electricity, how ought he to proceed in reading and working so as to get a little insight into the subject which may be of use to him in further reading?" In subsequent letters he continues to ask still more intricate questions, so doubtless Thomson's answers must have been satisfactory. In another letter he says, "I do not know the game laws and patent laws of science . . . but I certainly intend to poach among your electrical images". He fully appreciates Thomson's problem of an electrified spherical bowl. "Your bowl investigations are first-rate. I must find the induction through a round hole in a plate by means of them. Whether would you have me bag the whole thing for my book, or give results and references with an account of the method?" The letters given in this book were originally printed in Part 5 of vol. 32 of the *Proceedings of the Cambridge Philosophical Society*. As they will be of interest to many mathematical physicists, the Cambridge Press did well to publish them. Sir Joseph Larmor has edited the book.

Clean Milk and Pasteurization

DR. G. ARBOUR-STEPHENS, of 61 Walter Road, Swansea, writes, with reference to the article on the nutritive value of pasteurized milk (*NATURE*, 140, 389; 1937), that it is not justifiable to compromise a diminution of value in order to prevent the effects of handling by dirty people. Unfortunately, the problem is scarcely as simple as this: in spite of the greatest care and cleanliness in handling the milk, it cannot always be possible to prevent contamination from organisms which may have produced no obvious illness in the worker himself, but yet may be capable of producing illness in other people, or from organisms which may be disseminated during the incubation period of an infectious disease and before the symptoms have become obvious. To prevent otherwise unavoidable outbreaks of infectious diseases among the consumers of milk is the true function of pasteurization: it is certainly not to be considered as allowing the production of dirty milk, which can then be rendered innocuous before consumption. The aim should surely be the production of clean milk from disease-free herds, with pasteurization to obviate the ill-effects of any lapse in technique, which is bound to happen occasionally considering the many stages through which the milk has to pass under modern conditions before it reaches the consumer, or to prevent the accidental entry of virulent organisms.

Practical Aspects of Human Nutrition

THE text of a lecture entitled "The Place of Vegetables and Fruit in the Well-balanced Diet", which was delivered before the Royal Horticultural Society by Dr. G. E. Friend, is printed in the Society's *Journal* of July (62, 7, 286-295). A review of modern conceptions of the nutritional needs of the human body dealt principally with the quality of diet, rather than with quantity. Dr. Friend has charge of the health of the boys at Christ's Hospital; perhaps the members of this and similar closed communities may be regarded as adequate critics of palatability and other human aspects of diet. The nutritional value of fresh fruit and vegetables varies considerably, and but little is known about factors affecting variation. Emphasis is placed upon the necessity for co-ordinating human and plant nutrition. The best way of ensuring qualitative adequacy of protective vegetable foods is to begin with their cultivation. Soil conditions must be suitable for the production of sufficient amounts of vitamins and the minor essential elements necessary for human nutrition. Such high-grade vegetables naturally cost more to grow, and one of the problems of the future will be to convince those who hold the economic control of diet of the value of such improved produce.

The Tobacco Problem

IN an address on this subject before the Southampton Medical Society on October 6, Dr. J. D. Rolleston maintained that the tobacco habit is quite as much a concern of public health as that of acute infectious disease, a view which appears to be gaining ground in Germany, where many members of the public health service are of opinion that the harm done by nicotine is as great as that caused by alcohol. In Great Britain, however, apart from the Society for the Study of Inebriety and Drug Addiction, there has been little discussion in scientific meetings of the tobacco problem, like until recently any aspects of the sexual question. In a survey of the action of tobacco on the various systems of the body, Dr. Rolleston remarked that though in most cases little harm is likely to ensue from a mild degree of smoking, some smokers, even those of long standing, are liable to develop toxic symptoms after only a small amount of tobacco, while a considerable proportion of all tobacco consumers smoke to excess. Other subjects discussed in the address were the incidence of smoking in different countries, the relation of tobacco to cancer of the upper respiratory and alimentary tracts, tobacco in training, smoking in hospital wards, the occurrence of extensive fires due to smokers' carelessness and the formation in 1926 of the National Society of Non-Smokers.

A Philosophical Overhaul

WE have received the first chapter of a book entitled *A "Philosophical Overhaul"* by Oscar Ljungström, printed in English by H. Ohlsson of Lund. It is a well-written philosophical disquisition on such subjects as force, gravitation, chance, free will, causation, time, etc. It is most readable and forces one to think. The author begins "A philo-

sopher is a doubtful man, and he puts all kinds of unnecessary questions. Not like Socrates in the forenoon, to the citizens of his own town. For if he did that nowadays they would probably turn him out with the American injunction: 'If you have nothing to do, don't do it here'. So it is safest for him to keep his doubts within his own soul, murmuring some answers to himself." The questioner has contracted the habit of writing books, and so he gives the first chapter of a proposed book. He suggests that gravitation may be explained by cosmic radiation and that time cannot be measured at all. He has the merit of not being dogmatic and his suggestions are interesting and put forward modestly.

A Business Man's Library

A SELECTED list of books under the heading "A Business Man's Library" compiled by the Management Library has been issued by the National Book Council, 3 Henrietta Street, Covent Garden, London, W.C.2, from which copies may be obtained. The list covers purchasing, factory management, personnel and industrial psychology, sales management, market research, advertising, transport, general management, accountancy and statistics, commercial law, industrial biography and industrial history. While not exhaustive, it includes most of the significant recent additions to the literature of this field and is a useful adjunct to the more comprehensive "Business Man's Guide to Management", the fifth edition of which has just been published by the Management Library (23 Bloomsbury Square, W.C.1). In addition to the classified lists of books, with brief descriptive notes on their scope or contents, the latter contains a subject index, a publisher index and an author index as well as suggested courses of reading. Reference to the main divisions, general management, accounting, production, distribution, company secretary, psychology, industrial economics, in which the books are listed is facilitated by use of different coloured paper for these divisions.

Library of the American Philosophical Society

THE report on the library of the American Philosophical Society for 1936 includes details of the more important additions (Philadelphia: American Philosophical Society). Among the new exchanges of publications established during the year is one with the library of Armstrong College, Newcastle-on-Tyne. At the end of the year the Library contained 80,918 volumes, 48,468 pamphlets and 5,374 maps. The Library does not attempt to develop all fields of learning, but only those in which it is already strong or has historic interest. No expansion in modern books on medicine is contemplated owing to the existence in Philadelphia of a very important medical library, but fields in which development is intended include exploration; botany, scientific and applied; the history of science; the inter-relation of the sciences; the co-operation of learned societies and institutions. Further contributions have been made to the promotion of the Union Catalogue of Philadelphia, and the report includes a summary list of archival materials in the possession of the Library,

the most important of which is the collection of Franklin manuscripts. Much work has been carried out in preparation for the issue of a descriptive catalogue of these manuscript collections.

Smithsonian Publications

A CLASSIFIED list of Smithsonian Publications, available for distribution, August 10, 1937, compiled by Helen Monroe, has been published by the Smithsonian Institution, Washington (Publication 3394). The papers are supplied only as an aid to researches or studies in which the applicant is specially interested, and accordingly applicants are required to state the grounds for their request. Except where prices are given in the list, the papers are distributed gratis. The serial publications of the Smithsonian Institution are of three types: Smithsonian Contributions to Knowledge; Smithsonian Collections; Smithsonian Annual Reports. The reports are distributed gratuitously to libraries and individuals throughout the world, but very few are now available at the Institution. The papers issued in the Contributions to Knowledge and Miscellaneous Collections are not public documents but are printed in limited editions and distributed without charge to public libraries, educational institutions and learned societies. They are supplied to other institutions and to individuals at the prices indicated.

Calendar of Chemistry

AN interesting list of names and dates has been drawn up by E. H. Huntress with the title: "Daily Chemical Anniversaries as a Teaching Tool", published in the *Journal of Chemical Education* (14, 328; 1937; obtainable in reprint form at a small charge). In this, each day of the year is assigned to some names of investigators distinguished for their contributions to chemistry and related sciences, who were born on that day in a year specified. The date of death is also given when the person is no longer living. In this way a valuable historical document has been produced, and it is clear from the brief introduction by the author that he has taken a great deal of trouble in collecting his material from reliable sources and in converting the dates based on different calendars to the Gregorian basis. He suggests that the list can be made use of in teaching, and it certainly offers interesting possibilities in this direction.

Game Research

APART from a few special investigations, such as that on grouse disease, little persistent attempt has been made to study the diseases of game or methods of controlling disease or increasing the health and productivity of game. The opening a few years ago of a game research estate at Knebworth by Imperial Chemical Industries Ltd. was therefore a movement of scientific as well as of sporting interest, and now a second centre has been set up at Jealott's Hill, Warfield, Berkshire, for the study of problems relating to intensive rearing and the incidence of disease. From these stations appear occasional short pamphlets dealing with the progress of research or

summarizing present knowledge regarding specific diseases. Advisory Leaflet No. 12 (June 1937) deals with a few diseases of game most commonly encountered on rearing-fields and amongst wild stock, and offers some suggestions for simple treatment such as a keeper could apply. The diseases referred to are gapes, coccidiosis, cramp, pneumonia, 'sore mouth', and strongylosis or 'partridge disease'.

Partridge Mortality

THE question of "Partridge Stocks and Mortalities" is discussed in I.O.I. Game Researches, Advisory Leaflet 13, June 1937. The pamphlet is based upon information gathered from a large number of partridge manors throughout Great Britain and analysed by A. D. Middleton, of the Bureau of Animal Population. The matters discussed include losses of nests, fertility of eggs, mortality in young partridges, stock estimates, winter wastage, mortality and its reduction. The pamphlet is simply written and should be a useful guide to the shooting man and his keeper—to whom the original papers are not likely to be available—as to what may be expected amongst a normal stock of wild partridges.

Bibliography of Seismology

THE recent quarterly part of the "Bibliography of Seismology", edited by Mr. Ernest A. Hodgson, concludes the record for the year 1936 (*Pub. Dominion Observatory, Ottawa*, 12, 1936-37). The value of the work will be evident from the fact that the number of entries for the year is 429. To a great extent, the practice of adding notes on, or abstracts of, the memoirs is abandoned. On the other hand, the useful plan of giving references to notes or articles in various scientific journals—such as *NATURE*, *Science*, etc., and the *Proceedings* of such bodies as the Academy of Sciences of the U.S.S.R., the Geodetic Survey of India and the Society of Petroleum Geophysicists—is extended. The countries in which earthquakes are studied are now so well represented on the list of contributors that few, if any, memoirs of importance can escape notice. The last number contains a useful subject-index under more than fifty headings.

An Active Sunspot

A LARGE and active group of sunspots, visible to the naked eye, is in transit across the sun's disk (September 28–October 11) in latitude 10° N. The date of central meridian passage was October 4.6. The following measures of area made at Greenwich and expressed in millionths of the sun's hemisphere illustrate the rapid growth of the group from September 28, when it was seen coming into view at the sun's east limb:

Sept 28 44	Area 450
" 29 3	" 1100
" 30 4	" 1700
Oct 1 3	" 2100
" 4 4	" 3100

By October 1, a number of separate nuclei had developed into one very long complex spot.

(Continued on p. 641)

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Scientific Endeavour and Inferiority Complex

Recollections of My Life

By Santiago Ramón y Cajal. Translated by Prof. E. Horne Craigie, with the assistance of Prof. Juan Cano. (*Memoirs of the American Philosophical Society*, Vol. 8, Parts 1 and 2.) Part 1. Pp. xi+272+13 plates. Part 2. Pp. ii+273-638+plates 14-21. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1937.) 22s. 6d. net.

IT is a pleasure to greet this work in an English dress. The Spanish original appeared in Madrid in 1923. A personal document, at once historical and self-revealing, it went through three editions before its author's death in 1934. For it to be accessible to a larger audience has been a desideratum for some years.

Among autobiographies of scientific men this seems likely to occupy permanently an outstanding place. It presents features, and attaches to circumstances, of exceptional interest. It comes from the pen of one who was not only a great master in his branch of science but was also a personality of rare attraction. It deals with the story of a time pregnant with change and revulsion from old ways in the writer's own country. It tells this story from its particular angle the more effectively by reason of a certain detachment from the political field, a detachment based on loftiness of view rather than on any lack of passion for his country's cause.

The microscopist on the whole is, we may think, at some disadvantage for facts in his career which shall enlist general or public interest. He has not the romance of being armed with a gigantic instrument exploring spaces and systems which by their mere enumeration leave thought staggered. His life is perforce a sedentary one with little opening for adventure. Moreover, even with the microscope, Cajal's scope of observation lay in

a field not containing such exciting things as the seeds of new diseases or the specks identified as carriers of particulate heredity. It was on no such grounds as those that these "Recollections of My Life" have justified their writing. As to Cajal's scientific work, it is not always the discoverer himself who can best set forth to a lay world the broad meaning of what he has discovered. Nor do we think Cajal excels in that particular respect. Yet the book succeeds in presenting his scientific work clearly and well, though not with much gift of popular exposition. His achievement was not of a kind made easily the subject of spectacular appeal. It introduced, however, a new conception of the structure of the nervous system in its entirety and throughout.

It is probably true to say that no single observer ever yet so enlarged our knowledge of the construction of that system. His fresh conception of the structure carried with it unusually unequivocal inferences regarding certain fundamental features of its working. For physiologist and pathologist, the nervous system after Cajal's discoveries and interpretation was something so much clearer and so other than it had been as to be a system almost new, and one immensely more intelligible. That was a revolution dramatic enough to those observers technically facing the problem. But to those not so specially acquainted with it, its very technicality stood in the way of the investment of it with great general interest. The work before us has therefore, we think prudently, curtailed some of the scientific summaries and discussion, and dispenses with some of the scientific illustrations. Those parts of the work which are its truer sources of appeal and value are thus assisted rather than impaired.

One of the permanent sources of appeal in this unrestrained autobiography—for such it is—is its

frequent half-naïve, but never gratingly egotistical, resort to and exposition of its author's own views on human life and character in general, his own instance being commonly their text. These thoughts are often strikingly unsophisticated, the very reference to them somewhat of a departure from convention. At times this, like magic, turns a slight circumstance into a memorable and arresting passage for the reader. It is surely a prerogative of the Latin genius little permitted or possible to what goes by the name of Anglo-Saxon. It must have presented especial difficulty for this translation of the book. Prof. Horne Craigie has, we think, dealt with it in the best way possible. "So much of the personality of an author is contained in his very diction and phraseology, that it was felt best to risk sacrificing to some extent the values of literary English in order to try to give as precise rendition as possible of each word or phrase of the original". The reader finds that this has been done with exemplary care. In result a trace of exotic character tends to attach to the text in many places, and to our thinking harmonizes with it, because it seems in keeping with something exotic to us in the author's sentiment.

One interest of the book is, and will probably for a long time increasingly be, the writer's picture of Spain, the position science and scientific medicine held there, and their social and quasi-political contacts in Spain during the writer's long career. Light is shed on, for one thing, an inefficiency of educational organization for science such as, whatever be the issue of the present conflict in Spain, can, so long as this book speaks, never return. The book is a self-portrayal of a heroic figure striving to regenerate his country's science and, as regards science, his country's faith in itself. It is a portrayal undertaken without vanity, and in its way free from self-consciousness. It raises before us a figure which might well serve as a symbol for a future Spain cultivating scientific achievement. We get a picture of the devoted effort of a few to re-establish in their country the cult of scientific knowledge for its own sake. The struggle depicted was against not so much any organized opposition from creed or class as against apathy under a starved educational system. Further, the national conscience had come ruefully to consent to believe that in natural science Spain was no longer to be taken seriously. An inferiority complex in respect of science sapped the nation's strength and initiative. Cajal's own contributions to research called forth from his university colleagues the remark "who is our Cajal to judge of foreign scientists!" "So deep in the vitals of our race had taken root the conviction of our sad and utter incapacity for the cultivation of Science."

Another stumbling-block for Spain, as her great master here points out, was her own language. It invests with a certain pathos some valedictory words he addressed to the young scientific Spain he had created. "One of the urgent tasks our young investigators will have is the translation into English, French or German of the essential facts discovered in our country." He had in 1897 at no small pecuniary sacrifice started a Spanish quarterly of microscopy. This with the opening of the new century became the famous *Trabajos*. But after a quarter of a century's trial he felt forced to change the title into French and to "publish the work of our laboratory in French or English". His experience was that otherwise it did not reach the scientific world; "a bitter reflection," he remarks.

Cajal had consented to be Minister of Education under a prospective term of one of the Liberal Governments. Partly at his own later request that did not come to pass. But the volume is full of reflections upon education in general and the public organization of education in Spain in particular. It is rich in reminiscence illustrating the system as it existed; he watched it in school, college and university. He lived through a period which, largely by his own example and exertion, was in some respects one of great transition. For those historians to whom the phases of history of most interest are the phases of transition, Cajal's volume provides a valuable original source. As a young student he heard vitalistic doctrines taught direct from Borden and the Montpellier School of the eighteenth century. Some ten years later he was facing cholera with pure cultures of the 'bacillus' and an oil-immersion lens; and he lived to find himself in a palatial laboratory abreast of the latest in the world in respect of the particular study he had made his own.

Bits of the "Recollections" were rendered into English some years ago by the accomplished medical historian Fielding Garrison, now passed away. He recognized a vein of poetry in some of Cajal's writings. It is present in this book, and with it a vein of melancholy—without that bitterness which stings in some of the aphorisms of the "Charles de Café"—also in part at least translated by Garrison. An instance of the melancholy—and the poetical—is a passage in the last chapter of these "Recollections". Its subject is the scientific master whom old age is gripping—in fact himself at the time of his writing it. Unconsciously it challenges, by contrast, Browning's picture of Linares in "A Grammarian's Funeral". It says, too, what Mr. Aldous Huxley, in the memorial lecture on his grandfather, said of the fate of scientific writing—but says it with a wistfulness of regret. "It is certain and even desirable

that in the course of time my insignificant personality will be forgotten; with it will doubtless perish many of my ideas. In spite of all the blandishments of self-love, the facts associated at first with the name of a particular man end by being anonymous, lost for ever in the ocean of Universal Science. The monograph impregnated with individual human quality becomes incorporated, stripped of sentiments, in the abstract doctrine of the general treatise. To the hot sun of actuality will succeed the cold beams

of the history of learning." We may express this in short by saying that, as Aristotle thought of the soul, a scientific writing has no personal immortality. Yet this book will, we fancy, long have its place on the library's 'international shelf'.

Prof. Horne Craigie is to be congratulated on his work. The volume is well produced. There are a few misprints, for example, on pp. 303, 327 and 531. The book meets a distinct need.

C. S. S.

Primitive Art and Artists

The Savage Hits Back:

or The White Man through Native Eyes. By Prof. Julius E. Lips. Translated from the German by Vincent Benson. Pp. xxxi + 254. (London: Lovat Dickson, Ltd., 1937.) 21s. net.

AFTER this book had been written and was passing through the press, Prof. Julius E. Lips, formerly director of the Rautenstrauch-Joest Museum of Cologne, was moved to tell his readers in a foreword the circumstances of its production. Although not a Jew, his championship of freedom of thought and research brought him into conflict with the authorities and cost him his appointment. When deprived of all opportunity to continue his work and summoned to deliver up the material, which he had collected laboriously for the purpose of investigating this particular manifestation of primitive art, on the ground that it was subversive of the Nazi doctrine of Aryan supremacy—it certainly does not flatter the white man—he left his country to take refuge in Paris and later in America.

This prelude may seem irrelevant to the purpose of a study of a form of art; but it is a story which is fittingly told here. It literally shocks us into an appreciation of the fact that such masterpieces of expression and critical characterization as are shown could be produced only in an atmosphere of emotional and intellectual freedom removed *totò còlo* from the suspicions and repressions of a totalitarian regime. The advantage lies entirely with the savage.

Prof. Lips had brought together, classified, and analysed a large number of examples of primitive art in which the artist embodied his impressions of the white men with whom he has come into contact, and also of some, though indeed not many, of the white women, as well as his conception of his distant rulers in Europe. Of these a selection is figured and discussed in this volume. Most of them, though not all, are sculptures in

wood, ivory and other material. They are drawn from a wide field—Africa, Australia, Melanesia and New Guinea, the Eskimo and the Indian of the North-West Coast and South America. In time they range from the sixteenth century bronze and ivory figures of Benin art down to the present age of the motor-car. Some of the best belong to the nineteenth century. Generally, the art of the higher cultures, such as India, Japan and China, has been omitted from consideration, although some work of the Chinese has been included for purposes of comparison—a severe test, from which the primitive emerges not without credit.

When they are considered without reference to the author's purpose, these examples of primitive art are seen to attain a high standard. So far as technique and execution are concerned, they serve to illustrate the author's brief but excellent dissertation on the principles and conditions of primitive art. This dissertation, however, is more or less by way of necessary introduction to the main theme. Of the abilities of the primitive artist in his representation of that strange and in many ways mysterious being, the white man, the most striking characteristic brought out in the examples shown here is that only rarely, if at all, has there been any failure to catch and express the national particularities of the model. Englishman, Frenchman, German, Russian, whatever he may be, it is impossible to mistake what the artist intended to represent—and the likeness is more than superficial, it is a portrayal of the spirit. Here, as always, African art excels, perhaps most because of its deep-seated humour and its genius for exaggerated characterization, amounting at times to caricature. In contrast, Prof. Lips maintains that before Gauguin no European artist, with one exception, had succeeded in representing the primitive; while in travel books before the photograph, representations of natives were no more than Europeans sometimes, but not always,

decked out in the appropriate native costume and ornament. This sweeping statement is something of an exaggeration; but it has much to support it. In these examples of African art, however, there can be no question; and English officer, French officer, native soldiery, missionary, trader, and even the English female tourist are touched off to the life. Africa, however, has no monopoly. Russian figures from the North-West Coast are no less successful, and the masks of massacred sailors or traders from New Ireland are distressingly true to fact.

Prof. Lips, in discussing the principles which govern the approach to the study of primitive art, emphasizes the fact that such an art can exist only as a manifestation of, and in relation to, a specific culture. Incidentally, in characterizing a certain school of modern sculpture as purely African, he provides both a condemnation and a refutation of aesthetic theories which ignore the anthropological point of view. When, however, he goes on to deplore the inevitable disappearance of primitive art, as do other writers on African

art for example, he is guilty, may it be said with all due respect, of a certain confusion of thought. His material must surely demonstrate this. The primitive cultures which produced it had already undergone modification by European contacts. The art, in consequence, had suffered some change, but it had neither deteriorated nor perished. Provided that it can be ensured that change in culture is organic, as for example is the aim of 'indirect rule', and not disruptive, but follows lines of development inherent in native custom and institutions, there is no reason why the capacity for artistic expression should not develop likewise, provided it is not disturbed and crippled by the introduction of alien European ideas, principles and technique. This, at least, would seem to be the lesson of the experimental introduction of native craftsmen as teachers at Achimota.

Finally, it may be said that this is a book which no student of social anthropology can afford to neglect. Apart from the light it throws on primitive art and artists, it is an illuminating study of the ways of thought of the primitive mind.

The Distribution of Animals

(1) Ecological Animal Geography

An authorized, rewritten edition based on "Tiergeographie auf ökologischer Grundlage" by Prof. Richard Heese. Prepared by W. C. Allee and Karl P. Schmidt. Pp. xiv + 597. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 30s. net.

(2) Animal Communities in Temperate America: as illustrated in the Chicago Region—a Study in Animal Ecology. By Victor E. Shelford. (Geographic Society of Chicago, Bulletin No. 5.) Second edition. Pp. xiii + 368. (Chicago: University of Chicago Press; London: Cambridge University Press, 1937.) 13s. 6d. net.

DURING the present century, the study of the distribution of animals has entered upon a new phase, marked by a more intense examination of the relationship between animals and their environment, and a desire to bring to the understanding of distribution a physiological point of view applied to communities as well as to individual species and systematic groups. As regards land animals the older works, of Murray, Wallace, Heilprin, Trouessart, Beddard, Lydekker, Selater and others, were based largely upon the knowledge of mammals and birds, and these warm-blooded animals were less obviously subject to several climatic factors which regulate the distribution of less specialized animals; whereas, as regards

marine organisms, from the time of Edward Forbes, the tendency had been to accumulate data of distribution with reference to 'zones' or other generalized areas.

The development of ecology has given a new complexion to the understanding of distribution, and although in this respect the zoologist has lagged behind the botanist, the works noticed here have consolidated the position and placed the zoologist in line for further advances.

(1) Prof. Richard Heese's "Tiergeographie" set a new standard, with its appeal to modern methods and its weighty accumulation of examples widely drawn from zoological research papers. There has been no English work quite like it, although the posthumous volume of Dr. Marion I. Newbigin, "Plant and Animal Geography" (1936), discussed ably and in a rather less minute way some of its main topics. Since the publication of the "Tiergeographie" in 1924, however, much has been done, and the translators and joint-authors, realizing that a transcript would no longer meet the needs, have with Prof. Heese's concurrence placed their own stamp very thoroughly upon the work. They have used their own experience and reading to revise and add, have deleted material with which they did not agree—for example, Lamarckian interpretations stuck in their gorge and were rejected—and they have increased the emphasis upon the influence of marked climatic

variations during the world's history and upon the stability of the present ocean basins. The chapter on the influence of man upon animals has been rewritten, mainly from an American point of view, and the text has been made more readable by the weeding out of Hesse's plethora of scientific names and the simplification of the scientific references. The result is a first-rate work, containing much widely gathered information, and suggesting many problems for the ecologist.

Since the original book was not reviewed in NATURE, its scope may be indicated. The greater part, in three sections comprising nineteen chapters, discusses the actual distribution of animals, in the sea (138 pp.), in inland waters (89 pp.), and on the land (180 pp.). In each case the discussion leads off with an account of the environmental factors and of their relation to animal life, and this is followed by more detailed accounts of the various communities and their structural and physiological relations to the natural conditions in which they live. Preceding these descriptive sections is a valuable introductory section of nine chapters (149 pp.) setting out the general problems and relations of ecological animal geography.

The difficulty about biological generalizations is that exceptions so often threaten to break the rule; in other words, the factors are so complicated that clear cases seldom occur. Here the familiar zoogeographical regions of the earth's surface are condemned as abstractions, because transition areas transgress their supposed objective boundaries; but the positive conclusion is the more helpful, namely, that "the faunal regions are divisions of the earth's surface in which the animal life bears a somewhat uniform aspect, and differs from that of the neighbouring regions in consequence of independent evolution during longer or shorter periods of isolation". When the authors, in support of Bergmann's rule that when the same species inhabits different climates the individuals tend to attain the greatest size in the coolest regions, cite (amongst others) the case of the red-deer as increasing in size towards the north-east of Europe and decreasing towards the south-west, they seem to lean upon a weak reed, for the Norwegian specimens are less than the Swedish, and both are inferior to the deer of Germany and the Carpathians; perhaps the factor of food upsets the rule. Also, how are we to account for the fact that the distinctive forms of the sea-girt St. Kilda (oceanic climate), whether they be field-mice or house-mice or wrens, are larger than their fellows on the Scottish mainland? It is an interesting thesis, supported by many examples and accounted for in various ways, that the extent of a region is reflected directly in the numbers of its species and even in their size.

In regard to the major facts of historical geography, the authors dismiss Wegener's theory of continental drift in a sentence; but since the 1928 symposium which they follow, geologists have been weakening in their opposition, and the remarkable parallels drawn by du Toit between the geological formations of South America and South Africa suggest that zoologists should for the present keep an open mind.

In the bibliographies the translators have included many important works published since 1924, but admitting that rigid selection was necessary, reference might usefully have been made to C. B. Williams's "Migration of Butterflies" (1930) in connexion with the movements of insects, to Taussig's important "Ökologische Haustiergeographie" (1932), and in connexion with inland waters to Murray and Pullar's six-volume "Bathymetrical Survey of Scottish Fresh-water Lochs" (1910), and Hora's accounts of the adaptations of animals in rapidly running streams.

The book is well printed, is illustrated by instructive and modern text-figures (although there is a wretched photograph of the gannets on the Bass Rock), and is very free from slips ("save" for have, p. 117, l. 31; "Agric." for Avic.; p. 418 ref. 10; and the misleading "Baltic starfish" given as the English name for the four-bearded rockling).

Most of these points are matters of opinion, but there can be no two opinions about the value of the book itself.

(2) Shelford's "Animal Communities" has been for so many years an indispensable guide in the teaching of ecology in Great Britain that its merits do not require to be stressed. The second edition is an impression of the first, unchanged except for the correction of typographical and clerical errors, the modification of community nomenclature, and the addition of a short bibliographical appendix. But the advances of animal ecology since the original work appeared in 1912 make it odd to read the complaint that zoology has furnished geography only with data almost exclusively concerning the taxonomy and morphology of animals (p. 318); Hesse (not mentioned in the bibliography) and his cloud of witnesses are the answer. In the first chapter (where "Thompson" (p. 6) should be Thomson), the section on "the economic importance of animals" contains no reference to domestication.

However, the body of this pioneer work, a descriptive account of typical habitats and their communities, with occasional suggestions of the changes which both may undergo in parallel, retains its original value as an introduction to the modern method of field natural history.

JAMES RITCHIE

Communal Life Among Termites

The Soul of the White Ant

By Eugène N. Marais. With a Biographical Note by his Son and translated by Winifred de Kok. Pp. xv+184+8 plates. (London: Methuen and Co., Ltd., 1937.) 7s. 6d. net.

THIS book is of considerable interest; it contains a number of original observations and there are some good plates and text figures. The original was written in Afrikaans and the translation is by Winifred de Kok.

The translator, in her preface, writes: "His years of unceasing work on the veld led Eugène Marais to formulate his theory that the individual nest of the termites is similar in every respect to the organism of an animal, workers and soldiers resembling red and white blood corpuscles, the fungus gardens the digestive organs, the queen functioning as the brain, and the sexual flight being in every respect analogous to the escape of spermatozoa and ova.

"About six years after these articles appeared (his original papers) Maurice Maeterlinck published his book "The Life of the White Ant", in which he describes this organic unity of the termitary and compares it with the human body. This theory aroused great interest at the time and was generally accepted as an original one formulated by Maeterlinck."

Marais further classes the workers as the mouth and teeth and the soldiers as the functional equivalent of the medulla oblongata; the fungus gardens as the stomach and liver, and the termitary itself as not a heap of dead earth, but as a separate animal at a certain stage of development—a composite animal in exactly the same way that man is a separate composite animal, only without the power of locomotion. By the operation of natural selection the final result will be a termitary which moves slowly over the veld! We fear we have not sufficient imagination to conjure up such a miracle. Such a theory would naturally appeal to the poetical mind of Maeterlinck; but he should at least have given Marais the credit for it.

It appears to us that the author in his endeavour to prove his theory over-reached himself, and probably thereby lost sight of a number of equally interesting facts and problems. We have seen it stated that if his facts are beyond question his theory is quite unanswerable. We do not agree with this statement; but at the same time we propose to show that in many instances what he says is incorrect.

The theory itself is only a poetical invention and gets one nowhere. One might equally well compare the termitary to the heavenly bodies, the queen being the sun, etc., and use similar arguments to try to prove it. The statement that the king and queen are ordinary four-winged *neuropterous* insects is contrary to what is known on the subject. Termites are now considered to be descended from a common ancestor to that of cockroaches, and possess some characters similar to those insects.

The queen is said by Marais to have the power of producing three different forms of insects: the queen, the worker, the soldier. As a matter of fact she can produce, as shown by Wheeler, sixteen different kinds of individuals, as follows: first-form males and females (true kings and queens); second-form males and females; third-form males and females; large male and female workers; small male and female workers; large male and female soldiers; medium-sized male and female soldiers; small male and female soldiers.

It is probable that not all these occur at once in one colony, but five or six are often to be met with in a single colony.

It is stated that all direct activity ceases in the termitary immediately the queen is destroyed, and there is an end to the community as such.

This may be the case in a small new termitary, but certainly not in a large old one. The second- and third-form adults are complementary or substitutable kings and queens, and can be used if, or when, the true queen (or king) dies. The second form have wing pads or incipient wings and perfectly formed reproductive organs, though smaller than in the first form, and the third form are entirely wingless, but possess mature reproductive organs which are smaller than in the second form.

The author says of the true kings and queens that one moment the insect is flying, a moment later the wings are detached, yet one finds no evidence of a lesion. Wheeler points out that the wings of the first-form adults break off at pre-formed basal sutures, and old individuals of this caste can always be recognized by the truncated wing-stubs. Marais also mentions wing-buds being sometimes present, but attributes this to atavism.

Many other instances might be brought forward, but the space at our disposal will not permit. It must be remembered that the habits of different species of termites (as with ants) differ, and the author was only observing one species.

HORACE DONISTHORPE.

Amenities of the Countryside

(1) *England under Trust:*

the Principal Properties held by the National Trust in England and Wales. Described and illustrated by J. Dixon-Scott. Pp. xx + 339 + 62 plates. (London: Alexander Maclehose and Co., 1937.) 7s. 6d. net.

(2) *Britain and the Beast*

By J. M. Keynes, H. J. Massingham, Sheila Kaye-Smith, E. M. Forster, W. A. Eden, O. E. M. Joad, John Moore, Clough Williams-Ellis, Geoffrey M. Bompfrey, R. G. Stapledon, A. G. Street, Patrick Abercrombie, Thomas Sharp, G. O. Hines, Howard Marshall, Lord Horder of Ashford, G. M. Trevelyan, John Gloag, Sir William Beach Thomas, S. P. B. Mais, R. M. Lockley, Kenneth Spence, Edmund Vale, George Scott-Moncrieff, Lord Howard of Penrith, Aileen Tatton Brown. Pp. xx + 332 + 41 plates. (London: J. M. Dent and Sons, Ltd., 1937.) 10s. 6d. net.

THE almost simultaneous publication of these two books marks an important stage in the increasing consciousness of Englishmen that they have in their countryside and their older buildings a historic heritage of incalculable value which is in danger of destruction and ought to be made secure for the enjoyment and education of their descendants. One of them is a pictorial and descriptive account of the principal properties held by the National Trust and is thus primarily a record of achievement: the other contains the views of twenty-six eminent persons on various aspects of the problem, some being content to describe, and generally to deplore, the present situation, while others put forward suggestions more or less comprehensive and more or less practical, which they would like to see adopted in a future policy.

(1) "*England under Trust*" contains accounts of more than fifty properties now held by the National Trust. They range geographically from Cornwall to the Roman Wall in Northumberland, and from Kent to the Lake District: in area they may be as small as Coleridge's Cottage at Nether Stowey, or as extensive as the seven thousand acres of the Holnicote Estate in Somerset. They include properties of every description—ranges of cliffs in Cornwall, an ancient hostelry in Southwark, great stretches of moorland and fell in the Lake District, historic houses like Bodiam, Tattersall, or Montacute, a complete village in Buckinghamshire, and six hundred acres of Cambridgeshire Fens.

A most encouraging feature of the record is that the Trust seems to be accumulating properties

at a rate which is rapidly increasing: the number of acquisitions here illustrated which have come into its hands since 1930 is surprisingly large. It is also interesting to note that while Cornwall and the south-west generally seem to vie with the Lake District as the areas in which the Trust has been most successful in its aims, Norfolk, Yorkshire, and the north-east as a whole seem to be still almost untouched by its activities. Another fact which emerges is that the Trust now holds a considerable number of the few remaining ancient village clergy-houses; of these, the Alfriston parsonage is probably the best known, but the church houses of Widdecombe, Muchelney, and West Wycombe are all delightful buildings.

The most valuable feature of the book lies in the magnificent series of photographs by Mr. J. Dixon-Scott: every property described is illustrated by at least one of these, and both in composition and reproduction they could scarcely be bettered. It is a pity that the descriptive notes are not up to the standard of the illustrations: they are pleasantly written on the whole, but elementary grammatical errors can be found by the curious on pp. 81, 113, 147, 189, 197, 227, and 228; and it is somewhat disconcerting to find elementary historical errors also in a book the scholarship of which Prof. G. M. Trevelyan has specially commended in his foreword. The Antonine Wall, for example, was not built by Agricola (p. 24): nor did Boudicca sack Lincoln and York (p. 187), though she did sack London, which according to Mr. Dixon-Scott escaped her: nor did the Black Prince live in the fifteenth century (p. 208). In the account of Tintagel there is no mention of Mr. Radford's recent and very important excavations, which have illuminated its history far better than the shadowy Arthurian connexions, here detailed without a suggestion of doubt on their historicity. One would have hoped that a book issued under the auspices of what is after all the National Trust for Places of Historic Interest would have paid more regard to the claims of historic accuracy.

(2) "*Britain and the Beast*" is a thoroughly depressing book, partly because it directs attention to depressing facts with which most people are familiar (although apparently not familiar enough) and partly because its twenty-six eminent authors, in spite of ten introductory pats-on-the-back from ten even more eminent persons, have nothing approaching a common policy for improving matters. Indeed the editor, Mr. Clough Williams-Ellis, has probably been wise to let each member

of his curious team have his own say in his own way, permitting no argument with his neighbours, for if anything like a symposium, in the proper sense of that abused word, had been attempted, it would probably have developed fairly quickly into a 'rough house'. Thus O. E. M. Joad's opening assumption that the primary purpose of the countryside is to provide space for townsmen to play in, is met by A. G. Street, who asserts with some asperity that it is meant for countrymen to work in. H. J. Massingham, in a survey of English agrarian history which is little better than a caricature, believes that the big landowners have ruined the rural scene; W. A. Eden, on the other hand, thinks that they are responsible for most of its loveliness. G. M. Boumphrey urges that a rigid line should be drawn between town and country, while Aileen Tatton Brown apparently contemplates an England which by 1987 has become one vast garden city.

Most of the writers seem to want the establishment of national parks, but they are far from agreed either on their location or their purpose. The individual contributions are of very varying length and, one may add, of very varying merit: some of the authors have really nothing to say,

some have a great deal too much, and some again are so choleric that it is difficult to make out whether they have any coherent ideas at all. Among those which fall into none of these classes may be mentioned W. A. Eden's sensible and constructive account of the landowner's contribution; Sheila Kaye-Smith's interesting revelations on the economics of speculative building; the editor's scheme for scheduling historic houses and their owners; P. Abercrombie's practical analysis of the deficiencies of present town and country planning legislation; K. Spence's straightforward ideas on the Lake District; and Lord Howard of Penrith's excellent account of the amenity laws in Switzerland, Germany and Sweden; while Sir W. Beach Thomas's translation of '*Littera scripta manet*' (it is very hard to get rid of printed offal) deserves a cheer all to itself.

It is a great pity that the obviously excellent photographs have been ruined by running them right over the edge of the page, leaving no margin—a modern practice which has little to commend it—and by printing them on much less satisfactory paper than is used in '*England under Trust*'. Altogether a depressing book; but that, after all, is presumably what its authors intended it to be.

The Growth of Modern Chemistry

A Hundred Years of Chemistry

By Prof. Alexander Findlay. (The Hundred Years Series.) Pp. 352. (London: Gerald Duckworth and Co., Ltd., 1937.) 15s. net.

TO write an account of the development of chemistry during the last hundred years is a task which might well daunt even the boldest spirit; for chemistry is a major science advancing rapidly on an ever-widening front, and the period in question begins not long after chemistry had become an exact science capable of mathematical interpretation. The infusion into the body of science of a new spirit—an achievement which, in Liebig's words, constituted the immortal glory of Lavoisier—led rapidly to the formulation of that comprehensive Atomic Theory the ramifications of which form the nervous system of the wonderful body of physical science as we know it to-day.

Prof. Findlay's task has been to take up the story of chemistry soon after the birth of Dalton's theory, and to trace these ramifications in a concise and intelligible manner. Such a task calls for many qualifications. Among them may be mentioned the sixth sense of the historian, the power

of critical discrimination and selection, the gift of terse expression, unending patience, a courage which never fails, and a determination to achieve the highest possible degree of accuracy. A perusal of Prof. Findlay's book will convince the most fastidious reader that the author has all these requisites.

Covering with swift strokes of his brush the limited canvas represented by some three hundred pages, our 'chymicall Artist' has produced a harmonious panorama of this century of chemistry, peopled by a rich array of pioneers of the science. As the picture grows beneath our gaze, we see how the molecular theory of Avogadro arose as an inevitable outcome of the atomic theory of Dalton; how the molecular theory called with an increasing insistence for the development of a conception of the linking of atoms into a molecular structure; and how, in turn, a body of seemingly irreconcilable facts led to the expansion of the two-dimensional organic molecular structure into a three-dimensional configuration, and thus to the birth of that vast sub-science of stereochemistry, which now embraces all substances. We see, further, how these successive advances

in theory were followed by an increasing command of practical technique, leading to the gradual elucidation of the constitution of natural products, to the synthesis of an enormous range of natural and artificial organic substances, and to the foundation of manifold industries based upon the new chemical knowledge.

Other strokes of this facile brush reveal how the determination of atomic weights led to the law of periodicity; how this law "first enabled us to perceive undiscovered elements at a distance which formerly was inaccessible to chemical vision"; how the discovery of co-ordinate families of elements indicated an identical origin; and how, as we reach the edge of the canvas, there developed from this and other sequences the idea of the electronic constitution of matter.

Our artist depicts also the spectacular developments of physical chemistry, bringing out such high-lights as the kinetic theory of gases, the correlation of physical properties and chemical constitution, the law of mass action, catalysis, the phase rule, the theory of solutions, the ionic theory . . . and, in another field of vision, the recognition and study of radioactivity, and the development of the modern theory of atomic constitution. Truly, "the records grow unceasingly, and each new grain of truth is packed, like radium, with whole worlds of light."

The value of this bird's-eye view of the growth of modern chemistry is enhanced by the copious and accurate documentation, in the form of unobtrusive footnotes. Some of these original sources have evidently been tracked down by Prof. Findlay at a considerable cost in time and labour, as they are not to be found in the ordinary books of reference. The specialist will appreciate this feature of the book as fully as the reader with a less detailed knowledge of chemistry will enjoy the easy flow of a narrative which is of necessity somewhat condensed.

As we should expect, Prof. Findlay does not neglect the human aspect of his subject, although even here, where he might have been excusably discursive, he tempers his enthusiasm with a wise restraint. He says enough to show the reader how often one investigator seems to rise upon the shoulders of another, and how narrow is the margin which sometimes divides success from failure in chemical research work. It may also be deduced that some of the figures in this historical gallery were born under a lucky star. Thus, Pasteur's first great discovery—which laid the foundations of stereochemistry—was dependent upon the fortunate choice of a specific salt, and its crystallization below a temperature of 27° C. But chance and some auspicious star have accounted for much in the history of science, as in the social and political history of nations.

Regrettably, many of these fortuitous circumstances have passed unrecorded. It is unlikely, for example, that anybody except the present reviewer knows that the first optical resolution of a substance containing no asymmetric atom in its molecule, to which Prof. Findlay refers (p. 78), was due, in the last analysis, to the dilatory habits of a certain laboratory boy, whose inaction at a critical moment has until now remained unwept, unhonoured and unsung in the records of chemistry. And certainly nobody else knows what Sir William Pope exclaimed—when the resolution had at last been effected—at the first sight of the change in the polarimeter field: suffice it to say here that he did not repeat the English equivalent of Biot's historic utterance at the first sight of the optical rotation produced by sodium ammonium laevo-tartrate: "Mon cher enfant, j'ai tant aimé les sciences dans ma vie que cela me fait battre le cœur!"

The reflective reader may well put down this book with the query, *Quo vadis?* "The ultimate components of matter," says Prof. Findlay (p. 261), "now appear to be two in number, the positively charged proton and the unit of negative electricity, the electron". . . . Proton and electron—positive and negative—sulphur and mercury—Sol and Luna—masculine and feminine—Yang and Yin—Osiris and Isis—sun-god and moon-goddess: what a curious appeal this doctrine of the Two Contraries has made to the human intelligence throughout the ages! The wheel turns full circle, and the father-god and mother-goddess of the ancient civilizations reappear in the latest conception of the atom. So, too, the tail-eating snake of ancient Egypt reappeared some two thousand years later in the "Chrysopsis" of Cleopatra, and came once again in these latter days to whirl mockingly before the eyes of August Kekulé, whose fleeting vision of this ancient symbol of eternity gave birth in 1865 to the conception of the benzene ring—"the crowning achievement of the doctrine of the linking of carbon atoms".

Of chemical theory we may exclaim: "Plus ça change, plus c'est la même chose!" It is true that we have elaborated the alchemists' doctrine of the unity of matter and their sulphur-mercury theory of the constitution of metals; and that the modern imagination has bodied forth the proton, the electron, the positron, and the neutron (this last being the latest expression of the alchemical Rebis); but when we try to formulate the ultimate realities of matter we find them as elusive as that *ignis-fatuus* of alchemy, the Philosopher's Stone—the faith of Monday, Wednesday and Friday is the heresy of Tuesday, Thursday and Saturday. Is the path of scientific inquiry into the

fundamental nature of things fated to lead beyond the limits of human understanding into a four-dimensional world as unintelligible as the wild mysticisms of alchemy? Or will the Ouroboros Serpent, at the psychological moment, bring further enlightenment, in another vision, to some future seer of the sub-atomic world?

In these days, when an ever-increasing specialization threatens to produce a generation of

chemists running in blinkers, it is hard to find an all-round master of the science who is able to see it steadily and see it whole, and to depict it in its full coherence and beauty. Prof. Findlay is such a master, and all who have the interests of chemistry at heart will be grateful to him for producing this admirable account of the growth and present state of the science.

JOHN READ.

Atomic Spectra and Atomic Structure

(1) Atomic Spectra and the Vector Model

By A. C. Candler. Vol. 1: Series Spectra. Pp. viii + 237 + 4 plates. 15s. net. Vol. 2: Complex Spectra. Pp. vi + 279 + 4 plates. 15s. net. (Cambridge: At the University Press, 1937.)

(2) Atomic Spectra and Atomic Structure

By Prof. Gerhard Herzberg. Translated with the co-operation of the Author by Prof. J. W. T. Spinks. (Prentice-Hall Physics Series.) Pp. xv + 257. (New York: Prentice-Hall, Inc.; London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 4.25 dollars; 18s. 6d. net.

(1) MR. CANDLER'S two volumes upon atomic spectra will appeal to the spectroscopist rather than to the general reader. As the title implies, the whole work is developed on the vector model of the atom. There is a good deal to be said for a book of this nature, for the fact remains that most practical spectroscopists use the vector model in analysis and only turn to the wave mechanics solutions when vectors break down. There is, however, frequent reference to the findings of quantum mechanics, and an introductory chapter on this might well have been included. Throughout the book the historical method of approach is used, the result being an essentially empirical introduction to each branch of the subject. Both volumes contain much detailed material bearing on fundamental principles.

The first volume deals with series spectra and has a general introduction which is clearly written. A good deal of space is justifiably devoted to a very full description of the Zeeman effect, and this is followed by an excellent chapter upon atomic magnetic properties. The description of the Stark effect is rather more detailed than the accounts usually met with in a book of this nature, but this is all to the good. The chapter on the Periodic Table of the elements includes a good deal on valency and is of interest to the chemist as well as to the physicist. Extensive tables of g factors, intensities and Rydberg term values are

included, with the view, apparently, of assisting the experimenter.

In the second volume, dealing with complex spectra, there is detailed consideration of individual spectra, a very wide range being covered in order to illustrate the spectral types found in the different columns of the Periodic Table. It is obvious that the author has consulted a large number of treatises and has thoroughly digested a great number of research publications, the resulting summary being certainly effective. An unusual chapter of interest is that dealing with the line absorption spectra of solids. A good chapter on intensities in line spectra has been included, but the intensities in hyperfine structures seem to have been neglected. Throughout this volume, as in the first, the value of the Zeeman effect is correctly stressed, each point of theoretical interest being supported with a wealth of experimental detail.

The chapter on hyperfine structure is not so satisfactory as the rest of the book, containing some omissions and errors. It is stated, for example, that no absolute measurements of hyperfine structure intensities have been made, but at least four papers on this subject have appeared since 1931. The nuclear spin given for iodine on p. 204 is the earlier incorrect value, and it is questionable whether the author is justified in assuming that, in even isotopes, absence of hyperfine structure means zero spin. The hyperfine structure Zeeman effect is treated with the same clearness that characterizes the description of the ordinary Zeeman effect, and a useful summary is given of the applications of observed nuclear spin properties to the theory of nuclear structure. The interesting method of deriving information about the structure of spectral terms from the study of the depolarization of resonance radiation might have been included.

The last two chapters in the book deal with forbidden transitions and with fluorescent crystals, the latter being particularly well done. Incidentally,

it is time spectroscopists adopted uniformity in the description of forbidden transitions. Mr. Candler uses the term "quadrupole radiation" whilst Prof. Herzberg, in writing of the same thing, calls it "quadrupole radiation". Both notations are unfortunately in regular use.

There are many beautiful plates and diagrams in the work, which is essentially descriptive, easy to read and free from difficult mathematics. It ends with valuable lists of papers on the spectra of each atom and on the hyperfine structures in the spectra. The latter compilation is, I believe, the first of its kind to appear in print and will be found useful by the research worker. Considering the amount of material in the book, the errors are few and far between. It is an excellent treatise for spectroscopists and for investigators wishing to undertake spectroscopic work on line spectra.

(2) The book by Prof. Herzberg is a translation of his recent work "Atom Spektren und Atomstruktur" (Dresden, 1936). It is an introduction to atomic spectra and atomic theory, and is admirably suited to those physicists and chemists who wish to become acquainted with the elements of the subject. Beginning with the elementary Bohr theory of the hydrogen spectrum, the author goes on to show how the vector model breaks down as soon as the helium spectrum is considered, and proceeds to explain why the wave mechanics treatment is necessary. The introduction to the wave mechanics picture of the atom is particularly lucid and is deprived of the terrors usually associated with it in the mind of the student. Throughout the book the vector model and the quantum mechanical view are skilfully blended together into a unified description of atomic processes. A useful point is that certain more difficult paragraphs giving rather detailed wave mechanical explanations are printed in small type and can,

if so desired, be avoided by the reader without destroying the continuity.

The field covered by the book is very wide. The treatment of the Zeeman effect is particularly clear, a careful balance being maintained between vector theory and wave mechanics. The Stark effect is much more briefly dealt with. It is unfortunate that the important table on p. 127 exhibiting the application of the Pauli principle has such tiny lettering that the suffixes can only be read with difficulty. Perhaps too much of chapter iv is included under small type, since, surely, all should read the important details given on series limits, perturbations and jj coupling. The same chapter includes a brief but very clear and precise exposition of auto-ionization. Considering the scope of the book, the chapter on hyperfine structure is reasonably complete, but again one meets the unjustifiable association of zero nuclear spin with absence of fine structure in even isotopes. This remains yet to be proved, and should be qualified in a book of an introductory nature.

The last chapter will be greatly appreciated, particularly by chemists. It deals first with atomic magnetism and then devotes a good deal of space to the applications of the known facts about atomic ionization potentials, a complete table of which is given. Amongst the subjects covered in this chapter are electron affinity, collisions of the second kind and the quantum theory of valency.

The book is illustrated by excellent diagrams and by a number of very good plates. It is only on the rarest of occasions that evidences of the German original peep through the excellent translation. This book deserves to become popular and to become widely read. Students in particular will find it a very valuable introduction which will bring them right up to the most recent developments.

S. TOLANSKY.

Chemical Engineering: Position and Prospects

The Transactions of the Chemical Engineering Congress of the World Power Conference, London, June 22—June 27, 1936

Vol. 1. Pp. lxxxv+525. Vol. 2. Pp. vi+664. Vol. 3. Pp. vi+797. Vol. 4. Pp. vi+751. Vol. 5: Index. Pp. v+164. (London: Percy Lund, Humphries and Co., Ltd., 1937.) 5 vols., £12.

EIGHTY-THREE pages at the beginning of vol. 1 contain a very complete record of what took place at the first Chemical Engineering Conference of the World Power Congress, and include an account of the various functions as well as a list of the members of the Conference.

The remainder of this volume is devoted to an important subject to the chemical engineer, namely, the materials available for the construction of chemical plant. Since iron and steel still constitute the principal materials used by the engineer, the first section is devoted to this subject and the recent developments in the manufacture of ferrous alloys and their properties. In the second section of this volume are papers on the non-ferrous metals, refractory materials, stone-ware, rubber, plastics, and the use of fibrous materials, all of which are used in the formation of apparatus employed in various branches of the chemical industry.

Twenty papers, all dealing with the important subject of separation in its various aspects, such as separation without change of phase or physical state, separation with change of phase or physical state, and separation involving physical reaction, form the first part of the second volume, whilst the later portion of the volume comprises three papers relating to fine grading and the estimation of finely divided solids, and eight papers on electrolysis and the production, application and development of electricity in the chemical industry.

The contents of the third volume are divided into four sections, the first of which consists of eleven papers on destructive distillation, more especially in its relation to the gas industry, as well as the blending of coals for this purpose and the correlation between the analysis of coal and its carbonization in semi-scale and industrial plants. Waste materials and the disposal of effluents form an important problem both to the industrialist and to the individual members of any community and are discussed in four papers in the first part of the next section, whilst three other papers in the second part are concerned with the production, treatment and properties of lubricating oils.

High pressures and vacua are now being more and more extensively used in industry, so it is appropriate that seven papers on these subjects should be included in the third section of this volume, in which papers on the technology of high vacua, construction of welded pressure vessels, synthesis of organic compounds, and liquid and gaseous phase reactions under high pressure are presented.

Since the addition or removal of heat is an important feature in many chemical operations, it is not surprising that the last section of this volume is given over to this subject. In the nine papers presented, such aspects as thermal compression, condensation of vapours and mixtures of vapours and gases, and other important factors connected with the application of heat in industrial problems as well as the mechanism by which the transference of heat is actually effected, have been considered.

Vol. 4 also comprises four sections, the first of which is devoted to the education and training of a chemical engineer and contains seven papers. Considerable difference in opinion has been expressed from time to time on the question of the education and duties of the chemical engineer, so that this section should prove one of the most valuable in the volume and one which should be helpful in future conferences, as it indicates the views of the leaders in this subject in those countries where classes exist for the training of industrialists of this type.

To anyone engaged in the administration of an industrial concern such subjects as efficiency, planning and control of chemical works, prevention of accidents therein and the methods of analysing the cost of a process, which form the themes of seven papers in the second section of this volume, are of interest and importance.

Under the heading of trend of development are thirteen papers upon a variety of subjects which can be broadly classified into three groups, namely, treatment of water for both steam raising and industrial purposes; the heavy chemical industry comprising sulphuric acid manufacture, phosphatic fertilizers and the production of calcium carbide; and thirdly, papers relating to biological processes such as fermentation, fumigation and refrigeration, all of which are included in the general term of chemical industry.

In the last section of this volume and the last session of the Congress are a group of eleven papers classified under the heading of general aspects, which can be conveniently subdivided into two subsections, namely, those papers relating to fundamental research and those to applied research. Applied research comprises the development of research laboratories by large industrial organizations, the applications of the results obtained either from fundamental or applied research to the design of chemical plant, and the investigation and study of the raw materials of a country and their utility to chemical industry. At the end of each section is a report showing the main features of each paper in that section which might form the basis for discussion, and this is followed by the discussion which took place on the papers contained in that section.

Several factors have apparently influenced the grouping of the papers, of which one of the most important was the time available for presentation and discussion, which in many instances was too short for the importance of the subject under review. The different interpretations placed upon the term chemical engineer having been to some extent clarified during this Congress, should result in the papers submitted to subsequent conferences of this kind being even more germane to the subject.

Any review of this publication would be incomplete if no mention were made of a fifth volume of one hundred and sixty-four pages which has been very carefully prepared and edited, comprising both subject and name indexes.

These books should prove a very useful addition to any library dealing with their subject, since they give world-wide views on the various aspects of a large and complex problem.

One cannot conclude without expressing appreciation of the manner in which these transactions have been printed and edited.

Corrosion of Metals

Metallic Corrosion, Passivity and Protection

By Dr. Ulick R. Evans. Pp. xxiii + 720. (London: Edward Arnold and Co., 1937.) 45s. net.

THE importance of corrosion and protection of metals and alloys against corrosion especially to engineers, chemists and metallurgists needs no emphasis to-day. Wherever and whenever the commoner metals are used, corrosion may make its appearance. A significant feature of the study of corrosion is the enormous amount of investigation work that has been done during the past ten years. Dr. U. R. Evans has wisely taken the course of writing an up-to-date account of the subject as it stands at present in preference to revising his earlier book on "Corrosion of Metals", the last edition of which appeared in 1926.

The research work of Dr. Evans on corrosion is very well known not only to engineers and manufacturing chemists, to whom the new work is addressed, but also to the wider realms of science and technology of modern civilization. During the last ten busy years of corrosion-science, Dr. Evans has been the leader of a strong team of research workers at Cambridge, from which notable contributions to knowledge have emerged in a steady stream. For these reasons alone a new survey of the study of corrosion by Dr. Evans will be welcomed. Although fitting mention is made of Cambridge work, the author has not given undue prominence to it, but on the other hand has given a well-balanced account of his subject. The task of summarizing existing knowledge of corrosion is indeed an immense one, especially as the literature is so widely spread and so rapidly increasing in volume. No other author has attempted a work of these pretensions, and the new volume appears likely to occupy a unique position for many years to come.

The arrangement of the subject-matter is on a scientific basis. The author's aim is to unfold the facts leading to an understanding of the causes of the various types of corrosion, without which understanding the attempt to apply remedies may, as the author points out, be dangerous. There are fifteen chapters each dealing with a special aspect of corrosion or passivity. The treatment is somewhat unusual in that each chapter is divided into three sections, the first or *A* section of each being concerned with the scientific basis, the second or *B* section with practical problems, and the third or *C* section with quantitative treatment. This arrangement of the subject-matter should prove of value to readers who for various reasons are

more concerned with the practical aspects than the theoretical or with quantitative aspects rather than qualitative.

Separation of the aspects of corrosion studies in this way has not prevented the author from directing attention to all points of view, achieved by presentation of very interesting subject-matter in a well-sustained manner. The reader must inevitably find himself penetrating the *B* sections even though he may have intended at first to peruse the *A* sections. This is truly a good feature and bears on the larger treatment of corrosion matter, since the subject is one which does not lend itself to empiricism. To escape the ravages of corrosion it is necessary to know not merely what is the cause but also in what manner the prevailing conditions are of influence in one way or another. In matters of corrosion, scientific treatment has ploughed stubborn ground, and those concerned with any aspect of corrosion will be the better fitted to cope with their problems the closer their acquaintance with the basic principles.

The importance of surface films on metals revealed by researches of the modern age of corrosion-study demands for them a prominent position in any treatise on corrosion, and the author appropriately devotes the opening chapters to this side of the subject. Here a useful résumé of pickling methods and results of research on pickling is well placed in view of the recent advances in pickling treatment of iron and steel, for example, to leave a protective film of phosphate on the surface with benefit to the protective effect of paints. The next chapter deals with oxidation at raised temperatures, a subject of high importance in many branches of industry.

In the next five chapters, atmospheric corrosion, tarnishing, corrosion in stagnant liquids, corrosion in moving liquids, hydrogen evolution and influence of constituents of the liquid are reviewed and discussed fully. In view of the multiplicity of factors involved and the interdependence of effects, it is not a matter of surprise that in these fields of corrosion-study different conceptions arise. In this connexion the author fittingly presents a considered statement by Bengough and Wormwell summarizing their views on corrosion of metals in salt solutions, a field in which they have made extensive researches.

The next two chapters deal with the influence of intrinsic features of metals and alloys upon corrosion. From this aspect of corrosion-study notable lines of advance have been followed to fruition, and perusal of this portion of the book

leaves the reader with an impression of the great scope for further advances as further basic knowledge is gained.

A chapter is devoted to the influence of stress and strain, and here a survey of corrosion fatigue research is given. Corrosion fatigue is one of the youngest branches of corrosion-study, and the results have been, to say the least, alarming to engineers. As in other fields, however, systematic experiments and scientific treatment are yielding information of practical value.

The rest of the book is devoted to the influence of contacts and crevices, protection by metallic coatings, protection by paints and enamels and corrosion testing, with an appendix on optical measurement of film thickness.

The book is a rich mine of information on corrosion problems and will prove of value to all chemists, engineers and metallurgists. It seems doubtful whether the binding will endure the hard use that many of the copies will surely find.

H. S.

Developments in Air Navigation

Air Navigation

British Empire edition. By Lieut.-Comdr. P. V. H. Weems, U.S.N. Edited by Arthur J. Hughes and P. F. Everitt. Pp. xiii + 490. (London: McGraw-Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., Inc., 1937.) 30s.

THIS book presents clearly and systematically the theory and application of the present methods of air navigation, which form an integral part of the duties of the long-distance or 'deep sea' aviator. In the course of preparing this edition, the author has been in touch with officials of the Admiralty, Air Ministry, Imperial Airways, Air Service Training and others.

The rapidity with which the air pilot must determine his position—if it is to be of any value—has in recent years led to an overhaul of the abridged methods of the mariner, and, indeed, to the development of a school of air navigation. The fundamentals of dead reckoning and celestial navigation are common to all branches of the work, whether on land, on sea, or in the air; it is largely to the introduction of improved and abridged tables combined with the use of specialized instruments that the present advance in speed and simplicity is due. In short, the more quickly the observer must obtain his position, the more dependent has he become on the technical and instrumental side of the work. In this connexion Commander Weems has had the co-operation of Mr. A. J. Hughes, through whose public spirit the preparation of this edition is largely due.

The air pilot cannot stop on account of sudden fog or bad weather, and is thus forced to have at all times a fairly accurate knowledge of his position. For this purpose he employs pilotage, dead reckoning, radio and celestial navigation. Over stretches of uniform country, as for the mariner in open sea, pilotage may not assist, and dead

reckoning is handicapped by unknown variations in the direction and force of the wind, a factor of far greater importance for the aviator than for the mariner. Position lines from radio bearings are limited by the proximity of transmitting stations, and celestial navigation is, of course, dependent on visibility, though here the aviator has some advantage over the mariner in that he can usually rise above the clouds, while his bubble sextant is independent of the sea horizon. It is due to the development of the bubble system of artificial horizon that the navigators of the air and sea are now able to observe with equal facility throughout the twenty-four hours to within 5' or, under favourable conditions, considerably less. Improvements in the bubble sextant are in progress, and a type that will automatically register the mean of a series of six settings is under construction. To the list of observation reduction tables is to be added the forthcoming "Hughes Tables for Sea and Air Navigation", which appear to be a decided improvement on anything of their kind yet published. For air navigation time may be further saved by the use of precomputed altitudes, of which a full description is given.

Comprehensive descriptions, liberally illustrated, of all relevant instruments in use both in Great Britain and in America are found in appropriate parts of the text. The early chapters deal with charts, maps, projections, and their application to set requirements. The section on abridged methods of celestial navigation will be of particular interest to all navigators; it is perhaps as clear an introduction to this branch of the work as has hitherto been published.

The necessary, but often curtailed, explanation of the *Nautical Almanac* is further assisted by a comparison with the new *American Nautical Almanac*. In the latter is tabulated the Greenwich hour angle of the principal heavenly bodies, and

by this means the necessity for a knowledge of right ascension, sidereal time, the first point of Aries, or the equation of time is automatically eliminated.

The section on meteorology has been contributed by Dr. Sverre Pettersen, an international authority on the air mass theory.

It is a matter of opinion whether all the examples of the methods advocated are ideally chosen, and the present writer is not impressed with the nature of the star chart in the folder. Nevertheless, the book can be recommended with confidence to the aviator, navigator, or exploratory surveyor alike.

G. C. F.

Theory and Practice of the Calculus

The Elements of Mathematical Analysis

By J. H. Michell and M. H. Belz. Vol. 1. Pp. xxiv + 516, Vol. 2. Pp. xii + 517-1087. (London: Macmillan and Co., Ltd., 1937.) 42s. net each vol.

THE authors have set themselves the task of writing a treatise on the differential and integral calculus which should be at once practical and rigorous, while assuming only the minimum of previous mathematical knowledge. The emphasis, however, is on the practical side, the book being, to quote the dust-cover, "adapted to the particular needs of students of science and engineering".

A fairly full account of the elementary theory of functions of one real variable is given, though not enough to cover the requirements of an honours degree in mathematics. Where an appeal must be made to an unproved theorem—for example, concerning differentiation of $f(x, y(x))$ —the reader's attention is directed to the fact; and, where possible, the theorem is made to appear plausible by being proved or verified in some special case. A good feature is that in several places a strict mathematical treatment is followed by a paragraph entitled "Working Notions", in which the student is shown how loose intuitive ideas suggest or recall the result.

The presentation of the theory is, in the main, well suited to the class of students for which the treatise is intended. For example, in the main body of the work the idea of the non-terminating decimal is taken as fundamental (the Cantor theory of numbers being explained in a final chapter). This introduces very naturally the method of continued decimal subdivision to prove the fundamental theorems. One might wish, however, that this important method were rather more fully explained. Continuous functions are introduced at an early stage, and the limit of a function is dealt with by means of the easily grasped idea of potential continuity. On the other hand, the "general principle of convergence" is derived from a general discussion of limit-processes, which appears to the reviewer to be too abstract

and difficult. Taylor's theorem is very well treated, losing that air of mystery which too often surrounds it. Integration is defined as the inverse of differentiation, the Riemann integral being introduced, but discussed only for a continuous integrand. Curvature, length, area and volume are dealt with rigorously but comprehensibly.

Mathematical rigour in language is usually maintained, but in one place we have "finite" for "bounded", while there seems to be a slight slip in the proof of the limit-sum integral formula. There are a few departures from standard terminology, some of which, such as the distinction between "upper barrier" and "upper bound", are good; while others, for example, "upper continuity" (for continuity on the right), seem likely to lead to confusion.

The practical side of the book is good. There are many worked examples and a large collection of problems. Maxima and minima, interpolation, Newton's method for solving an equation, and other applications of the derivative and of Taylor's theorem are thoroughly dealt with. The trigonometric, exponential and hyperbolic functions are discussed at length and used as examples of methods previously explained, while the cycloidal and epicyclic functions also are introduced. There is a long section on the standard forms of integrand (with recurrence formulæ), and approximate methods of integration are not neglected. Special emphasis is laid on the calculation of the uncertainty in approximations. There is a section on curves, and one on polynomial approximation by various methods. Finally, we have an introduction to differential equations, the second order equation with constant coefficients being completely discussed. It is perhaps a pity, from the practical point of view, that the authors here keep strictly to the domain of the real variable.

To sum up, the book may be recommended to all those who wish to know something of the mathematical discipline of function-theory, but whose main concern with mathematics is as a tool.

A. J. WARD.

Short Notices

Anthropology and Ethnology

A Tribal Survey of Mongalla Province

By Members of the Province Staff and Church Missionary Society. Edited by L. F. Nalder. (Published for the International Institute of African Languages and Cultures.) Pp. viii+232. (London: Oxford University Press, 1937.) 15s. net.

THIS collective work by Government and mission officials in the most southerly part of the Anglo-Egyptian Sudan may be regarded as a supplement to the studies of O. G. and B. Z. Seligman, Driberg and Evans-Pritchard. It contains useful information, particularly about several tribes for whom hitherto there has been scarcely any published material available, and bears witness to the painstaking interest of European residents of the area in the institutions of the native peoples among whom they work. A feature of note is that nearly all the data have been collected in the vernacular.

But in view of this it is to be regretted that, except for Mr. Mynors on the Moru and Mr. Arber on the Latuka, scarcely any writer has supported his generalisations by quotation of native statements or distinguished what he actually observed from what he was told. In the absence of such empirical records, statements such as "the people's ideas [on religion] are generally very vague and unco-ordinated" or "the basis of Bari society is the clan" or "the Lango women are very liable to hysteria" are of small value. Moreover, even in matters which are comparatively easy to observe, there are many gaps in the analysis which could have been filled. In the chapter on tribal structure there is no section on family life; and the meagre summary of economic life (less than four pages) deals almost solely with technical processes, without reference to methods of productive organization and exchange.

The book has much interesting comparative material, and suggests lines for future inquiry; but it illustrates also how necessary it is nowadays that enthusiasm and hard work should be backed up by systematic anthropological training.

R. F.

Anthropology:

an Introduction to Primitive Culture. By Prof. Alexander Goldenweiser. Pp. xxi+550+80 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937.) 18s. net.

PROF. GOLDENWEISER'S "Anthropology" was undertaken originally as a revision of his "Early Civilization"; but in the process of expansion it has grown into a new book. It now falls into three parts. The first, "Animals, Man and Culture", deals with man's place in Nature, and his relationship, physical and psychic, to the animal world, as well as his reactions in the development of culture; the second, "Primitive Life and Thought", discusses in twenty-two chapters culture traits, both material and social in

the broader sense, in the light of specific examples as exhibited in varied cultural environments; and in the third, "The Ways of Culture", certain general problems of theoretical import are considered in four chapters on culture and environment, the spread of culture, and evolution and culture. This last section will be particularly valuable to the student. It is a well-balanced and objective examination of topics into which controversial methods are apt to introduce some, however little, distortion. A chapter on "The White Man's Burden" deals with the deplorable effects on backward peoples of contact with white civilization, and describes the efforts which are being made in the United States under the legislation of 1934 to reintegrate the tribal culture of the Indian. Prof. Goldenweiser, while generally approving the object, confesses that he is not an optimist as to the result, although the Indians have shown themselves eagerly ready to take advantage of the offers made by the Government.

Biology

Atlas of the Scale Insects of North America

By G. F. Ferris. Pp. 280+104 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1937.) 40s. net.

THIS is the first section of a large work undertaken by Prof. G. F. Ferris of Stanford University, who has for many years made a special study of scale insects. The author hopes eventually to deal with every species of scale insect that is definitely established in North America and to make possible their identification. The "Atlas" is primarily a collection of well-reproduced plates of admirably clear drawings illustrating each species, with brief notes on synonymy, hosts and distribution, habit, and the chief recognition characters; and the matter concerning each species can, if desired, be obtained separately in loose-leaf form.

In an interesting introduction describing the plan and basis of the work, Prof. Ferris also discusses the system of classification adopted. He considers that the old family Coccidae "must be stepped up at least to a super-family", Coccoidea, within which he recognizes eleven families occurring in North America. Among these, the Diaspididae is divided into the sub-families Diaspidinae and Phoenicococcinae, and the volume under notice deals with the tribe Diaspini of the former sub-family. This covers some 34 genera, including species of *Aulacaspis*, *Ohionaspis*, *Diaspis*, *Epidiaspis*, *Lepidosaphes* and *Parlatoria*. The debatable problem of the genera to be accepted is shortly discussed, the author admitting that it "cannot be settled to the satisfaction of everyone, or perhaps even of anyone, the author included". About a hundred species in all are illustrated and, as a rough estimate, it is thought that the complete "Atlas" will include perhaps 750 species.

The difficulties of identification of scale insects are considerable, but they are a highly interesting group from the taxonomic point of view and have the added attraction that many species are of great economic importance and wide distribution as pests. In spite of this their study has been much neglected, and all who are interested will be grateful to Prof. Ferris for undertaking the valuable publication, which should prove a stimulus to further work.

Some Beautiful Indian Trees

By the late Rev. E. Blatter and Walter S. Millard. Pp. x+110+68 plates. (London: John Bale, Sons and Curlew, Ltd., 1937.) 21s. net.

THIS book represents the elaboration of materials already published in the *Journal of the Bombay Natural History Society*. 31 beautiful coloured plates, 35 full-plate photographs and 42 line drawings in the text of 108 pages are ample and excellent illustrations for the guidance of those who desire to acquaint themselves with some of the striking trees that are frequently met with in the plains of India. Detailed descriptions of the more common species have been given, together with notes on their distribution, economic uses and gardening. A long list of popular names has also been added. Suitable English names of some of the species have been coined. The generic name is followed by an appropriate explanatory note. The book is nicely bound and well printed.

But such rich materials lack in proper arrangement and uniformity in the treatment of families, genera and species dealt with in this volume. Such want of sequence in the subject-matter is a bit confusing to the reader. Notes on distribution might have been made more useful by incorporating further details of localities by consulting herbarium specimens of different parts of India and Burma. The lists of popular names in some cases are too long. The names of some of the species require slight modification in the light of the international rules of botanical nomenclature.

The book is entitled "Some Beautiful Indian Trees"; but some of the species dealt with are not indigenous to India.

Although there is room for several improvements in the book, yet it is indeed a laudable attempt on the part of the authors towards better recognition of some of the attractive Indian trees. The volume is a valuable addition to the Indian botanical publications. It will undoubtedly prove useful to the lovers of plants, both Indians as well as foreigners visiting India.

Mytilus

By Kathleen M. White. (Department of Oceanography, University of Liverpool: L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 31.) Pp. vii+117+10 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1937.) 9s. net.

SIR WILLIAM HERDMAN did a good day's work forty years ago when he planned out for the Liverpool Marine Biological Committee the series of papers

known ever since as the "L.M.B.C. Memoirs". They have put on record, in more or less detail, the structure and natural history of one common animal after another—no small service; for, as Huxley once said, if the commonest of our British animals became suddenly extinct, we should find we knew next to nothing about many of them. The writing of these memoirs has trained the prentice hand of many a naturalist, among them Ashworth and James Johnstone, Cole, Dakin, Eales, Fleure, Hickson, Imms and Punnett. A new part still comes out every now and then, and No. 31 has just appeared; it is by Miss Kathleen White of Reading, on the common mussel.

Abundance, cheapness and convenient size all fit *Mytilus edulis* for students' use, but it is not very easy to dissect—until you know how. Miss White gives a clear and full account of its anatomy, with the part on the circulatory system particularly good; her figures are excellent, and her brief instructions for dissection are very much to the point. There have been several other monographs on the mussel since de Heide wrote a book on its anatomy two hundred and fifty years ago. Seventy years ago Sébaste began an elaborate study, but never finished it; Field wrote a better and more complete one in a bulletin of the U.S. Fisheries Bureau; now Miss White has given us the best and handiest of them all.

Biology for Students of Pharmacy

By E. J. Moore. Pp. vii+415+8 plates. (London: Edward Arnold and Co., 1937.) 15s. net.

ELEMENTARY biology is one of the basic subjects for several types of students reading for professional degrees or diplomas such as in agriculture, medicine, dentistry, pharmacy and so forth. A general elementary course in biology should satisfy all needs, yet since most professional examining bodies set their own syllabuses, he would be an ambitious author who attempted to satisfy all requirements in one text-book.

A course which is really a combined one of botany and zoology is not the kind of biology which meets with approval to-day; but the author of this book disarms this justifiable criticism of his work by stating explicitly that "the arrangement of the chapters has been decided partly by the fact that the published syllabus [of the Preliminary Scientific Examination of the Pharmaceutical Society of Great Britain] is divided into plant and animal sections". So he wisely follows the syllabus.

This enforced failing aside, the book can be described as excellent. It is quite clear that the author takes his subject as a serious teacher and has not merely compiled his book from other publications or teaching schedules. The text is quite up to date and very lucid, and the two hundred diagrams and eight plates are so clearly produced and labelled that every student of pharmacy can be sure of getting as much out of the book as he requires.

Teachers and students of biology in the pharmaceutical departments of colleges and universities would do well to consider adopting this book as their standard.

Chemistry

Chemical Principles with particular Application to Qualitative Analysis

By Prof. John H. Yoe. Pp. ix+311. (New York: John Wiley and Sons, Ltd.; London: Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

THE keynote of this book is the correlation of reactions and phenomena encountered in qualitative analysis with the student's training in the theoretical principles of inorganic and physical chemistry. All teachers recognize that qualitative analysis should form a part of the student's training, and too frequently it remains almost a separate compartment of the student's knowledge with little or no correlation with the rest of his chemical knowledge.

Prof. Yoe's book is comprehensive. There appears to be no type of reaction or physico-chemical phenomenon likely to be met with in a well-directed course of qualitative analysis but what is discussed. For example, the nature of solution, oxidation-reduction reactions, co-ordination and stereoisomeric co-ordination compounds, neutralization and hydrolysis, theory of indicators, determination of hydrogen ion concentration, the preparation and properties of colloids, adsorption phenomena, crystal structure, atomic structure and even the quantum theory are some of the topics dealt with. To most chapters there are illustrative set problems, answers being supplied to the numerical ones.

Bearing in mind the size of the book, the range of its contents is surprisingly large. In some cases the result is a lack of clarity undoubtedly due to too great compression. An example of this is the chapter on the electrical theory of matter, radioactivity and atomic structure, which occupies rather less than seven pages, in which the neutron is not specifically mentioned.

As an introduction to specialized text-books and monographs, for which all students do not have time or inclination to study, such a book as this has a useful place in the student's library. C. S. G.

Quantitative Pharmaceutical Chemistry:

containing Theory and Practice of Quantitative Analysis applied to Pharmacy. By Prof. Glenn L. Jenkins and Prof. Andrew G. DuMez. (McGraw-Hill Publications in Pharmacy.) Second edition. Pp. xxv+466. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21s.

THE gratifying reception accorded to this excellent text-book on its first appearance has led the authors and publishers to issue a new edition, which has been largely revised in order to bring the subject-matter into conformity with the many changes made in the official methods of analysing pharmaceutical materials in the latest issues of the United States Pharmacopoeia and the National Formulary. The theoretical matter has also been brought up to date, while the number of assay exercises has been increased. In addition, the contents have been rearranged, being now divided into three parts instead of four as in the original edition. This compression has been achieved by

deleting the section on ultimate analysis and by incorporating the chapters on pH determinations, electro-analysis, etc., which originally represented non-official procedures, with the other physico-chemical determinations such as refractive index, specific rotation, etc. These are now all contained in Part 2, while, as before, Part 1 deals with gravimetric, volumetric and gasometric methods. The third section is devoted to special procedures such as the assay of alkaloids and volatile oils and the determination of the constants of fats, waxes, resins and balsams.

The volume is well written and produced, and although all the methods advocated are not official in Great Britain, nevertheless they will be found useful to those who are interested in the application of quantitative analysis to pharmaceutical materials.

G. R. D.

The Drama of Chemistry:

How Man deals with Atoms. By Prof. Sidney J. French. (The University Series: Highlights of Modern Knowledge.) Pp. vii+170. (New York: The University Society; London: Chapman and Hall, Ltd., 1937.) 4s. 6d. net.

It requires confidence and wide knowledge to give a stimulating account in a small space of the work of the chemist through the ages, to discuss something of the future of the science and to suggest how a more detailed knowledge of it may be obtained. Dr. French has tackled his difficult task boldly.

The section dealing with organic and biological chemistry is not so satisfactory as those portions dealing with phenomena of solution and with atomic structure. Certain drawbacks are inevitable in a work of this kind. Formulae of some organic compounds need revision and expansion, and the account of Pasteur's resolution of racemic acid is inaccurate. The author surely does not believe that sucrose has been synthesized, that amino acids cannot be condensed together and that Willstatter had nothing to do with the elucidation of the structure of chlorophyll!

It may also seem strange that an account of the development of our knowledge of atomic structure can be given without mentioning the names of Sir J. J. Thomson and Lord Rutherford. While later workers are referred to, Prof. F. Soddy's pioneering work on the isotopic forms of the elements is overlooked. On the other hand, "Henry Armstrong", according to Dr. French, was famous for having dared to oppose Arrhenius's dissociation theory and is described with Louis Kahlenberg as being "chief among the hardy rebels".

In spite of these criticisms, Dr. French has given us a most readable and brief account of what he aptly describes as "The Drama of Chemistry".

C. S. G.

Practical Organic Chemistry

By A. J. Mee. (Dent's Modern Science Series.) Pp. x+284. (London: J. M. Dent and Sons, Ltd., 1937.) 5s.

THE author has managed to compress nearly three hundred experiments into this little volume, which is intended to be used in conjunction with a text-book

dealing with the underlying theories. The aim has been to provide a course of instruction in practical organic chemistry up to pass degree standard, consisting of preparations of compounds, arranged to illustrate the main groupings of the subjects and of typical reactions of many of the prepared compounds. Two short chapters at the end deal respectively with the application of dyestuffs and the identification of unknown compounds. Quantitative analysis has been omitted. A very useful feature of the book is the inclusion at the beginning of some of the chapters of tables showing the chemical relationships of the products described.

It is rather surprising to find the old-fashioned method of drying glassware with alcohol and ether mentioned. In Fig. 16 the positions of the manometer and the safety-flask might have been interchanged and the use of rubber stoppers avoided entirely. In testing for the elements, Lassaigne's reaction with sodium often fails; Middleton's reagents (sodium carbonate and zinc dust for nitrogen and pure sugar and sodium carbonate for sulphur and the halogens) are both safer and more satisfactory. The book covers a fairly wide field and the instructions are very clear and concise.

Engineering

Aerodynamics

By Dr. N. A. V. Piercy. Pp. xvi+423. (London: English Universities Press, Ltd., 1937.) 30s. net.

DR. PIERCY has, to use a hackneyed phrase, "fulfilled a long felt want" in producing this book. Although there are several excellent English books on aerodynamics, the exceptional rate at which the applied outlook of the subject has developed recently has left a distinct gap in text-book literature, although such information is available in a more scattered form in periodicals, Government publications, etc. Students and professional technicians will certainly find this volume an indispensable companion.

In keeping with the breadth of his title, the author attempts to survey the whole field of his subject, and merely because of lack of space fails to do some parts of it justice. This is a pity, in a book from so able an author and unquestionable an authority as Dr. Piercy, but on the other hand the treatment is logical. Discussions start *ab initio*, and treat the subject properly up to a certain point. This makes a book that appeals to the student rather more than to the professional aerodynamicist. Is it too much to hope that this will be followed by a second volume with a more practical aspect?

Such matters as the rotating wing, interference, movements of the transmission point and the measurement of profile drag, the empirical treatment of the subject of skin friction and the boundary layer, are a few of the questions that aircraft designers need to see treated from their applied point of view. The last chapter, dealing with the analysis of performance, is exactly what is required by the practical reader, and provokes one to hope for more of this sort of treatment in either an extra volume or a second edition.

Engineering Properties of Soil

By C. A. Hogentogler, with the collaboration of Henry Aaron, Richard C. Thoresen, Edward A. Willis, and Adolph M. Wintermyer. Arranged and edited by C. A. Hogentogler. Pp. xiii+434. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30s.

SOILS are a subject of interest to a large circle of investigators, since they play an essential part in most human activities. Not least are they of importance to the engineer, who has to deal with them as foundations and as materials for his structures. A text-book on these aspects of their utility is therefore not only justifiable but also eminently desirable, and the authors of this joint compilation have produced one on clear and comprehensive lines. Part 1 of the volume deals with the origin and composition of soils; Part 2 with the characteristics of soil; Part 3 with the structural properties of soil; and Part 4 with practical design and construction. The chief author and his collaborators are highway engineers in the service of the United States Bureau of Public Roads: their point of view, therefore, as well as the sources of their data, is naturally mainly American, as is evidenced throughout the volume in nomenclature and classification and in the fairly extensive bibliography at the end. The book is well illustrated with diagrams, and there is a glossary of geological terms as well as a serviceable index.

B. C.

An Introduction to Fluid Mechanics

By Alex. H. Jameson. Pp. x+239. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

RECENT developments in aeronautics, the turbine and the use of liquid and gaseous fuels have produced a great change in the science of fluid mechanics. As a consequence, an elementary knowledge of the modern advances in the subject is now required by engineering students. This book has therefore been written for the use, primarily, of second year students preparing for the London engineering degree. The author has made a special feature of keeping the course as free as possible from empirical formulae and tables of coefficients. The text is well illustrated by clearly drawn diagrams and fully worked-out examples. Both the calculus and the method of dimensions have been used wherever necessary, and although the book is designed to cover adequately a specific syllabus, it should be very useful to all engineering students.

Storage Reservoirs

By George Bransby Williams. Pp. ix+293+24 plates. (London: Chapman and Hall, Ltd., 1937.) 25s. net.

WITHIN the modest compass of 300 pages, Mr. Bransby Williams has succeeded in compressing a very comprehensive and up-to-date survey of a subject the full development of which would require a number of volumes. The survey is necessarily

brief and compact, covering as it does a wide range of topics: rainfall, off-flows (or run-offs) and storage capacities; flood discharges and spillway capacities; masonry gravity dams; single arch masonry dams; multiple arch and reinforced concrete dams; earth, hydraulic-fill and rock-fill dams; regulation of storage and reservoir features (including power stations); methods of construction and treatment of water for domestic supplies. In addition to these technical matters, the author finds space to conclude with what he terms an Engineer's Odyssey, being an account of a tour around the dams and reservoirs of Great Britain. Having occupied the post of chief engineer in the Public Health Department of the Government of Bengal, Mr. Williams naturally gives prominence to water storage installations in India, but his survey is representative of the most modern practice in other countries. There are a number of diagrams and some photographs.

B. C.

Philosophy and Psychology

Theory and Art of Mysticism

By Prof. Radhakamal Mukerjee. Pp. xvi+308. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 15s. net.

A book on Oriental mysticism—which being traditional is essentially sound—is nowadays of an actual as well as of a general interest. Europe is suffering to-day from crude and brutal mysticisms; obsessed by an apparently overpowering need of spiritual surrender; the desire for a crazy submission to 'leaders' with a false mythological halo and a perverted racial or nationalistic background. The understanding of how this mental attitude has come upon us in our Western world, what it means, and what it portends for the future, is perhaps the most vital problem of modern social science.

This book, written by one of India's foremost scholars, himself fully in sympathy with the mystical point of view, will be a great help towards the understanding of mysticism in general. The chapters which deal with the "training in the art of contemplation" will assist us in grasping the inner attitude of the mystic. Dr. Radhakamal Mukerjee has already established a world-wide reputation as an economist. He is also a distinguished scholar in social science. The width of outlook and the richness of literary and factual evidence save the work from the one-sidedness from which a piece of special pleading might suffer. The introductory chapters on the foundations of religion, on its primitive manifestations, on magic and ritual, reveal the writer's competence in dealing with anthropological problems. The discussion of the relation between religion and economic life is of special interest because here his appreciation of mysticism and his professional knowledge mingle and cross-fertilize each other. The book will therefore be of value to the student in political science, the economist, and also of course to the philosopher concerned with the history of religion.

B. M.

The Philosophy of Relativity

By Prof. A. P. Ushenko. Pp. 208. (London: George Allen and Unwin, Ltd., 1937.) 8s. 6d. net.

So many books have been written on this important subject that one may almost doubt whether anything really new can be said about it. Yet Prof. Ushenko succeeds in being both interesting and new, thanks to his method of treatment of the theory of relativity. To begin with, he wants philosophers to understand what the mathematics of relativity mean; so in Chapters ii and vi he gives a step-by-step deduction of the main equations of relativity. Then he goes on to give a critical account of the meaning of these equations. He bases his discussion on the fact that events are described by dispositional characteristics, and that they must have an essence which is distinct from these characteristics. For him, this essence is a fusion of space with time, thus rejecting physical substance as an alternative category of natural philosophy, and involving an attitude which is antagonistic to the new positivistic tendencies.

T. G.

Physics

Electrolytic Condensers:

their Properties, Design and Practical Uses. By Philip R. Coursey. Pp. viii+172+10 plates. (London: Chapman and Hall, Ltd., 1937.) 10s. 6d. net.

THOUGH the development of the electrolytic condenser goes back quite a long time, it is only in recent years—mainly through the demand of the wireless industry—that they have reached their present important position. Mr. Coursey's book is the first one published in English on this subject. It is, in the first place, intended for the prospective user, that is, for designers of apparatus incorporating such condensers.

This explains the mode of treatment adopted—in combination with the restraint which the author had to impose on himself as technical director of a firm manufacturing these condensers. We find a bare minimum of information on the physico-chemical processes underlying the action of the condenser, a general survey of the various types of construction and of their electric properties, and a fairly detailed description of the methods used for testing and of the points which have to be considered when selecting a condenser for some definite purpose. The electric properties in question are illustrated by numerous curves, many of which are characteristic; all are, however, presented in a way which makes identification with definite types of condensers or experimental conditions impossible. In order to reach as wide a public as possible a rather elementary mode of presentation has been adopted. There are few references to patents or literature, those given dealing nearly all with circuit problems.

The book will be definitely useful to the research worker who wishes to employ this type of condenser in his experimental apparatus.

A. B.

Alternating Current Measurements at Audio and Radio Frequencies

By Dr. David Owen. (Methuen's Monographs on Physical Subjects.) Pp. vii+120. (London: Methuen and Co., Ltd., 1937.) 3s. 6d. net.

THIS new addition to Messrs. Methuen's well-known series of monographs is devoted to the principal methods used for the measurement of frequency and circuit constants for alternating current in the audio and radio frequency range. Its main contents are as follow: introduction to the treatment of A.C. circuits by vector methods and complex notation, measurement of inductance (self and mutual), capacity and frequency at audio frequencies, mainly by the use of bridge methods, including, however, a special chapter on A.C. potentiometers; measurement of the same magnitudes at radio frequencies by resonance methods. The author, who with the 'Owen bridge' has himself made a definite contribution to the subject, has succeeded in presenting the matter with agreeable shortness, outlining well the points which should be observed in the experimental procedure. Numerous examples, worked out in detail, add to the usefulness of the book by illustrating the order of magnitudes and errors encountered.

A. B.

Miscellany**Interpretative History of Flight:**

A Survey of the History and Development of Aeronautics, with Particular Reference to Contemporary Influences and Conditions. (Board of Education: Science Museum.) By M. J. B. Davy. Pp. 208+31 plates. (London: H.M. Stationery Office, 1937.) 5s. net.

THIS is a fourth volume written by Mr. Davy, of the Aeronautics Section of the Science Museum, South Kensington, which, although not directly descriptive of the exhibits there, is based upon the historical aspect of such an exhibition, and might well be read in conjunction with a visit to it.

The book describes the continuous development of the idea of flight and provides a record of the human activities leading to its achievement. The subject has been dealt with from a somewhat new point of view in that the outstanding phases, facts, and events are explained with reference to the contemporary conditions and the general trend of human development, it being felt that there exists a need for the presentation of this subject in a form which embraces more than bare facts and technical details unrelated to the social and economic background.

It is divided into three parts, and is fully illustrated with contemporary prints and photographs. Part 1 deals with the principles of natural flight and the early history of man's attempts. Part 2 treats the period from the beginning of definite historical records up to the end of the Great War in 1919, that period in which flight was first conceived, then achieved, and afterwards developed towards the wartime outlook exclusively. Part 3 covers the post-War applications to the various transport activities,

and speculates upon the social and economic aspects of the question.

This is a thoroughly readable book, written by an author who is in a position to be, and is, a master of his subject.

Prosperity Beckons:

Dawn of the Alcohol Era. By Dr. William J. Hale. Pp. viii+201. (Boston, Mass.: The Stratford Co., 1936.) 2 dollars.

THE interdependence of industry and agriculture is gradually gaining wider recognition, but current conceptions of agriculture are largely dominated by inherited views of its functions. In this spirited forecast of the possibilities of an era in which alcohol will largely displace petrol and other hydrocarbons as fuel for the internal combustion engine, as a result of developments from the discoveries of Bergius on the hydration of cellulose and Hertz on the isolation of α -cellulose from wood pulp, the author discards such conceptions. The production of food, he suggests, is a purely secondary matter. A fifth of those engaged at present in agriculture could supply all our needs in respect of food and clothing. Agriculture's main business in the future should be the provision of raw materials for industry, especially raw alcohol, or as he terms it, "agriorude alcohol", and the crops to be cultivated should be determined primarily by industrial needs.

In a style which at times borrows too much from the devices if not the jargon of the publicity agent, Dr. Hale gives much food for thought, and the possibilities of advance in the direction he indicates deserve serious attention. His argument for a closer relation between the factory and the farm is reinforced not only as a contribution to the unemployment question and by the importance of utilizing the vast quantities of agricultural waste products, but also by the general tendency of economic nationalism to seek substitutes for materials imported from abroad. At a time when determined effort to formulate a genuine agricultural policy for this country related to the conservation of all its natural resources is long overdue, the book should appeal to all scientific workers who are considering the contribution of science in this field.

Noise

By Dr. A. H. Davis. (Changing World Library, No. 6.) Pp. x+148. (London: Watts and Co., 1937.) 2s. 6d. net.

THE author is well known for being in the forefront of noise studies. The present little book is suitable for the scientific worker who has not yet become acquainted with the many aspects of the noise problem, and for the general reader, who ought to be impressed by the manner in which a social problem can be attacked when treated scientifically. The measurement of noise level and the definition of the phon scale are carefully explained, but the feature of this little book is the amount of well-balanced information which is presented in such agreeable terms.

L. E. C. H.

Forthcoming Books of Science

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English Universities Press, Ltd. The Vegetable Garden—W. E. Shewell-Cooper. The Herbaceous Border—R. Sudell.
Faber and Faber, Ltd. Pig Breeding and Feeding—C. Forman.
Macmillan and Co., Ltd. Green Fields: a Journal of Irish Country Life—Stephen Rymne. Cacti: a Gardener's Handbook for their Identification and Cultivation—Dr. J. Borg.
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J. B. Lippincott Co. Feeding Behaviour of Infants—Dr. A. Gesell and Dr. Frances L. Ilg.

University of London Press, Ltd. The Sub-normal School Child (vol. 2, The Backward Child)—Prof. Cyril Burt.

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Observations made in hydrogen light ($H\alpha$) with the Hale spectrohelioscope at Greenwich Observatory showed considerable activity within the spot. Besides the occurrence of several minor eruptions, bright eruptions of large extent were observed on September 29 at 10^h 50^m until 11^h 50^m U.T. and on September 30 at 10^h 28^m until 11^h 30^m. The times of maximum intensity of these eruptions agree closely with those of pronounced fadings in short-wave wireless transmission as recorded in Great Britain and elsewhere. A magnetic disturbance was registered at Abinger from October 3^d 11.3^h until October 4^d 9^h, and an aurora was reported from the Southern Coast of England on the night of October 3-4.

Announcements

PROF. JOJI SAKURAI, president of the Imperial Academy and of the National Research Council of Japan, has been elected vice-president of the International Council of Scientific Unions in succession to the late Marchese Marconi.

GHE. MED. RAT DR. HANS VIRCHOW, emeritus professor of anatomy of the University of Berlin, celebrated his eighty-fifth birthday on September 10, and Dr. Karl Jacoby, emeritus professor of pharmacology and physiology of the University of Tübingen, was eighty years of age on September 12.

THE July issue of the *American Journal of Roentgenology and Radium Therapy* is dedicated to Dr. Henry K. Pancoast, in honour of his twenty-fifth year as professor of roentgenology at the University of Pennsylvania. Dr. Pancoast has served as president of the American Roentgen Ray Society, of the American Radium Society and of the first American Congress of Radiology held at Chicago in 1933.

MISS E. A. LANGLEY, at present organizer of school meals for the London County Council, has been appointed to fill a new post on the staff of the Board of Education as inspector of the arrangements made by local education authorities for the provision of meals. She will co-operate with the Board's medical staff in the campaign for improving the nutrition of school children.

A GRACIOUS tribute to the value of the scientific radio research conducted within the Empire has been recently paid by Mr. J. W. O. Hamilton, who has offered sums to found prizes for radio research at the Universities of Cambridge, Melbourne, Sydney and Tasmania. In his letter to the Vice-Chancellor of the University of Cambridge, offering the sum of £500 for this purpose, Mr. Hamilton has expressed a desire that the names of James Clerk Maxwell and Sir Ambrose Fleming, both Cambridge men, should be associated with the prize.

THE Quekett Microscopical Club is holding a conversazione in the rooms of the Royal Society, Burlington House, Piccadilly, W.1, on Tuesday, October 12, at 7.30.

A SPECIAL course of nine lectures will be delivered at the London School of Economics and Political Science by Bertrand Russell on "The Science of Power" on Mondays at 5 commencing October 11. Further information and forms of application may be obtained from the Secretary, London School of Economics, Houghton Street, Aldwych, W.C.2.

A CONFERENCE on Rubber Technology will be held in London on May 23-25, 1938, under the auspices of the Institution of the Rubber Industry. The president will be Mr. S. T. Rowe. The Conference will be divided into two parts: (1) Methods of Improving and Evaluating the Durability of Rubber; and (2) General Subjects. Further information can be obtained from Mr. W. F. V. Cox, Institution of the Rubber Industry, 12 Whitehall, London, S.W.1.

A GENERAL DISCUSSION on Lubrication and Lubricants, under the auspices of the engineering and technical institutions of Great Britain, is being held on October 13-15. It has been found necessary, owing to the large numbers of applications for membership, to arrange for the discussion to be held in the Central Hall, Westminster, London, S.W.1. In conjunction with the discussion an exhibition will be held at the Science Museum, South Kensington, S.W.7. The exhibits will include lubricants, bearings, applications of lubrication, filtration, testing and research, as well as an interesting series of exhibits from the Science Museum collections. The exhibition will remain open until October 31.

A CHAIR of the history of medicine has recently been founded at Buenos Aires with Prof. Juan Ramón Beltrán as its first occupant.

THE annual meeting of the International Society of Medical Hydrology, which is open to non-members, will be held at Frankfurt-on-Main and the neighbouring spas on October 17-22, when the subjects for discussion will be bioclimatology, psychological factors in health resort practice and the natural history of peats and muds. Further information can be obtained from the secretary, 109 Kingsway, London, W.C.2.

THE twenty-fourth French Congress of Hygiene will be held at the Pasteur Institute, Paris, on October 18 and 19 under the presidency of Dr. E. Léon, member of the Academy of Medicine, when the subjects for discussion, among others, will be school hygiene and wholesome milk. Further information can be obtained from Dr. R. Dujarric de la Rivière, Institut Pasteur, 28 rue du Docteur Roux, Paris 15^e.

ERRATUM. Referring to his letter "Transitive Interference in Gene Linkage" in NATURE of August 21, p. 322, Prof. K. de Kőrösy writes stating that the table on p. 323 contains a misprint overlooked by him in the proof; in column c, line g, for 0.279 read 0.249.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 646.

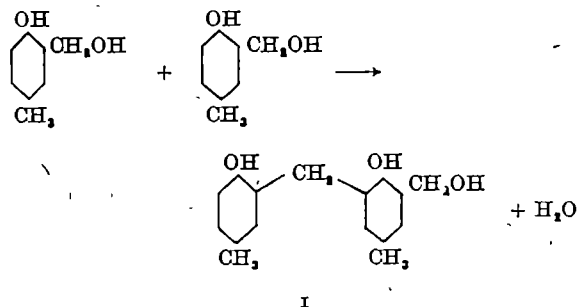
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Examination of Synthetic Resins by X-Rays

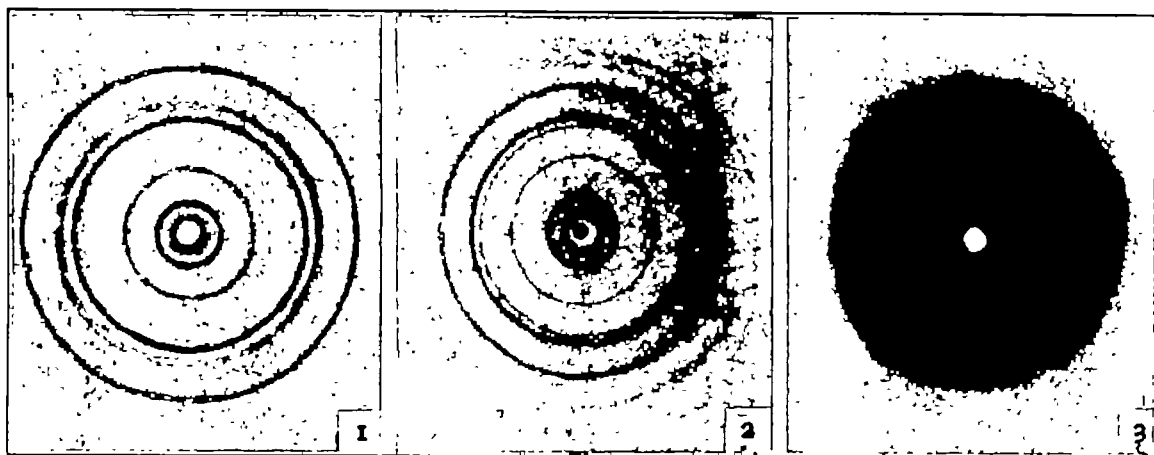
WE have attempted to study the process of resinification by following with the aid of X-ray diffraction the transitional stages of structure taking place in an initially crystalline compound which on heating forms a resin. Well-known substances of this type are the phenolic alcohols, which on heating form the class of resins termed 'saliretins'. A first result of the X-ray method has been to show that *p*-cresol monoalcohol (2-hydroxy-methyl-4-methylphenol) changes over at an intermediate stage to an apparently new compound to which this note directs attention.

The X-ray transmission spectrum of the initial material is shown in Fig. 1. After heating the substance under a pressure of 17 mm. of mercury for 30 minutes at 180°, the spectrum of the cooled product changes to that shown in Fig. 2, where the original rings, except for faint traces, are replaced by others. The new rings resemble the originals in a

cent; H, 6.98 per cent). It appears to be formed as follows, and to function as a true intermediate:



In addition to the detection of the new compound, further X-ray results in this particular case give more



X-RAY DIFFRACTION PHOTOGRAPHS SHOWING THE FORMATION ON HEATING *p*-CRESOL MONOALCOHOL OF INTERMEDIATE COMPOUND AND FINAL RESIN.

general way but have different diameters and, therefore, indicate a new structure. The isolation of a new compound by fractional extraction with light petroleum, from which it crystallizes in flakes melting at 99–100°, supports this conclusion. The nearness of this melting point to that of the initial material (105°) probably explains in part why the new compound has not previously been noted. The compound has tentatively been assigned the formula 3-hydroxy-methyl-2 : 2'-dihydroxy-5 : 5'-dimethyl-diphenylmethane (I) (found: C, 74.8 per cent; H, 7.29 per cent (micro-analysis); $\text{C}_{18}\text{H}_{18}\text{O}_2$ requires, C, 74.4 per

definite information than usual upon the structure of the resin itself. It will be noted that the characteristic feature of Figs. 1 and 2 is a strong inner ring followed by a gap and then a group of outer strong rings. Now the spectrum of the resin taken under the same conditions, and shown in Fig. 3, shows unmistakably the same characteristics. There is a strong central halo corresponding to the inner ring of Fig. 2 and two outer halos corresponding to the outer rings of Fig. 2. The resin is, therefore, not amorphous but a distorted crystal structure with a molecular arrangement essentially similar to that of the crystalline

intermediate. The resin is, therefore, formed structurally by small irregular relative displacements of the molecules from the crystalline formation and not by radical rearrangement of a random nature.

The size of the unit cell of *p*-cresol alcohol and the arrangement of molecules therein will be described in a more detailed communication.

This research has been carried out at the instigation of Sir Gilbert Morgan, director of the Chemical Research Laboratory, to whom thanks are due for permission to publish the results, and the X-ray work has been carried out under Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory.

Chemical Research Laboratory N. J. L. MASON.
(Dept. of Scientific and
Industrial Research),
Teddington.

National Physical Laboratory W. A. WOOD.
(Dept. of Scientific and
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Teddington.
Aug. 5.

Chemical Properties of the Rare Gases

It is known that the rare gases argon, krypton and xenon give unstable chemical compounds with van der Waals bonds, namely, the hydrates. They have been obtained by compressing the gas over water at 0° C. In the case of argon, the crystals of the hydrate are formed at a partial pressure of argon of about 100 atm. I have already shown by an independent method¹ that radon, too, forms a hydrate which is much more stable than those of other rare gases. Radon is easily held by crystals of sulphur dioxide hydrates, when they are formed from snow and sulphur dioxide below the eutectic point or recrystallized. The radon hydrate is isomorphous with the hydrate $\text{SO}_2 \cdot 6\text{H}_2\text{O}$, as its distribution between the gaseous phase and the crystal obeys the Berthelot-Nernst law: the ratio Rn/SO_2 in crystals is proportional to the corresponding ratio in the gas:

$$\frac{\text{Rn (crys.)}}{\text{SO}_2 \text{ (crys.)}} = D \frac{\text{Rn (gas)}}{\text{SO}_2 \text{ (gas)}}$$

where the constant D for Rn has the value 0.6.

I have also studied the possibility of an isomorphous 'seizure' of argon and neon by the crystals of sulphur dioxide hydrate, when formed from sulphur dioxide and snow at -8° C. I found that argon is held by this hydrate, and could thus be transferred quantitatively from the gaseous phase into the crystals. The partition factor is constant and equal to 0.007. No neon hydrate (or any other compound of neon) is as yet known. Its dissociation pressure is presumably some thousands of atmospheres. Nevertheless, neon is also taken up by the crystals of sulphur dioxide hydrate, though with greater difficulty than argon. Only 1.2 per cent of neon goes into the crystals after passing ninety charges of sulphur dioxide into a tube containing snow and neon at -8° C., each time about 80 per cent of the sulphur dioxide being deposited as hydrate. Under the same conditions only traces of helium, not more than 0.2 per cent, could be found in the crystals. Consequently neon, too, forms a hydrate, isomorphous with the sulphur dioxide hydrate, of the formula $\text{Ne} \cdot 6\text{H}_2\text{O}$; the constant D for neon is of the order of 0.00005.

Different stability of the rare gas hydrates makes it possible to separate them quantitatively by chemical means. After twelve depositions of sulphur dioxide as hydrate of the order of 60-70 per cent each, more than 99 per cent of radon is transferred into the crystals. By means of a current of sulphur dioxide more than 99.5 per cent of helium and neon, and about 90 per cent of argon, may be separated from crystals containing radon. For a quantitative separation of argon and radon, the hydrate must be decomposed and the separation repeated. For quantitative deposition of argon (98 per cent), 160 depositions of sulphur dioxide hydrate (80 per cent each) are needed. The whole operation lasts 8-9 hours. The depositing crystals seize, chemically and mechanically, no more than 0.5 per cent helium and about 3 per cent neon. Consequently, it is possible to separate chemically argon and radon from helium and neon, and radon from argon. It is interesting to note that the chemical properties of argon are nearer to those of radon than to neon.

B. A. NIKITIN.

State Radium Institute,
Leningrad.
Aug. 26.

¹ Nikitin, B. A., *Z. anorg. allg. Chem.*, **227**, 81 (1936).

Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation

As reported in this journal¹ and elsewhere², fractions which stimulate the growth, fermentation and respiration of yeast have been isolated in our laboratories from cells injured by ultra-violet irradiation, X-rays and other means. The following experiments by a new technique have confirmed the production of proliferation-promoting substances by cells injured by ultra-violet radiation.

Reader's medium solidified with agar was cut into blocks 3 mm. × 5 mm. × 5 mm. Dilute suspensions in Reader's medium from cultures of *S. cerevisiae* grown on Sabouraud's slants were applied to the tops of these blocks. Cover glasses were put over the inoculated areas and sealed to the blocks with agar. The materials to be tested for proliferation-promotion were added to the bottoms of the blocks, and the cover glasses and hanging blocks placed on culture slides ringed with 'Vaseline'. The cultures were incubated at room temperature for 24-48 hours. Areas of growth on the tops of the blocks were then recorded by photomicrographs. The proliferation-promoting materials diffused from the bottoms of the blocks to the cells on top, where they caused increased proliferation.

Effects of the following materials were compared: water, Reader's medium, unirradiated and irradiated yeast suspensions, cell-free fractions from unirradiated and irradiated yeast suspensions, and a highly potent bios preparation from malt combings. Yeast suspensions were prepared by adding 3.5 gm. of baker's yeast to 200 c.c. of Ringer's glucose-phosphate solution. Portions of these were irradiated in quartz test tubes, with constant stirring, by the full ultra-violet from a quartz mercury arc until about ninety per cent of the cells were killed. Cell-free fractions were usually prepared by centrifuging the suspensions for 15 minutes and decanting the supernatant fluid, occasionally by filtration through a Berkefeld filter.

In all experiments, growth on blocks to which ultra-violet injured cell suspensions or cell-free fractions from these had been added was much greater

than on blocks to which unirradiated cell suspensions or cell-free fractions therefrom, water, Reader's medium, or nothing had been added. Bios caused approximately the same growth as the irradiated cell-free fractions. The accompanying table summarizes the results and the photomicrographs (Fig. 1) are typical of the 24-hour cultures. Addition of Reader's medium (not included in the table because it was used in only a few experiments) produced no noticeable effect. The apparent stimulation by cell-free fractions from non-irradiated cells seemed to result from mechanical injury to the cells during centrifuging.

SUMMARY OF EXPERIMENTS

Material added to bottom of block	Per cent of area on top covered with growth		Dry weight of material added to block
	After 24-27 hr.	After 47-48 hr.	
Non-irrad. cell suspension	7.1	16.2	0.025 mgm.
Water	7.8	10.5	
Nothing	9.8	20.5	
Cell-free fraction from non-irrad. cells	14.8	no data	0.0011 mgm.
Irrad. cell suspension	30.6	70.2	0.025 mgm.
Cell-free fraction from irrad. cells	27.1	70.2	0.0038 mgm.
Krake's bios prep. No. 14	41.4	no data	0.0087 mgm.

Ultra-violet absorption spectra of cell-free fractions from irradiated and non-irradiated cells showed considerable difference. Those of irradiated fractions were similar to the spectra of proliferation-promoting factors from yeast and irradiated liver cells reported previously².

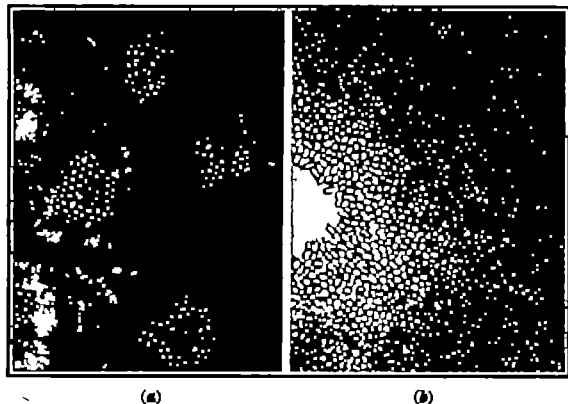


Fig. 1.

PHOTOMICROGRAPHS OF TOPS OF AGAR BLOCKS AFTER 26 HR. (a) NON-IRRADIATED CELL SUSPENSION ADDED TO BOTTOM OF BLOCK. (b) IRRADIATED CELL SUSPENSION ADDED TO BOTTOM OF BLOCK.

We believe the proliferation-promoting factors produced by ultra-violet injured cells afford a clue to the explanation of wound healing and possibly of certain types of malignancy, as will be discussed more fully elsewhere.

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JOHN R. LOOFBOUROW.
CECILIA MARIE DWYER.

Institutum Divi Thomae Graduate School
of Scientific Research,
Cincinnati, Ohio.

July 15.

¹ Fardon, Norris, Loofbourow and Buddy, *NATURE*, 139, 589 (1937).

² Fardon, Carroll and Buddy, *Studies of the Institutum Divi Thomae*, 1, 17 (1937). Fardon and Buddy, *ibid.*, 1, 41 (1937). Norris and Buddy, *ibid.*, 1, 53 (1937).

³ Loofbourow, Schmieder, Skimmon and Dwyer, *Studies of the Institutum Divi Thomae*, 1, 79 (1937).

Infra-Red Spectrum of Tetradeuteroethylene

THE molecule C_2D_4 has twelve fundamental modes of vibration, of which six should be observable in Raman scattering, five in infra-red absorption, while the remaining one must be deduced from combination frequencies in the infra-red or from measurements of specific heat. A knowledge of these is of considerable interest in the theory of molecular vibrations (a) as a qualitative check on the assignment of the fundamental frequencies of the C_2H_4 molecule, (b) as a test of various potential functions which have been advanced to correlate the frequencies of C_2H_4 . Of these twelve frequencies, so far only four have been reported, being recently observed in the Raman spectrum by de Hamptinne, Jungers and Delfosse¹. We now wish to report briefly an investigation in the infra-red by which we have identified another four of the twelve fundamentals.

The specimen of C_2D_4 employed was kindly given us by Prof. de Hamptinne of the University of Louvain and contained about 10 per cent of $C_2D_2H_2$. Strong absorption bands were found at 4.28μ , 4.56μ , 9.28μ and 13.85μ ; a weaker band was observed at 6.7μ , while still weaker bands appeared at 8μ and 10.75μ . The stronger bands have all been examined under high dispersion with the exception of that at 4.28μ , which practically coincides with a very strong atmospheric absorption due to carbon dioxide. From the contours obtained it has been possible to make the identifications indicated in the accompanying table. The most puzzling feature is the non-appearance of the frequency ν_5 . This is particularly interesting since the corresponding frequency in C_2H_4 has usually been supposed to coincide with ν_{11} , although it is not easy to distinguish two separate bands in the absorption contour. One might have expected the separation to be quite marked in the deuterio-compound. We have, in fact, observed a distinct double maximum in the band at 13.85μ , but it is not possible to attribute one of these to the frequency ν_5 since the latter should not possess a sharp Q branch. The possible explanations of this double maximum would take too long to discuss here, and will be dealt with elsewhere, as will also the interpretation of the weaker bands.

As regards (b), it is interesting to compare the observed values of the infra-red frequencies with those predicted by using the various potential functions proposed for C_2H_4 . This is done in the table.

C_2H_4 (cm. ⁻¹)	C_2D_4				
	Mannebeck and Verleyen ¹	Sutherland and Dennison ²	Thompson and Linnett ³	Bonner ⁴	Observed
ν_1 2988	2153 (1.8)	2220 (1.4)	2101 (3.7)	2150 (1.8)	2192.3
ν_2 1444	1072 (0.5)	1055 (1.9)	1187 (10.3)	1071 (0.4)	1077.4
ν_3 3107	2225 (0.4)	—	2223 (0.4)	2205 (1.8)	2235 ± 5
ν_4 950(?)	678	—	1016	757	?
ν_{11} 950	—	720 (0.6)	—	505 (20)	719.5 724.7

It will be seen that discrepancies between predicted and observed values (which are expressed as percentages in brackets below each frequency) are only of the order expected through the neglect of

anharmonicity (2 per cent), except in the case of two of Linnett and Thompson's, and one of Bonner's predictions. It is also noticeable that an observation of v_2 would be another extremely helpful criterion, since here the predicted values show the widest spread. Work is being continued on the location of v_2 .

G. B. B. M. SUTHERLAND.

G. K. T. CONN.

Laboratory of Physical Chemistry,
Cambridge.
Sept. 6.

¹ de Hempinna, M., Jungers, J., and Delfosse, J., *NATURE*, **140**, 323 (1937).

² Mannebeck, C., and Verlooyen, A., *NATURE*, **123**, 867 (1936), *Ann. Soc. Scient. Bruxelles*, B, **56**, 849 (1936); **57**, 81 (1937).

³ Sutherland, G. B. B. M., and Dennison, D. M., *Proc. Roy. Soc., A*, **148**, 250 (1935); Sutherland, G. B. B. M., *Proc. Roy. Soc., A*, **141**, 356 (1933) for treatment of v_{11} .

⁴ Thompson, H. W., and Linnett, J. W., *J. Chem. Soc.*, 1376 (1937).

⁵ Bonner, L. G., *J. Amer. Chem. Soc.*, **58**, 34 (1936).

Physiology of Nematodes

THE initial success, or failure, of a primary infestation of a host by parasites must be largely the result of the effect on them of the environmental conditions provided by the host, conditions which must also control their distribution within the host. Unfortunately, little is known of the reactions of parasites to definite features in their environment, and in order to help relieve the paucity of our knowledge of these problems, experiments were made with nematodes from the alimentary canal of sheep.

Before the experiments could begin, it was necessary to make an attempt to settle the controversial question of the respiration of parasitic nematodes. Most workers, mainly as a result of experiments with various species of *Ascaris*, believe them to be anaerobic, but I was forced to conclude that nematodes from the sheep, at least, have an aerobic existence. They are killed by periods of oxygen-lack greater than forty-eight hours, even when arrangements are made for any by-products of their metabolism which may have permeated their cuticle to be removed from their environment.

Studying the effect on the nematodes of solutions of varying pH, it was found that the lower limit of acidity tolerated by *Ostertagia circumcincta* (pH 3.2), a species normally found in the abomasum or digestive stomach of the sheep, was not low enough to allow it to live in the stomach of animals such as the dog or horse, or in the abomasum of cattle. The lower limits without adverse effect on the species from the small intestine are not low enough for them to parasitize the abomasum.

In an infestation by nematodes of the small intestine of sheep, the various species inhabit more or less definite regions, each characteristic of the species. It was found that the distance of these 'regions' from the bile duct opening could be correlated with the effect of sodium glycolate and sodium taurocholate on the different species. Thus the peaks of infestation of *Trichostrongylus colubriformis* and *T. vitrinus* occurs within about five feet of this opening, while those of *Nematodirus* sp. and *Cooperia* sp. are not within nine or ten feet of it, and it is *Trichostrongylus* which withstands the greatest concentration of bile salts.

An effort was also made to discover the food of the nematodes—the species dealt with are *Trichostrongylidae* and are not found attached to the mucous

membrane. The demonstration of haemoglobin within them was not taken as proof of their blood-sucking habits; indeed, the evidence leads to the conclusion that nematodes of the alimentary tract synthesize this substance for themselves, presumably because it is a necessary constituent of their bodies if they are to live an aerobic existence. No definite indication of their actual food was obtained. Bacterial difficulties hampered the experiments, but in one series, when they were overcome by placing *Ostertagia* in an apparatus whereby abomasal fluid could be percolated over the worms, they lived no longer than the controls in Ringer-Locke solution. The attempts at blood-feeding with this species and with those from the small intestine also failed to keep the worms alive longer than 'starving' controls. As yet, only tentative conclusions can be drawn, but it seems that something to be found at or in the mucous membrane of the intestine, possibly the tissue itself, must be incorporated into the experiments before the culture of adult nematodes will be successful.

A full account of the experiments will be published shortly.

D. G. DAVEY.

Institute of Animal Pathology,
University, Cambridge.

Effects of Salts on Emergence from the Cyst in Protozoa

THE physiology of encystment and excystment of Protozoa and other micro-organisms has received little attention. In the case of the ciliate *Colpoda cucullus*, it has been earlier shown¹ that emergence from the cyst, or excystment, is brought about by some special substances present in the excysting medium, which is usually hay infusion. Part at least of the active material was shown to be ether-soluble. We have therefore subjected hay infusion to fractionation in order to isolate and identify the active excysting substance.

It was found unexpectedly, however, that excystment is not due to a special substance but is a property of the salts of a number of organic acids of low molecular weight. There were identified, in the ether extract of an infusion of timothy hay, oxalic, succinic, acetic, fumaric, tartaric, malic and citric acids, these being either isolated or determined by methods in the literature. The potassium salts of all these were active, to varying extents, in causing excystment. Activity is a property of the salts and not of the free acids, potassium and sodium salts being about equally active.

Since activity varies widely among the different acids, this provides perhaps the most favourable opportunity yet known for studying the relation between chemical structure and a biological activity. Preliminary results of this part of the work indicate that, in a homologous series, activity decreases with increasing molecular weight, heptylic and azelaic being the upper limits with mono- and dibasic acids respectively. Activity is greatly increased by the presence of a hydroxy group in the β -position, but apparently decreased when it is in the α -position.

In an attempt to account quantitatively for the activity of hay infusion in terms of its content of known acids, two important modifying factors have been disclosed. First, the ether-insoluble residue considerably increases the activity of the salts of the various acids, although it possesses little activity

alone. Evidence for this phenomenon, which resembles the interaction of the bios factors in promoting yeast growth, was given earlier¹. This action of the ether residue, we now find, may be imitated by means of a mixture of sugars and phosphate having approximately the same dry weight per cubic centimetre as the ether residue.

Secondly, some of the salts increase the apparent activity of others. In certain combinations this effect may be as large as that of the ether residue, that is, the activity is multiplied about four times. Although even L-malate, the most active so far found, shows little activity at the concentration at which it is present in hay infusion, nevertheless in combination with other salts the activity is considerable. A synthetic mixture of potassium salts of the various acids, each at the concentration present in hay infusion, possessed about one sixth the activity of the original infusion, but when in conjunction either with the ether-insoluble residue or with the mixture of sugars mentioned above, this figure is raised to two thirds. Several active fractions from hay infusion remain unidentified; but since the total activity of these is small compared to that of the acids already determined, it is clear that the excysting activity of hay infusion is largely explained on the above basis.

KENNETH V. THIMMANN.

A. J. HAAGEN-SMIT.

Harvard Biological Laboratories,
Cambridge, Mass.

Sept. 10.

¹Thimmann, K. V., and Barker, H. A., *J. Exp. Zool.*, **60**, 87-87 (1934).

Galileo and Mathematical Demonstration

In support of his contention that Galileo regarded mathematical demonstration as an *a priori* method of reaching truth, G. J. Whitrow, in his contribution

to the supplement to NATURE of June 12¹, states that my uncle, the late Mr. J. J. Fahie, has shown that "to satisfy his [Galileo's] own mind alone he had never felt it necessary to make any [experiments]". This is a misquotation. In my uncle's book the words are: "It was in reference to this controversy [on floating bodies] that Galileo declared that ignorance had been the best master he ever had, since, in order to be able to demonstrate to his adversaries the truth of his conclusions, he had been forced to prove them by such a variety of experiments as made himself doubly confident; though to satisfy his own mind alone he had never felt it necessary to make many".

WILLIAM CUBACK FAHIE.

University College,
Dublin.

¹NATURE, **139**, 1008 (1937).

²Fahie, J. J., "Galileo", p. 145 (1903).

The statement in my contribution to the supplement to NATURE of June 12 is inaccurate, and I apologize for misquoting the late Mr. J. J. Fahie. Actually I did not have access to his original article and quoted from E. A. Burt's "Metaphysical Foundations of Modern Science" (2nd edition, Jan. 1932), p. 65, where, in referring to Mr. Fahie's article, the vital word 'any' is misquoted for 'many'. Until receiving Mr. Fahie's letter I was naturally unaware that Dr. Burt had misquoted.

The point I wished to emphasize (owing to the unfortunate misquotation it was over-emphasized) is that *a priori* mathematical reasoning played a much larger part in Galileo's work than is generally realized.

G. J. WHITROW.

Christ Church,
Oxford.

Points from Foregoing Letters

X-RAY photographs indicating changes in the structure and molecular orientation of *p*-cresol mono-alcohol during the process of resinification on heating are submitted by N. J. L. Megson and W. A. Wood. A new crystalline compound (m.p. 99-100°) is first formed apparently by condensation of two molecules with elimination of water. The resin which results on further heating shows signs of a distorted crystal structure, and the authors suggest that it is formed by small irregular displacements of the molecules from the crystalline formation and not by radical rearrangement of a random nature.

B. A. Nikitin states that, as in the case of radon, other rare gases, namely, argon and neon, are taken up in definite proportions by sulphur dioxide hydrate (formed from sulphur dioxide and snow at - 8° C.); he concludes that neon also forms a hydrate, as is known to be the case with argon, krypton, xenon and radon. Different stability of the rare gas hydrates makes it possible to separate chemically argon and radon from helium, and neon and radon from argon.

Photomicrographs showing the growth-stimulating effect upon yeast (*S. cerevisiae*) of substances produced in cells irradiated with ultra-violet light are submitted by G. S. Sperti, Prof. J. R. Looffbourov and Sister

C. Marie Dwyer. The authors describe a new technique of testing proliferation-producing substances, and give a table showing comparative effect of irradiated cells, Kreke's 'bios' preparation and controls.

The infra-red absorption spectrum of tetradeuteroethylene has been investigated by Dr. G. B. B. M. Sutherland and G. K. T. Conn, who have thus identified four of the fundamental frequencies of vibration of the molecule.

D. G. Davey discusses certain aspects of the physiology of nematodes from the alimentary canal of sheep. Acidity and the toxicity of bile salts are factors which influence their specificity and also their distribution within their host. He has failed to discover their actual food requirements, but points out that simple immersion in blood or alimentary canal fluid is probably insufficient for their culture *in vitro*.

Emergence from the cyst of the protozoan *Colpoda oucillus*, which takes place in hay infusion, is found by K. V. Thimmann and A. G. Haagen-Smit to be due to the presence of potassium salts of certain organic acids (oxalic, succinic, acetic, fumaric, etc.). They find that the ether-insoluble portion of the hay infusion, which by itself is inactive, increased the activity of the organic salt.

Research Items

Pleistocene Relations in East Anglia and Germany

DR. FREDERICK E. ZEUNER, in support of the tentative scheme for the interpretation of the Pleistocene deposits of East Anglia put forward by Prof. P. G. H. Boswell (1932 and 1936) has instituted a comparison of these deposits and those of the Pleistocene of northern Germany (*Proc. Prehist. Soc.*, 3, 1; 1937). There is a remarkable similarity between the two series in (1) stratigraphical sequence, (2) in the palaeontological evidence from the Cromer Forest Bed and that of Mosbach and Mauer, and (3) a fair agreement in the archaeological sequence. In the geological evidence the correlation is as follows: (6) Scottish Readvance—Pomeranian—Würm 3; (5) Hunstanton Brown Clay—Wechsel—Würm 2; (4) Upper Chalky Boulder Drift—Warthe—Würm 1; (3) Great Chalky Boulder Clay—Saale—Riss 2; (2) Norwich Brick-earth and (?) Cromer Till—Elster—Mindel 2; (1) a possible glaciation in late Crag times—a supposed early glaciation of unknown extension—Günz. The evidence from Hoxne is the first from a British station to show a minor interglacial oscillation, which is correlated with the "Pre-Würm", or so-called warm Mousterian, of Germany between Saale and Würm 1. This implies the identification of Hoxne as Riss-Würm and not Mindel-Riss, as has been maintained by some. A comparison of the Cromer Forest Bed fauna with Mosbach and Mauer indicates that it belongs, as they do, to the Günz-Mindel interglacial, while the Crag, affording evidence both geological and palaeontological of a cool climate or even of two cool sub-phases, may be regarded, with some reserve, as Günz. The archaeological succession, beginning with Mr. Reid Moir's Crag industries as Günz, and the Chellean or Abbevillian as Günz-Mindel interglacial, while Clactonian 3 (High Lodge) is assigned to Riss-Würm, is shown to coincide fairly closely with the sequences and their geological correlations in both Germany and France.

Early Sculpture from Iraq

SOME unusual and important examples of early Sumerian and Babylonian sculpture from Iraq acquired for the British Museum (Bloomsbury) by the National Arts Collections Fund have been described and figured by Mr. Sidney Smith (*Brit. Mus. Quarterly*, 11, 3). The earliest in date is a grey granite vase, egg-shaped, with slightly flattened base. The present maximum height is $5\frac{1}{2}$ inches. Beginning $\frac{1}{4}$ inch above the base are three rows of fund-topped leaf-like decoration, which often represents mountains; while the circumference at the centre is divided between two groups representing lions, each attacking a bull. The theme and carving show that this vase is closely connected with a limestone libation vase now in the Bagdad Museum found at Erech, stratum III. This fixes the date as the period of the polychrome pottery called Jamdat Nasr ware, before the archaic Sumerian period. A steatite bowl, 7 inches in diameter, $4\frac{1}{2}$ inches high, is carved on the outside in continuous low relief, which breaks up into separate groups, representing several acts, or different parts of a ritual, the connexion of water, bulls, snakes, vegetation, pointing to a rain-

making ritual. Apart from its exceptional artistic merit, the bowl is of interest from the historical point of view. It is not later than the early part of the Agade period, about 2500 B.C., and it may be earlier. The appearance of Indian bulls on a local piece of work shows that close trade connexions led to an interchange of religious ideas. Secondly, the appearance of marked astral symbolism is important, because ordinarily Early Dynastic monuments show no such symbols, whereas they appear on the seals of early Indian type in some profusion, and in the same obscure connexion as on the vase. At present there is nothing improbable in the hypothesis that astral symbolism came into Sumer in the Early Dynastic period, through contact with the ancient civilization of India.

Movement within *Paramecium* Fragments

IN the usual protoplasmic streaming, or cyclosis, within *Paramecium*, the whole space of the endoplasm is occupied by a counter-clockwise movement, the cause of which has not yet been adequately interpreted. Teruhiko Hosoi narcotized *Paramecium* (caudatum type) by iso-propylalcohol and then cut the animals transversely into two parts at different levels (*J. Fac. Sci. Imp. Univ. Tokyo, Zoo.*, 4, 209; 1937). In each cut portion of whatever type cyclosis took place in the same direction as in the intact animal and without any marked change in the rate of flow after the injurious effect due to dissection had subsided. The author suggests that the motive force of the movement may lie in special substances attracted to the intersurface between the ectoplasm and the endoplasm and thus may lie along the entire course of the cyclosis.

Antarctic Polychaetes

A STUDY of the polychaetes collected by the *Belgica* Antarctic Expedition of 1897-99 was begun by M. Pruvot many years ago, and by 1905 he had made numerous notes and drawings on the Aphroditidae. His death unfortunately took place before the work was ready for publication, and thus it happens that it is only now that Prof. P. Fauvel has ably edited and brought together those observations and drawings of Pruvot's, which are still of interest to-day ("Résultats du Voyage de la *Belgica* en 1897-99". *Rapports scientifiques: Zoologie. Polychètes* par Pierre Fauvel. Anvers, 1936). Prof. Fauvel has in addition completed a description of the collection. At the time when it was originally made, more than a dozen species were new to science, but during the years that have elapsed since then most of them have been described in the reports of other expeditions, leaving three only to be here recorded as new. The *Belgica* records are, however, valuable in that they give additional evidence concerning geographical distribution, and from that point of view especially this report will be welcomed. Emphasis is placed on the cosmopolitan distribution of certain species, at one time considered bipolar, but actually found in temperate and tropical seas of both hemispheres. It is also remarked that temperature seems to have much more influence on polychaetes than does pressure.

Rust Fungi of the Philippines

MANY new species are described in the second paper, by J. C. Arthur and George B. Cummins, on Philippine rust fungi in the Clemens collection, made in 1923-26 (*Philippine J. Sci.*, 61, No. 4, 463-488; Dec. 1936). *Crossopora flot*, as its specific name suggests, attacks *Ficus variegatus*; *Pucciniosira clemensis* parasitizes a species of *Berberis*; *Gonovasia ascioulata* occurs on *Rubus* sp., whilst *Uredo derricola* forms pustules upon the insecticidal *Derris* plant. *Sphaerophragmidium irregulare*, *Ravenelia laevigata*, *Spumula clemensis*, many species of the genus *Uredo*, *Endophyllum emasculatum*, *Puccinia plectranthella*, *P. hemigraphidis*, *Acidium manilense* and *A. dapsile* add to the imposing list of species new to science. Latin diagnoses make the descriptions of international value.

Tobacco Mosaic Protein

Two papers recently available (*Proc. Amer. Phil. Soc.*, 77, No. 4, April 22, 1937) summarize the fundamental work on virus proteins carried out at the Rockefeller Institute for Medical Research. Dr. W. M. Stanley gives evidence to justify the conclusion that a protein of unusually high molecular weight, obtained by him in crystalline form, is actually tobacco mosaic virus. The crystalline protein prepared from such different hosts as tomato and phlox, has the same chemical composition, isoelectric point, optical rotation and biological activity. Normal plant protein has a much lower molecular weight, and has other properties different from the virus protein. Crystals of the prepared material are needle-shaped, 0.02-0.03 mm. long, and give a regular crystalline pattern on X-ray analysis. Dr. Stanley's paper is highly informative, and supplies a succinct digest of the most recent work on this complex subject. Dr. Ralph W. G. Wyckoff describes "The Ultracentrifugal Study of Virus Proteins" in the same journal (pp. 455-462). He gives particulars of an air ultracentrifuge inspired by the original apparatus of Svedberg, with which he has demonstrated that the virus protein has a molecular weight of approximately 17,000,000. The apparatus can also be used to test whether the virus is one molecular species, or a family of related proteins, and can be employed to purify a virus extract, without chemical treatment, with its ultimate loss of strength. The delicacy of this method should make it possible to study less sturdy viruses than tobacco mosaic, and should open a new avenue of investigation.

Map of Ellsworth Trans-Antarctic Flight

THE material for a map of the Ellsworth trans-Antarctic flight of 1935 has been assembled by Mr. W. L. G. Joerg and Mr. O. M. Millar in the *Geographical Review* of July. The data consisted of sixty-six photographs taken during the flight and certain related photographs taken by Wilkins during his flight in 1928. Although much of the map is tentative, certain important conclusions emerge. Stefansson Strait of Wilkins disappears, and the peninsular character of Graham Land is re-established. Of equal interest is the narrow strip of shelf-ice lying on the south-western side of Graham Land and separating it from an enlarged Alexander Land or Island. This was crossed at an altitude of 3,050 metres and photographs were taken especially of the Alexander Land side. This strait was more thoroughly explored later by Mr. J. Rymill and found to be at

least 200 miles long. The Graham Land side was found to be mainly eruptive rocks, and the Alexander Land side fossiliferous stratified rocks. The two sides, contrasted in the photographs, probably represent the meeting of the plateau and Andean structures of Antarctica. Farther along the track various mountain peaks were seen, notably the Sentinel Range (lat. 77° 15' S., long. 88° W.) and another too far distant to photograph or even to place accurately, in about lat. 78°-80° S. and long. 85°-90° W. Nearer the Ross Sea the high ice plateau seems to be unbroken by range or nunatak. The maps are on varying scales and bring out these and other features clearly.

Effect of Obstacles on Sunshine Records

THE ideal to be aimed at in the placing of a recorder for the measurement of the duration of sunshine is a position where the sun is never obstructed when at a sufficient height above the horizon for a record to be obtained. For the standard instrument used in Great Britain—the Campbell-Stokes recorder—which focuses the sun's rays on a card and produces a burn when those rays are strong enough—it has been found that practically no record is obtained until the elevation of the sun exceeds 3°. The task of finding a position quite free from obstacles of greater elevation than 3° over those portions of the horizon, roughly from north-east to south-east, and from south-west to north-west, above which the sun passes during some part of the year at less than 3° elevation, is in many places an impossible one, consequently some information is desirable about the amount of loss resulting from obstruction, and this has been supplied by E. G. Bilham in "The Effects of Obstacles on Sunshine Records" (*Prof. Note* 76. (M.O. 336p.) London: H.M. Stationery Office. 4d. net.). The problem cannot be solved simply by calculating the length of time during which the sun is obstructed and comparing that with the total time during which it is above 3°, because there is a decided falling off in the frequency of recordable sunshine as the sun's elevation diminishes, due to haze, atmospheric absorption, varying cloud perspective, and other factors. If, however, the average percentage of the day's sunshine recorded when the sun's elevation is below various values in places free from obstruction is obtained, it is then possible to find the average percentage losses for obstruction of those values at places that have such obstructions. This is done up to 12° elevation, and it is shown that the percentage loss for a given altitude of obstruction is less in summer than in winter and less in the south of England than in Scotland. It is cheering to find that in general the percentage loss is much smaller than might have been expected; for example, in the summer half of the year, obstacles of 6° cause on an average little more than 1 per cent loss even if they extend laterally over the whole of the region occupied by the sun when its elevation is less than 6°.

Nature of Calomel Vapour

CONSIDERABLE interest has been taken in the nature of calomel vapour as deduced from vapour density measurements, that is, whether calomel is HgCl or Hg_2Cl_2 , since this is connected with the problem of the molecular complexity of mercurous salts. Earlier measurements corresponded with HgCl . Odling, in 1864, observed that a piece of gold leaf is amalgamated in calomel vapour and he concluded that the vapour is dissociated to some extent at least

into Hg and HgCl_2 , and this was confirmed by others. Smith and Menzies in 1910 showed that at 400° dissociation was complete in the sense of the equation $2\text{HgCl} = \text{Hg} + \text{HgCl}_2$. Since the mean molecular weight still corresponds with the formula HgCl , this is in agreement with previous work. H. B. Baker in 1900, however, had reported that when calomel was dried for three weeks in the dark with phosphorus pentoxide its vapour density at 400° corresponds with Hg_2Cl_2 . F. T. Gucker, jun., and R. H. Munch (*J. Amer. Chem. Soc.*, 59, 1275; 1937) have now reinvestigated the matter by measuring the absorption of the resonance line 2537 Å. by calomel vapour. From 450° to 100° the results indicate complete dissociation of the vapour, in accordance with Smith and Menzies' results, in the case of undried calomel. The vapour of carefully dried calomel shows the presence of mercury only at temperatures from 400° to 250° but not below. Calomel sublimed in a vacuum at 200° and condensed on a target cooled with liquid air shows no trace of mercury, whilst the condensate from a mixture of mercury and excess of mercuric chloride, sublimed in the same way, showed mercury in the deposit. The vapour of carefully dried calomel also showed general absorption in the ultra-violet, which the undried calomel does not show. The results of vapour density measurements of carefully dried calomel at 375° – 425° , however, corresponded with HgCl (or $\text{Hg} + \text{HgCl}_2$) and not with Hg_2Cl_2 , as found by Baker.

Production of Artificial Radioactive Elements

INTERESTING work on the production of artificially radioactive elements by bombarding lithium and magnesium with α -rays of 8 cm. range from thorium-C' is reported by A. Eckardt (*Ann. Phys.*, [v], 29, 497; 1937). No radioactive elements could be detected by means of a Geiger counter when lithium was bombarded. Nuclei which might possibly have been formed are ${}^6\text{Be}$ and ${}^7\text{Be}$; ${}^6\text{Li} + {}^4\text{He} \rightarrow {}^9\text{B} + {}^1_0\text{n}$; ${}^7\text{Li} + {}^4\text{He} \rightarrow {}^{10}\text{B} + {}^1_0\text{n}$; but ${}^6\text{Be}$ is shown to be a stable nucleus. The stability of ${}^7\text{Be}$ remains an open question, since its mass had not been determined when these experiments were carried out. Three possible radioactive nuclei, ${}^{28}\text{Si}$, ${}^{27}\text{Al}$ and ${}^{26}\text{Al}$, could be obtained from magnesium, of which the first two were detected. Their half-life periods are 7.6 min. and 2.2 min., respectively.

Adsorption of Gases and Vapours on Activated Charcoal

A CONTRIBUTION to our knowledge of adsorption and the formation of surface compounds is made in a note by R. Juza and R. Langheim (*Naturwiss.*, 25, 522; 1937). The adsorption of gases and vapours on activated charcoal was investigated, particularly from the point of view of changes in the magnetic properties of the adsorbed substances. The paramagnetism of oxygen disappears when the gas is adsorbed at room temperature on activated charcoal. This probably indicates the formation of surface compounds between the charcoal and oxygen, which, like carbon monoxide and carbon dioxide, are not paramagnetic. In the case of the adsorption of benzene vapour, the paramagnetism of the system is less than that of the two substances taken separately and added together. Similar results are found for bromine and iodine. If the magnetism of the charcoal is assumed to be unaltered, there is a decrease in the diamagnetic susceptibility of benzene, whilst bromine and iodine become paramagnetic on adsorption. The paramagnetism in the case of bromine and iodine

may indicate a splitting of the molecules into atoms under the action of surface forces, though another explanation is that the diamagnetism of the charcoal does not remain constant, but is decreased owing to the introduction of the adsorbed substance between the lattice planes of the graphite.

Astronomical Work at the Hamburg Observatory

IN the yearly report for 1936 by Dr. Schorr, director of the Hamburg Observatory at Bergedorf, it is stated that the 60-cm. refractor has been used for the photography of open star clusters, for spectrograms of Nova Lacertae 1936 and for the spectra of variable stars. Vol. 2 of a *Durchmusterung* of stellar spectra is complete, and vol. 3 is in course of preparation. A very useful catalogue of proper motions (*Bergedorfer Eigenbewegungs-Lexikon*, 1 and 2) has been distributed. Two specimen plates taken with the Schmidt reflector and correcting lens are reproduced. These plates show the "North America" nebula in Cygnus and the Great Andromeda nebula. The diameter of the field is 8° , and the images on the edge of the field show, in the reproduction, no trace of elongation. An investigation has been made of the astrograph telescope and measuring machine (sources of error, corrections, methods of reduction, etc.) with the view of using this instrument in taking part in the re-observation by photography with wide-angle lenses, of the zones of the Astronomische Gesellschaft Catalogue, which was originally based on meridian observations centred around 1880. The work of deriving accurate star places by photography with lenses covering a field of $5^\circ \times 5^\circ$ or greater was initiated, as is well known, by Dr. Schlesinger of the Yale Observatory.

Red Shifts and the Distribution of the Nebulae

IN a paper under this title (*Mon. Not. Roy. Astro. Soc.*, 97, May 7, 1937), Dr. Edwin Hubble considers the possible interpretation of red shifts as Doppler effects or otherwise. The subject has been treated in his recent work, "The Realm of the Nebulae", and the present paper deals more fully with the problem. In the former work he points out that if red-shifts are simply velocity-shifts, the correction to magnitude is $4\Delta\lambda/\lambda$, but if they are not it is $3\Delta\lambda/\lambda$, and as the relation derived from observation is $2.7\Delta\lambda/\lambda$, red-shifts are not velocity-shifts, unless some vital factor in the investigation had been ignored. The paper considers some of the criticisms of Eddington and McVittie. Eddington showed that in certain equations used by Hubble the possible effects of dispersion in the absolute magnitudes of nebulae had been neglected. Nevertheless, Eddington himself, after investigating the effects of dispersion, finds that the necessary corrections are of no importance. Hubble is of opinion that the observational data, when weighted in favour of the theory of red-shifts being due to an expanding universe, "still fall short of expectations". McVittie's numerical errors in some previous calculations have been corrected; but, as Hubble points out, the revised figures do not affect the argument in the present paper. In a homogeneous, expanding universe, when corrections are applied for the dimming effects of red-shifts, a negative curvature would introduce an apparent thinning out of the nebular distribution. As observation shows an apparently increasing distribution density, a negative curvature can be adopted only if we discard the theory of homogeneity or expansion.

Road Design and Road Safety

THE causation of road accidents and the measures which can be devised for their prevention are subjects of close study all over the world, but despite all the efforts which have been made, the fact has to be faced that in Great Britain, during the past ten years, a daily average of nineteen persons have lost their lives on the roads. This gives emphasis to the importance of a paper published, with the discussion to which it gave rise, in the *Journal of the Institution of Civil Engineers* (December, 1936), entitled "Road Design and Road Safety", and presented by Mr. Frederick O. Cook, chief technical adviser to the Ministry of Transport.

A lengthy examination of the statistics of the problem was made. As was suggested in the discussion, it is to be regretted that the records and investigations are confined to fatal accidents, as the fuller information obtainable in the other and more numerous cases might be expected to shed more light on causation. From these figures, the outstanding facts are that in 1935 the number of persons killed on the roads in Great Britain was 6,477, of whom 3,079, or forty-eight per cent, were pedestrians, and that the total number of vehicles involved was 8,730, of which the largest number in any one class, 2,513, or twenty-nine per cent, refers to private cars. On referring the figures either to a basis of 100,000 vehicles licensed in each class or to each 100,000 estimated vehicle-miles, the author shows the private car to be the least responsible, public conveyances being most culpable on the first basis and motor-cycles on the second. Examination of the published official figures reveals that in view of the complexity of the problem and the number of factors involved, they are inadequate to lead to reliable conclusions. For example, it is indicated that fully half the fatal accidents occurred on straight roads; yet here, where it might be that there were the elements of a clear case to decide as between road, car and driver, no analysis is given.

Going on to deal with the design of roads, the author considers and explains the influence of speed, desirable widths of carriage-ways, segregation of different classes of traffic and provision of dual ways, service roads, cycle tracks and footpaths, and their relation to traffic conditions. Such details of construction as the radius of curves, super-elevation, visibility, gradient and crossfall or camber are discussed and suitable minimum or maximum values recommended. In relation to the lay-out of road intersections, the author discusses the relative merits of a traffic signal installation, a roundabout, and a fly-over junction, and, of the last, illustrations were given both of a simple type and of one of the clover-leaf pattern.

With the view of obtaining a satisfactory road surface, testing of roads and materials and research are being continuously carried on, and it is hoped that asphaltic and bituminous coverings will be devised capable of maintaining non-skid properties for many years. Among the conclusions reached by the author, the most prominent are that the overwhelming majority of accidents are due to the personal element, that the main contributing cause is the simultaneous use of the road by motor vehicles, horse transport, pedal cyclists and pedestrians, and

that, as the mechanically propelled vehicle is the most destructive agent, the most effective safeguard is the provision of special ways for its exclusive use.

Also appearing in the same volume is an abridged report of a paper—"A Study of the Underground Road Crossings of Paris"—contributed by M. Gaston Bardet, in which he gives particulars of the subways built when the fortification belt of 1814 was converted into a circular boulevard. Some unexpected problems were encountered in these, notably owing to the dazzling glare reflected by the glazed stoneware lining from ventilation apertures. In one subway the electric lighting is controlled by photo-electric cells, so that the internal intensity is synchronized with that outside. Consideration of the varying degrees of visibility to which the eye of the driver has to be adapted led to the arrangement of zones of graduated lighting in lengths of sixteen yards, and while incandescent lamps had been employed in some cases, the monochromatic character of the sodium light was found to make it more easy to regulate.

In Road Research Bulletin No. 1 (H.M. Stationery Office, 1936. 9d. net), G. Bird and W. J. O. Scott describe the construction and operation of a machine for accurately comparing the 'slipperiness' of surfaces. This has been developed at the Road Research Laboratory of the Department of Scientific and Industrial Research, and consists of a motor-cycle and side-car in which the wheel of the latter, by being set at an angle to the direction of travel, introduces a skid component into its motion relative to the road. Dynamometers are carried which record the transverse and vertical forces on the wheel, the ratio of these giving a 'sideway force co-efficient' analogous to 'co-efficient of friction', by which the non-skid properties of road surfaces can be compared. The technique of testing by means of the machine is explained and typical results quoted. The apparatus has been in use for a number of years, and having been brought to a sufficiently high degree of development is recommended for use by road engineers or surveyors to measure and compare for themselves the frictional properties of the road surfaces for which they are responsible.

Road Research Technical Paper No. 1, by the same authors (H.M. Stationery Office, 1936. 1s. 6d. net), the first of a series of studies in road friction, summarizes the results of a large number of measurements of resistance to skidding, made under varying climatic conditions and at different speeds on roads of several types, by means of the machine previously referred to. The main facts which emerge from these tests are: dry, clean road surfaces, free from loose material, give a high coefficient at all speeds and may be regarded as non-skid; on wet surfaces the figure decreases as the speed increases and in most cases is subject to seasonal variation, being higher in winter than in summer; in a dry-wet-dry cycle, the co-efficient decreases rapidly to a minimum, increases slowly to a fairly constant value until drying commences, when it begins to rise to the normal dry surface value. It is also shown that, notwithstanding greater first cost, improved results and ultimate economy can be obtained from close attention to technique in construction of road surfaces in the light of the information derived from these tests.

Agricultural Meteorology in India

THE progress of agricultural meteorology in India is outlined in the latest annual report of the Agricultural Meteorology Branch of the India Meteorological Department, which covers the third year of that branch, ending Aug. 21, 1935. In the Experimental Section, a diagram is shown in which is plotted for three different levels the march of temperature throughout the 24 hours in the stem of sugarcane and in the air at the same levels, the observations having been made in a small plot of sugarcane at Poona with the aid of a portable thermo-couple set specially designed for obtaining plant temperatures. This set was described in the previous year's report. It is seen that the sugarcane is cooler than the air during the day, but warmer at night. Further work on portable percolation gauges and evaporimeters is described in the same section.

Another interesting diagram relates to the micro-climates of growing crops. Graphs are shown of the variation of dry bulb temperature and of vapour pressure at various heights up to 6 feet within the crops and in the open air during the hottest part of a typical fine afternoon in October, that is, in the clear season. The observed differences are greatest at the level of the ground, and in the case of the vapour pressure become small at a height of 6 feet. A large amount of experimental work was also done on the behaviour of various soils with respect to evaporation during the day and absorption during

the night. It was found that the black cotton soils have the greatest diurnal variation of moisture content and the alluvial soils the least.

Radiation received a large share of attention, especially the nocturnal radiation from the surface of the earth and its relationship with the water content of the atmosphere. It is claimed that this study of the exchanges of radiation between the ground and various layers of the atmosphere explained why the temperature was found to decrease with height in the first few centimetres above the ground and then to increase.

In addition to these nocturnal studies, measurements were made with a pyrliometer at Poona at fixed times on clear days, and every hour on representative days during each month, of the intensity of direct solar radiation and the distribution of energy in different parts of the spectrum; a self-registering Moll solarigraph was also maintained in action during a large part of the year. Another solarigraph was set up at Shahjahanpur, and it is intended to install a third at Lyallpur, with the view of discussing eventually the seasonal variation of the total radiation of sun and sky in different parts of India.

A striking feature of the work in nearly all the branches of agricultural meteorology described in this report has been the amount carried out voluntarily by research students, some of whom were working for the M.Sc. degree.

Game Sanctuaries or National Parks

THE subject of the preservation of the wild fauna of the world, especially in those parts where for a variety of reasons there exists grave danger that interesting species may under the actions of man be exterminated, has been before the public on several occasions lately. The well-known national parks in the United States and Canada are often quoted as examples to be followed elsewhere. It is true that on a far smaller scale both national park and fauna (and flora) sanctuaries can be formed—even in the small island of Great Britain; and evidence shows that steps are being taken to give effect to so desirable an object.

It appears to be a curious fact that in the British Empire such suggestions have met with little response until lately, either in Asia or Africa. That position is now also being rectified in some degree. In India the subject of fauna preserves has been ventilated for a number of years. In fact, fauna sanctuaries have been in existence since early in the present century.

The commencement was made in Assam, for the protection of rhinoceros, bison, buffalo and elephant; though the latter has been under protective laws in British India for decades. About 1908-10 a fauna sanctuary was formed, under the auspices of Sir John Hewett, Lieutenant-Governor of the United Provinces, in the great sal forests at the foot of the

Himalaya in these provinces. At the time there was a considerable divergence of opinion as to whether the sanctuary should be permanent or only for so many years, after which it would be opened to shooting and another area closed.

As a result of these early attempts and the more modern ideas attached to a national park which have been given ventilation in the Press of late years, in the spring of 1934 Lord Hailey, at the time Governor of the United Provinces, suggested that the Forest Department should make proposals for the creation of a game sanctuary or national park on the lines recommended by the International Conference of 1933, that is, a national park to be created by legislative authority. The account of this departure, and the formation of the Park to which the name of the Governor, Lord Hailey, was given, is detailed by E. A. Smythies ("The Hailey National Park". *Indian Forester*, 2, 487). The area selected for the park is in the famous and beautiful Patli Dun and the hill forests to the south of it in the Ramganga Valley, situated at the foot of and in the foothills of the Himalaya somewhat to the east of the River Ganges. The total area selected is about 125 square miles.

A Bill, the first of its type in India, was drafted. The United Provinces National Parks Act, 1935, was finally passed by the Legislative Council and

received the assent of both Governor and Governor-General. Its provisions are very wide. For example, "animal" is defined as "any mammal, reptile (excluding snakes, except python) or bird"; and it is an offence "to kill, injure, capture, or disturb any animal or to take or destroy any egg or nest of any bird". Permits have to be obtained by anyone wishing to enter or reside in the Park. Photography is permitted, but no flashlight apparatus may be taken in. Roads are projected in

order to make this area freely accessible to the public.

Since the Patli Dun has long been famous for its tigers and leopards, it will be of interest to note any changes which may take place in their habits and attitude towards man, when the Park, which to date has seen little save the forest officer, timber contractor and hot weather shooting and fishing parties, becomes frequented by the holiday-maker and tourist.

Association of Special Libraries and Information Bureaux

FOURTEENTH ANNUAL CONFERENCE AT CAMBRIDGE

THE fourteenth Annual Conference of the Association of Special Libraries and Information Bureaux was held at Gonville and Caius College, Cambridge, on September 24-27. The programme of the Conference covered a wide field and merited a considerably larger attendance, although that was well up to the average of recent years. The address of the president-elect, Sir Harry Lindsay, on the Friday evening on "The Interrelation between Science, Agriculture and Industry" gave an excellent start to the Conference. Sir Harry stressed not merely the way in which the prosperity of agriculture and of industry were really connected, but also the importance of understanding the real differences between the objectives and methods of the agriculturist and the industrialist, with the view of developing a long-range policy which would eliminate conflict.

Pointing out that the manufacturer was better able than the agriculturist to adjust his output and methods quickly, so as either to benefit by increased demands or to shelter himself against reductions of demand, Sir Harry emphasized that the lesser susceptibility of agriculture to scientific control was due essentially to the fact that the agriculturist was dealing with Nature and the growth of living organisms, not with inorganic or dead matter. In addition, while the Great War gave a great impetus to scientific discovery and to the application of scientific method, it had also a disintegrating effect on the whole structure of industry and commerce, particularly in the destruction of credit. Although the ultimate effects of scientific discovery were beneficial, their immediate effects on business relations were disturbing. As an example, Sir Harry referred to the use made by the business man of modern means of obtaining knowledge of events to lay in or unload his stocks, and asserted his belief that the huge stocks of primary products which were a feature of post-War commerce had always existed, but in pre-War days were so spread that they were invisible and their effect unfelt. This throwing back of stocks on to the primary producer was another factor in the post-War years of disparity between the prices of agricultural produce and those of manufactured goods. Quality was another factor, and in competition between natural and synthetic products, the natural was usually the better although liable to fail in its resistance to standardization or to respond to increased demands. As regards foodstuffs the natural products still held their own. Despite the general cheapening of production and the higher

standard of living, the cost of transport remained high and the question should be faced whether profit-making was the soundest principle on which to build our economic policy. Sir Harry considered that we were at present evolving a new technique of conscious control of economic life; long-range and not short-range solutions of our economic problems were required, and we were advancing to a new technique whereby instinct was supplanted by conscious constructive action.

A symposium on "Newspaper Indexing", at which Capt. A. C. Taylor presided, was opened by a paper by Miss Marie-Anne E. Walker of the *New York Times*, read by Dr. R. H. Hutton, which described the efforts made in this field in the United States, particularly the *New York Times Index* and the indexing project initiated under the New Deal Administration. Mr. J. J. Eaton of the *Yorkshire Post* approached the subject from a different angle, giving an impressive picture of the range of information which a newspaper library was expected to supply whether for the internal staff of the paper or for its readers. In describing the actual indexing system used, Mr. Eaton referred to the possibilities of using micro-photography for this work which they were now exploring. The discussion and papers alike stressed the value of the newspaper as a source of contemporary history, and the increasing reference to scientific matters in the Press renders the subject of some immediate interest to scientific workers. Already it not infrequently happens that not merely the earliest but sometimes the only report of a scientific meeting or discussion appears in the daily Press.

At the next session of the Conference, Dr. S. P. Turin presented a paper on "Scientific and Technical Research in Soviet Russia", in which he emphasized the need for establishing some system of regular research work on Russian subjects if much valuable work was not to be lost. Already constant watch on publications was required to obtain really exhaustive knowledge of any subject of research. Dr. Turin gave a list of various research institutes as well as an outline of the work of three associated with the oldest universities, and some details of science and special libraries in Russia. His plea for a central research body was accompanied by reference to conditions which must be fulfilled in establishing regular contact with Russian institutions. In the first place it was necessary to emphasize our *bona fide* interest in scientific and technical research and to show that we did not desire to utilize Soviet inven-

tions and patents to undermine the Soviet system, but that our aim was international co-operation in the interests of science. Intercourse must be established through the official channels, although direct intercourse with scientific workers on the spot was not excluded. In summarizing the discussion, Mr. J. G. Crowther, who presided, pointed out that it was clear that the present position was not entirely satisfactory and that real difficulties were being experienced in obtaining Russian scientific and technical publications.

A somewhat disappointing discussion on Saturday afternoon, over which Mr. W. MacNab presided, in the absence of Mr. T. F. Burton, dealt with the extent to which the present system of abstracting services covered scientific periodical literature. In his paper opening this discussion, Dr. S. C. Bradford, without adducing anything essentially new, called attention to the duplication which persisted under the present system and also to the danger of papers in an out-of-the-way language or in border-line sciences being missed. His conclusion that at present nearly two thirds of the worth-while scientific and technical papers are published only to be buried out of reach on the library shelves was obviously received with a good deal of scepticism by the Conference, and in spite of his insistence on the need for recognizing the essential unity of science and for much closer co-operation, the discussion led to no concrete proposals, nor was the question of organizing abstracting and indexing services by divisions of industry rather than by branches of science even raised.

The report presented to the annual meeting of the Association referred to an actual excess of expenditure over income during the year of £69, partly due to increased office expenditure and staff. While increased sales of publications are likely to rectify this position, a considerable increase in membership is required if the Association is to take up many projects which are in need of its attention. The report also refers to the progress of the Book List, the re-organization of the Panel of Expert Translators, the preparation for a new edition of the ASLIB Directory and the attention given to the indexing of early newspapers.

Lieut.-Colonel E. T. Crutchley's address on "The Public Relations Officer" on Saturday, which described the work of the Public Relations Officer in the Post Office, provoked an interesting discussion which largely centred on the success of this experiment in applied psychology by the Post Office in explaining its work to the public and recording its activities. The scheme was also highly suggestive for all those who are interested in the establishment of good relations between management and staff and customers in industrial organizations and commercial undertakings, or in large Government departments or public utility companies. Lieut.-Colonel Crutchley showed convincingly the opportunities for applied science which exist in this field.

An excellent paper on the principles and practice of technical translating was contributed by Dr. J. E. Holmstrom at a session on Sunday morning over which Mr. J. G. Pearce presided. Dr. Holmstrom laid considerable stress on the importance of lucidity and style in translation work and referred to the advantages of the diatophone system in saving the time of translators. Dr. Holmstrom gave details of a number of useful dictionaries, on the merits of which Mr. H. H. Johnson of *Engineering* and other speakers in the discussion commented.

The most interesting session of the Conference was the second session on Sunday morning which, as Prof. R. S. Hutton pointed out in his introductory paper, was almost the first opportunity in Great Britain for librarians to review the development and prospects of micro-photography. The high capital cost of the mechanized equipment required was compensated by the large reduction in the running costs. The Draeger camera, the Folmer Graflex Corporation camera, the Recordak camera and the Saint Ret-Seidell camera all aimed at labour- and time-saving by mechanized control of exposure and advancing the film, by book-holding devices, etc., and for some of this apparatus an output of 5,000 exposures or 10,000 pages a day was claimed. The spools of films could be selected for either small quantities such as 36 exposures on a 5 ft. length or up to 1,000 ft. of film. The British Museum was already making micro-films for an American project to secure for subscribing American libraries copies of all English books published before 1550. It was estimated that there were 4,000 separate books to be copied and the cost of copying the 400,000 pages works out at about a farthing a page. Such films are available for reading in one of the projection or enlarging machines constructed for the purpose or can be used to obtain a photo-enlargement on paper. The use of micro-film for newspaper record purposes in the United States is already being extensively tried, and its large saving in space—estimated at more than 98 per cent of that required for the bound volumes—renders it highly attractive for other libraries. Dr. Hutton stressed the durability and non-inflammability of the film used and referred to its possibilities in regard to library union catalogues, bank cheques, census purposes, and the like as well as to others in conjunction with the Kolleritt system or photo-electric cells for selecting material required.

A paper by Mr. Watson Davis, which in the author's absence was read by Prof. Hutton, referred to developments in the use of micro-film in the United States, particularly those sponsored by the Documentation Division of Science Service to assist the publication of scientific papers and the Bibliofilm Service in the Library of the U.S. Department of Agriculture, which have now both been taken over by the American Documentation Institute. Mr. L. A. Sayce described his experience of micro-film work at Armstrong College, Newcastle-on-Tyne, and Mr. K. Stuart-Smith gave some account of work in this field for which Kodak Ltd. had been responsible. The discussion left a distinct impression on the mind that the library of the future may present an interesting resemblance to the library of the ancient world with its rolls of film in place of the rolls of manuscript.

At the concluding session on Sunday evening, when Mr. Will Spens, Master of Corpus Christi College, presided, Lieut.-Colonel O. Bridge described the work of the British Council, in which he insisted on the need for further private support if the work initiated was to be carried on effectively. Besides helping to establish lectureships and professorships at foreign universities and sending distinguished lecturers abroad, to build up libraries of British books abroad and to increase the circulation of British periodicals, the Council was now dealing with broadcasting and films. Colonel Bridge emphasized the endeavour of the Council to avoid counter propaganda in its work but rather to interpret the national point of view and to make known the full wealth of our civilization.

Recent Excavations in Roman Britain

COLONEL C. D. DREW, who is in charge of the excavation of the Roman house-site in Colliton Park, Dorchester (see *NATURE*, Aug. 21, p. 311), reports the interesting and unusual discovery of the leg of a Roman chair, made of Kimmeridge shale. It was found beneath the damaged floor of the heated room, of which the tessellated pavement, as previously reported, had collapsed. It was found that stonework supporting the floor had sunk where the filling of a pit had proved less compact than the surrounding chalk. The chair leg was found deep down in the filling of the pit, which was of considerable depth. It is richly carved with the head of an open-mouthed animal, and the foot terminates in a lion's claw. It is in an excellent state of preservation, but requires skilled treatment to prevent flaking, before it can be placed on exhibition in the Dorchester Museum. As articles of Roman furniture are of rare occurrence in Britain, the find is of considerable interest. Among other recent finds on this site are thirty bronze coins of the fourth century A.D. from a trial trench. The excavation committee has approached the County Council with the view of securing the preservation of the remains of this Roman house, and the matter is now under the consideration of a sub-committee of the Council.

A large and important collection of Roman relics has been discovered by the excavation section of the Thoroton Society of Nottingham on the corporation housing estate at Broxtowe in the old part of the city. According to report (*The Times*, Oct. 4), the finds include a grave containing bones and Roman coins, brooches, a silver spoon, rings, knives and dice of wood. Among the broken pottery is some highly glazed Samian ware of the first century, decorated with hares and hounds. A portion of the Roman road was uncovered and a quantity of oyster shells was found.

At Lincoln the demolition of an eighteenth century house abutting on the Newport Arch, the only remaining Roman arch in Britain which spans a public road, has brought to light evidence which reveals that the arch in its original form has a postern gate on either side. There is at present on the eastern side a postern gate which is used by foot passengers; but when the western side of the arch was laid bare by the recent work of demolition, the beginning of the spring of the second postern gate was disclosed. It corresponds with the gateway on the eastern side. The arch was scheduled as an ancient monument in 1924; and according to a report in *The Times* of October 4, it is hoped to modify the rebuilding scheme in such a manner as to allow for the restoration of the postern gate on the west side.

Excavation on what is supposed to be the site of the Roman town of Sulloniaca at Brookley Hill, Middlesex, two miles north of Edgware on the east side of Watling Street, points to the possibility that it may have been originally a native town or *oppidum*, of which the population shifted after the conquest, attracted by the facilities for traffic offered by this trunk road. The investigation is being carried out by the London and Middlesex Archaeological Society with the co-operation of the Stanmore and Edgware Historical Society under the direction of Mr. F. Cottrill, local secretary of the Society of Antiquaries (*The Times*, Oct. 1). The site lies at the east end of a gravel ridge, which rises to a height of five hundred feet.

The arrangement of banks and ridges at Brookley Hill recalls the site of Prae Wood at St. Albans, excavated by Dr. R. E. Mortimer Wheeler. A Belgic potsherd has been found in one of the ditches. A trench dug near the east side of the road gives a section of two depressions, twenty feet and nine feet wide respectively, in the natural clay. The filling of these depressions produced pottery of common late first and early second century types in considerable quantity, the common 'screw-neck' flagon predominating. Some sherds showed signs of over-firing, while some almost complete pots had been thrown away on account of flaws in manufacturing. This, with the evidence of masses of baked clay, brick and tile 'wasters', points to the existence here of a roadside industrial settlement for the making of bricks and pottery. Another trench revealed a Roman occupation layer of the first century, which had been partly removed by seventeenth century and early eighteenth century builders. Exploration farther away from the road produced no evidence of occupation beyond a small Belgic pit. No traces of a Roman building have been found. Evidently the kilns had been placed at the east end of the town to avoid the fumes which would be carried by the prevailing south-west wind.

University Events

GLASGOW.—Dr. Paul Bacsich has been appointed lecturer in embryology in the Department of Anatomy, and Dr. H. Ellis O. Wilson lecturer in pathological biochemistry at the Royal Hospital for Sick Children.

LONDON.—The following announcements have been made from University College: Prof. S. Sugden, formerly of Birbeck College, succeeds Prof. F. G. Donnan in the chair of chemistry; Prof. C. K. Ingold becomes director of the Chemistry Laboratories.

The Department of Geography has been moved to new, freshly equipped quarters in Foster Court (the block of buildings on the south side of the College, acquired in 1931).

The University has accepted the benefaction of the late Mrs. Florence Joy Weldon, of Oxford, who bequeathed her residuary estate upon trust for the foundation of a professorship of biometry for the higher statistical study of biological problems. The chair has been established at University College, the first holder being Prof. J. B. S. Haldane (see p. 612).

READING.—Dr. G. W. Scott Blair, of Rothamsted Experimental Station, has been appointed head of the Dairy Chemistry Department of the National Institute for Research in Dairying in succession to Captain J. Golding, who has retired.

ST. ANDREWS.—In connexion with the celebration of the quatercentenary of St. Mary's College on September 28 the honorary degree of LL.D. was conferred, among others, on the following: R. F. J. Fairlie, architect for the restoration of St. Salvator's Chapel, St. Andrews, and of the Scottish National Library; the Right Hon. Sir John Simon, Chancellor of the Exchequer; Prof. G. F. Stout, formerly professor of logic and metaphysics; and Sir Leonard Woolley, director of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia.

Science News a Century Ago

Government Experimental Distillery

THE issue of *The Times* of October 12, 1837, gave an account from Government papers of the Government Experimental Distillery, by which it was anticipated several millions a year would be added to the revenue and illicit distillation be suppressed. "The extensive premises, formerly the Hope Brewery, in Brown's-lane, Spitalfields," said *The Times*, "having recently been fitted up as an experimental distillery upon a large scale, under the superintendence of Dr. Birkbeck, by order of the Lords of the Treasury, for the purpose of testing the efficiency of Mr. Rudkin's apparatus for taking the excise on spirits in process of distillation, several preparatory distillings have taken place during the last fortnight, and yesterday the distillery was set at full work. The experiment so far has been in the highest degree satisfactory and in the opinion of Dr. Birkbeck and other scientific men sufficiently conclusive as to the utility of the invention."

The instruments previously in use were the saccharometer and thermometer, but "the utter inefficiency of the saccharometer and the thermometer for the purposes for which they are used has long been well known", and it has been declared that "there is at present no security for the collection of any portion of the revenue, except in the conscientiousness of the distillers. . . . Government, chiefly through the medium of the Royal Society, has long applied itself to remedy this evil. About 70 years ago Lord George Cavendish carried out a series of laborious experiments for this purpose, which led to no results, and upon his failure the matter was committed to Sir Joseph Banks; but his labours were attended with no better success". According to Dr. Birkbeck, however, Mr. Rudkin has solved the great and important problem. "If his instrument eventually realises his professions . . . it will do away with all the inconveniences of the present system . . . as it registers the quantity, temperature and strength of every gallon of spirit as soon as produced, and before it comes under the control of the excise man and distiller."

Faraday's Diary

FARADAY'S DIARY contained not only his notes on experiments but also his queries, references and reflections. Under the date October 14, 1837, he wrote:

"4048. Charge of clouds. How do they become electrified if there be no absolute charge?"

4049. No charge from breaking up sulphur or change of state.

4050. Nature of discharge through cracks in glass.

4051. Is Fischer's observation on variation of conductivity of platina sound or no, and if it is, what bearing will it have on thermo-electricity? Bib. Univ., 1831, xlv, 267.

4052. Matteucci—Expts. on Evaporation of water from soil as a source of Electricity. Bib. Univ., 1834, lvi, 328.

4053. Thermo-electricity. Is it possible Peltier's experiment (Bib. Univ., 1834, lvii, p. 181) can be true, i.e. that a thermo electric current produced such an effect elsewhere as to create an opposite current greater than the original?

4054. Electricity in motion penetrates bodies. Statical Electy. does not, but is superficial. The

reason of this is evident on the particle action theory without breaking in on a law or requiring a new one. Before the conduction took place and after the communication was completed, both insulating and conductive particles were polar—but one can equilibrate or discharge more than the other.

4055. Induction—Nobili has some general facts in very good relation to induction. Bib. Univ., 1835, lix, pp. 275."

Caverns in Brazil

THE October 1837 issue of the *Gentleman's Magazine* contains the following information: "Dr. Lund, the Danish traveller, now in Brazil, has discovered in the mountain chains between the Rio Francisco and the Rio das Velhas a great number of caverns; among which Sappa Nova de Maquiné, in the Sierra de Maquiné, is one of the most remarkable. The mountain consists of clay slate, flinty slate and limestone of the transition period, in which last is the cavern described; the total length of which from north to south is 1,440 feet, the height being from 30 to 40 feet, and the breadth from 50 to 60. It is separated by masses of stalactite into twelve divisions, of which only three were known before Dr. Lund explored them. The others, especially the innermost, were of such extraordinary beauty that his attendants fell on their knees and expressed the greatest astonishment."

"On the River Velhas, the banks of which the traveller afterwards traversed, the vegetation assumes a peculiar character. The inhabitants call the forests *catingas* (white forests). They form a thicket of thorny trees and bushes interwoven with parasitical plants of the same nature. The leaves fall in August, and from the beginning of September till the rainy season the *catingas* are as bare as European forests in winter. On this excursion Dr. Lund had an opportunity of examining nineteen caves, all of which confirmed his opinion of their geological formation. He has collected many remarkable particulars respecting the circumstances which must have taken place in a great inundation, as well as respecting its effects, and convinced himself by several indications, that its course in South America was from north to south."

German Scientific Association

"Soon after the meeting of the British Association at Liverpool," said the *Mechanics' Magazine* of October 14, 1837, "its German prototype the Society of 'Enquirers into Nature' (Naturforscher) held its fifteenth annual assembly at Prague. The object which seems to have attracted most attention this year was an apparatus for the production of powerful electric streams by means of steel magnets operating on a multiplying conductor. It was exhibited and explained by its inventor, M. von Ettingshausen, professor of physics in the High School at Vienna. This gentleman acknowledged that his apparatus bore some resemblance in principle to that invented for the same purpose by Mr. Clarke in London, and that it was by no means superior in power, but contended that the apparatus was the more simple and convenient of the two." It was agreed to hold the next meeting of the Society at Freiburg, in Baden, to afford an opportunity to Prof. Oken, the founder of the institution, "to be present at the operation of his own new apparatus, for the production of electric streams of science, from which he has been for ten years an unwilling absentee".

Societies and Academies

Paris

Academy of Sciences, August 2 (*C.R.*, 205, 301-344).

A. LACROIX: The reality of an eruption of the Soufrière of Saint-Vincent in 1718, from an observation made at Guadeloupe. In the records of the Royal Academy of Sciences for 1718 a letter has been found confirming an eruption at the island of Saint-Vincent, previously regarded as doubtful.

PAUL LANGÉVIN: Sagnac's experiment. Criticisms of a recent note on this subject by A. Dufour and F. Prunier.

PIERRE LÉVAY: The variations in the quantity of ozone contained in the atmosphere in the neighbourhood of Shanghai. An analysis of five years observations.

NIKOLA OHRBACHOFF: A theorem for the zeros of polynomials.

RAPHAËL SALM: A generalization of Poisson's method of summation.

ROBERT CORDONNIER: The application of Verdet's law to solutions. The magnetic rotatory power of the ions.

JACQUES DUCLAUX and MIGUEL AMAT: Ultra-filters of carborundum. Carborundum powder has been separated by levitation into fractions of different sizes of grain, and from these, ultra-filters have been prepared capable of removing various colloidal suspensions, such as copper cobaltocyanide, arsenic sulphide and ferric hydrate. The finest grain filters prepared fail to filter off Congo red.

MME. GERMAINE CHAUVENET and GABRIEL VALENSI: The velocity of oxidation of cobalt.

ANDRÉ MAMAN: Contribution to the study of the octanes. Ten isomeric octanes have been prepared and the temperatures determined at which carbon monoxide appears when the hydrocarbon mixed with oxygen is heated.

ANDRÉ DEBIBERT and LADISLAS GOLDSTEIN: New transformations produced at low temperatures (*frigidreactions*). It was shown in a previous note that certain gases, especially hydrogen and helium, in contact with carbon cooled in liquid nitrogen, gave rise to a large evolution of heat. In the experiments now described, the carbon has been replaced by other elements (beryllium, magnesium, aluminium, nickel, copper, sand) and the heat evolution noted. With beryllium and helium the evolution of heat is larger than with helium and carbon. Generally, the light elements give the most marked reaction. No radiations could be detected outside the apparatus, but it is suggested that the *frigidreactions* correspond to nuclear actions.

GEORGES PRUIT: The mechanism of the attack by sulphuric acid on monomethylarsenic and dimethylarsenic acids.

RENÉ DUBREIL and ALBERT SAINT-MAKEN: Researches on the basic lead acetates.

MAX MOUSSERON and ROBERT GRANGER: Some derivatives of the C₄ and C₅ 1,2-cyclanediols.

LUIGI D'AUTREBANDE, PIERRE ANGENOT and EDMOND DUMOULIN: The study of esparto grass antiseptic filters. The protection of the antiseptic filters against moisture by a layer of dehydrating substance.

RAYMOND JACQUESSON: A type of crystalline texture observed in aluminium wires submitted to alternating torsion.

EDOUARD ROCH: The Visean of the Haut-Atlas to the east of Marrakech.

EMILE THILLIER: The disappearance of the permanent magnetization of baked earths by reheating in zero magnetic field.

MME. C. SOBA BOURDOUIL: Remarks on the composition of the pollen of some Ranunculaceae and on their systematic position. The nitrogen percentage in pollen is different in different botanical groups. Thus in the *Aquilegia* type the nitrogen in the pollen varies between 6.6 and 7.2 per cent; in the *Olematis* type, between 5.3 and 5.7 per cent; the *Ranunculus* type, between 4.2 and 4.9 per cent.

MARC MURAT: The vegetation of the western Sahara in Mauritania.

G. LAVIE: The cytology of the Protists of the genus *Blastocystis*.

Cape Town

Royal Society of South Africa, July 21.

A. J. H. GOODWIN: Archaeology of the Oakhurst Shelter, George. (6) Stratified deposits and contents. The stratified deposits, excluding grave infillings, etc., are here discussed. The deposits include Middle Stone Age, Smithfield B, Smithfield C, Normal Wilton and Developed Wilton. (7) Summary and conclusions.

H. ZWARENSTEIN: Gonadotropic activity of amphibian pituitary. Implantation of 8-20 mgm. of anterior pituitary tissue of *Xenopus laevis* in immature female mice caused opening of the vagina, enlargement of the ovaries with occasional haemorrhagic follicles (blood spots) and a two- to four-fold increase in uterine weight. Control implants of frog's brain, muscle, liver, kidney, spleen and ovary gave negative results.

R. H. SMITHERS: Notes on the stranding of a school of *Pseudorca crassidens* at Berg River mouth in December, 1936.

F. SEBBA and W. PUGH: Gallium. (4) The phosphates and arsenates of gallium. Gallium orthophosphate has been prepared by neutralizing a solution of a gallium salt in presence of a phosphate. The gallium is completely precipitated as a gelatinous phosphate. A crystalline variety has been prepared under pressure. Both forms are anhydrous. Gallium ortho-arsenate has been prepared in a similar way, and both gelatinous and crystalline forms have been obtained. The arsenate separates as the di-hydrate. A crystalline complex galli-arsenate has been prepared by using a large excess of arsenate in strongly alkaline solution under pressure.

August 18.

W. PUGH: Mercurous perchlorate as a volumetric reagent for chlorides and bromides. With bromophenol blue as absorption indicator, mercurous perchlorate gives an excellent colour change at the equivalent point. The results are accurate. It has the advantage over silver nitrate that it can be used in acid solutions.

P. W. LAIDLIE: Pipes and smoking in South Africa: an account of the typology and distribution of pipes of clay, stone and bone in South Africa.

M. R. LEVYNS: The geographical distribution of plants in the western portion of the Little Karroo. The area discussed is bounded on the north by the Zwartberg and on the south by the Langeberg, and has an altitude a little under 2,000 feet. Numerous kopjes are dotted over the area. The flora consists largely of succulent plants and the vegetation as a whole is of a very open type. Four mountain ranges with altitudes in the neighbourhood of 5,000 feet occur as islands in the Karroo. Towards the summits of these isolated mountains the Cape flora gradually replaces the Karroo flora. This change may be correlated with an increase in rainfall.

J. C. MIDDLETON-SHAW: The teeth of South African fossil pigs (*Notochoerus Capensis* syn. *Meadowesi*) and their geological significance.

J. L. B. SMITH: An interesting post-larval stage of the "Galjoen".

Cracow

Polish Academy of Sciences and Letters, June 14.

TH. BANACHIEWICZ: The precision of an elliptical orbit determined from three observations.

S. KACZMARZ: The resolution of a system of linear equations by successive approximations.

K. KOZIEL: Some formulae relating to the ratios n_1 and n_2 of the areas of triangles.

MILE. L. STANISLAWICZ: The arithmetical operations in the calculation of inverses according to the method of Banachiewicz.

S. PIOTROWSKI: A method of determining the orbital elements of double stars with eclipses.

S. PIENKOWSKI: The fluorescence of octahydro-fluorocyclohexene (C_8H_{14}).

S. MROZOWSKI: The influence of the presence of a gas and of the magnetic field on the degree of polarization of the fluorescence of iodine vapour.

A. JAGIELSKI: The dielectric polarization and viscosity of the chloronitrobenzenes in the liquid state.

MILE. B. TWARDOWSKA: Contribution to the study of the fluorescence and adsorption of bisacnaphthylidene ($C_{24}H_{18}$).

MILE. Z. LEWKOWICZ: The influence of the wavelength of the exciting light on the relative yield of the fluorescence of benzene solutions of bisacnaphthylidene ($C_{24}H_{18}$).

K. DZIEWONSKI and L. GIZLER: The synthesis of fluorocyclohexene (C_6H_9F) and its transformations into other hydrocarbons.

W. BEDNARCZYK and L. GIZLER: The absorption of ultra-violet radiation by fluorocyclohexene and by hydrocarbon products of its transformations.

B. SKARZYNSKI: The absorption of ultra-violet radiation by ascorbic acid (vitamin C).

J. NOWAK: The age of the Magura grit in the region of Babia Góra.

MILE. K. CIECHOWSKA and M. KSIĄŻKIEWICZ: Comparison of the Wienerwald fleisch with that of the Carpathians.

F. ROGÓŻENSKI: (1) Contributions to the estimation of magnesium. (2) The gravimetric estimation of chlorophyll.

E. FRÖHLICH: Systematic studies on the Cichleariidae of Poland and other congeneric European species.

L. KORZENIEWSKI: Biometric studies on the variation of the seeds of the Siberian cedar (*Pinus Sibirica*).

W. JUSZCZYK: The distribution of the chromatophores in the skin of *Pelobates fuscus* and in that of flavistic specimens.

F. ROGÓŻENSKI: Carotenoids and chlorophyll in the digestion of the ruminant.

J. GALLERA: The development of the extra-neuronal ectoderm in birds.

ST. MARKOWSKI: Evolutive cycle and biology of the nematode *Contracaecum aduncum*.

Rome

National Academy of the Lincei (*Atti*, 24, 493-530; 1936).

F. SEVERI: Supplements to the general theory of correspondences between algebraic varieties (1).

G. BARBA: Definite polynomials (2). Classes of definite polynomials obtained from some which are fixed in advance.

G. ARRHIGHI: Mechanics of floats with internal cyclic motions.

L. SONA: Dynamic actions of a transo-circulatory current which invests an obstacle consisting of two crossed laminae.

P. CALOI: Hypocentral depths, with particular regard to the earthquakes of the Carnic Alps (June 8, 1934) and of Lake Constance (January 31, 1935).

G. LOLLII: Curves of alcoholamia obtained by administering hydro-alcoholic drinks through a gastric and duodenal tube.

M. PIROTTI: Presence of a true subrenal capsule in *Selaci*.

S. RANZI: Endocrine glands, sexual maturity and gestation in *Selaci*.

Atti, 25, 3-71; 1937.

F. SEVERI: Supplements to the general theory of correspondences between algebraic varieties (2).

E. ALMANRI: Fundamental principle of classical mechanics.

G. CECCHIOIA-RISPOLI: Preliminary observations on the Cenozoic series of the Apulian Apennines.

G. BARBA: Definite polynomials (3). Interpretations, properties and supplements.

R. CACCIOPOLI: Analytical character of the solutions of a class of problems of the calculus of variations.

M. HAIMOVICI: Surfaces which correspond through parallel tangent planes so as to conserve a Tchebycheff lattice.

E. MARTINELLI: Cauchy's formula for the analytical functions of two complex variables.

G. OMBERTI: Wave propagation in imperfectly elastic systems.

G. PIACCARDI: Molecular spectra and spectroscopic analysis (5). Detection of gadolinium.

C. SANDONNINI and N. BORGHILLO: Electrolysis of iodine monochloride in various solvents.

O. VERONA and G. BONAVENTURA: Influence exerted on the development of plants by the partial elimination of the reserves accompanying the embryo, and the probable presence in them of 'growth substances'.

E. CARANO: Memorial lecture on Pietro Romualdo Pirotta.

L. CARNERA: Memorial lecture on Friedrich Kötner.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, October 11

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. Phyllis Tookay Keridge: "The Physiology of Hearing and Speech" (succeeding lectures on October 18, 25 and November 1)*.

Tuesday, October 12

UNIVERSITY OF LONDON (at the Institution of Electrical Engineers, Victoria Embankment, W.C.2), at 5.30.—Prof. Erwin Meyer: "Electro-Acoustics" (succeeding lectures on October 13, 15, 18 and 20)*.

ILLUMINATING ENGINEERING SOCIETY (at the Lighting Service Bureau, 2 Savoy Hill, W.C.2), at 5.30.—Dr. S. English: Presidential Address.

Thursday, October 14

INSTITUTE OF FUEL (at the Geological Society, Burlington House, W.1), at 2.30. Sir Philip Dawson: "Coal: the Next Step" (Presidential Address).

At 3.30.—Prof. Morris W. Travers: "The Study of Gases" (Melchett Lecture).

CHADWICK PUBLIC LECTURE (at Manson House, 26 Portland Place, W.1), at 5.30.—Prof. W. A. Osborne: "The Study of Nutrition".*

CENTRAL HALL, LONDON, S.W.1, October 13-5. General Discussion on Lubrication and Lubricants.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

CHIEF LECTURER in ELECTRICAL ENGINEERING in the West Ham Municipal College, Romford Road, Stratford, E.15—The Principal (October 9).

TWO ASSISTANT KEEPERS on the Higher Technical Staff of the Science Museum, South Kensington, London, S.W.7—The Director (October 11).

CIVILIAN EDUCATION OFFICERS (Grade III—engineering or physics) in the Royal Air Force Educational Service—The Air Ministry (H.S.1), Admiralty House, Kingsway, London, W.C.2 (October 15).

TWO ASSISTANT TEACHERS of MECHANICAL and MARINE ENGINEERING in the Liverpool City Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (October 16).

HEAD OF THE CHEMISTRY DEPARTMENT of Swansea Technical College—The Director of Education, The Guildhall, Swansea (October 18).

ECONOMIST to the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (October 18).

HEAD OF THE CHEMISTRY DEPARTMENT of Northampton Polytechnic, St. John Street, London, E.C.1—The Principal (October 31).

LECTURER in THERMO-CHEMISTRY in the Imperial College of Science, Prince Consort Road, South Kensington, S.W.7—The Secretary (November 8).

WATERWORKS ENGINEER for the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/5346).

HEAD OF CHEMISTRY AND APPLIED CHEMISTRY DEPARTMENT of Salford Royal Technical College—The Director of Education, Education Office, Chapel Street, Salford, 3.

ASSISTANT in the Intelligence Section of the Mineral Resources Department of the Imperial Institute, London, S.W.7—The Establishment Officer.

Official Publications Received

Great Britain and Ireland

Air Raid Precautions. Memorandum No. 5: Anti-Gas Training. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 23. (London: H.M. Stationery Office.) 4s. net. [219]

Report of a Joint Committee of the Chemical Society, the Faraday Society, and the Physical Society, on Symbols for Thermodynamical and Physico-Chemical Quantities and Conventions relating to their Use. Pp. 16. (London: Chemical Society.) 6d. [220]

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Physiology in General Education

UNTIL within very recent times, the study of the human body was practically solely the concern of physiological departments in medical schools. Undergraduates outside the medical curriculum had no opportunity of studying human physiology, and the people of Great Britain as a whole seemed well content to leave the control of their lives with respect to health and disease to the guidance of the medical profession. Thus, when 'science' was first introduced into the schools, educationists turned to chemistry and to physics, and, even to-day, such biology as is taught in schools deals almost wholly with plants and lower animals. That "the proper study of mankind is man" was the keynote of the discussion on "Physiology in General Education" in Section I (Physiology) of the British Association during the recent Nottingham meeting.

All the speakers in the discussions were unanimous that this loss of contact between human physiology and general education is a misfortune, not only for a modern democracy but also for physiology itself. Experimental psychology, which, as practised to-day, is but a branch of experimental physiology, has hived off from physiology, largely due to the absorption of physiologists in the needs of medical students. Biochemistry is shifting its camp from physiology to organic chemistry probably for the same reason.

This unfortunate lack of facility for study of human physiology in British universities reacts on school education and on adult education. The future school teacher has to rely almost wholly on training centres for instruction in human physiology and hygiene. These facilities, although admirable in many cases, are not to be compared with those already in being in our universities.

The end-result is that the content of physiological knowledge of the 'man in the street', and even of his legislators, is at a dangerously low level.

Moreover, whenever there is loss of contact between the practising scientific investigator and the public, there arises inevitably the risk of loss of understanding and of sympathy. The agitation against vivisection is very largely due to ignorance, on the part of the public, of physiological practice, and of the vital part played by physiological research in everyday life.

But the physiologist is not the only sufferer. From the cradle—and even earlier—to the grave, physiological first principles affect our health and well-being. In a modern civilized community it is no longer possible to rely solely on the bounty of Nature for our food and proper nourishment, or on our natural instincts for the conduct of our own and others' lives. The public, crassly ignorant for the most part of the elementary facts about the human body, ignores the simplest dietetic principles, falls victim to the specious advertisements of the vendors of fortified foodstuffs and of quack nostrums, and blindly follows the fatuous dictates of the latest fashion. Moreover, as one speaker in the discussion at Nottingham emphasized, all propaganda and legislation in the interests of public health must of necessity lose the greater part of their effectiveness if the public is incapable of appreciating the significance of, and reasons for, such activities.

After the comments made by Mr. H. G. Wells upon the teaching profession at this meeting of the British Association, it might have been expected that school teachers would not be in a mood to suffer tamely further suggestions from amateur, as

distinct from professional, educationists. Nevertheless, there was no protest at the suggestion that, to make way for the necessary instruction in human physiology, either some subject at present in the school curriculum would have to be dropped or a compromise effected by using human physiology as an introduction to, and a vehicle for, the teaching of general biology. It was pointed out that it is a sound pedagogic principle to proceed from the known, or at least the familiar, to the unknown. Study of the human body and of its functions is an admirable introduction to the study of other forms of life and of biological principles in general. Moreover, human physiology gives great scope for practical work with the minimum of apparatus; in short, it is good science, good biology and admirably adapted to school instruction.

Although the day is long past when all mention of human structure and of human function was taboo, yet some fear was expressed during the discussion that teaching of human physiology might lead to unhealthy self-consciousness and introspection on the part of the pupils. The

general opinion seemed to be, however, that such a danger is more likely to arise in the course of unofficial health talks conducted by enthusiastic but unskilled instructors than in routine school teaching. Indeed, Prof. Winifred Cullis, from her wide experience, believes that school instruction in human physiology, so far from inducing morbid preoccupation with the functions of the body, would rather tend to ventilate and bring into the unemotional atmosphere of the schoolroom, and thus into proper perspective, many matters which, even to-day, the modern child is shy of discussing with its elders.

The meeting was a very large one for a purely sectional discussion, and the fact that the practising physiologists were in an extremely small minority is an indication of the widespread interest the subject aroused. From every point of view it was unfortunate that a joint discussion with Section L (Educational Science) could not be arranged, for the time has clearly arrived when the place of physiology or human biology in school science courses must be given serious attention.

Registration and Privilege

THE extent to which the principles of 'free trade' are inbred in the people of Great Britain is well illustrated by the statutory provisions governing the registration of medical practitioners and pharmacists. For both professions the State establishes standards of education and examination, with a statutory register of those who reach them. To permit the public to differentiate between the qualified and the unqualified practitioner, the use of titles implying registration is prohibited and the signing of death certificates, the sale of poisons, and other minor matters are controlled. But in both medicine and pharmacy the practice of the calling by unregistered men has few statutory limitations.

By way of contrast, the lawyer is well protected. It is a statutory offence for a layman to practise as a solicitor, and in the High Court His Majesty's judges will neither see nor hear the advocate who is not a barrister. Accountants and architects have certain titles reserved to them, but few other statutory privileges. The high-water mark of protection for a calling is probably that given to dentists, the Dentists Act of 1921 making

it an offence for the unregistered to "practise dentistry".

Many attempts have been made in recent years to persuade Parliament to regulate the practitioners of a calling by means of a statutory register and to provide statutory privileges for the registered. The destruction of the Osteopaths Bill exemplifies the fate of such attempts. It is in the totalitarian States that there will be found the modern examples of restrictive legislation for the control and benefit of individual callings and their protection from competition. Whether the price to be paid compensates for the advantages, even to the sheltered practitioner himself, is a question the answer to which depends upon the temperament of the individual. The majority of the people of Great Britain are not temperamentally inclined to a régime of professional corporations, even for personal benefits, and that spirit is reflected in the attitude of Parliament towards Bills proposing to accord privileges to closed professions.

Nevertheless, there is a price to be paid for freedom. In the medical and pharmaceutical fields the price is the exploitation of the public by the

quack. Probably at no time in history has the British public provided so rich a field for the pseudo-scientific medicine-man with his tale of vitamins and hormones, rings, belts and exercises, massages and diets. *The Times* publishes its National Health Number, with the dominant note of healthy exercise outdoors, while from every hoarding, bus and tram an attempt is made to mesmerize the public into mass drugging.

A year ago, when the House of Commons was

invited to discuss this question on the second reading of the Medicines and Surgical Appliances (Advertisement) Bill, the House was counted out. It is small wonder that with public opinion so docile, the proprietary medicine industry was able to claim before the Select Committee on Medicine Stamp Duties in December last that the capital in the industry is £100,000,000, and that it spends between £12,000,000 and £15,000,000 annually in advertising its wares.

Air Raid Precautions

Air Defence and the Civil Population

By Dr. H. Montgomery Hyde and G. R. Falkiner Nuttall. Pp. xvi + 239 + 8 plates. (London: The Cresset Press, Ltd., 1937.) 12s. 6d. net.

THIS book has been written for the benefit of the 'man in the street'. It contains a moderate statement of the various risks to which the ordinary citizen may be subjected in an aerial bombardment, and explains the most effective methods of providing protection against them—collective, individual and structural.

The authors are generally in agreement with the recommendations made by the Air Raid Precautions Department of the Home Office, but they submit certain criticisms, the chief of which is the ineffectiveness of its propaganda, as public interest in the subject has not been aroused, nor has readiness on the part of the public to co-operate in defensive measures been achieved to the extent which both the seriousness of the international situation and the progress of military preparations throughout Europe plainly demand. They consider that, in the circumstances, instruction in passive defence should be as integral a part of the life of the nation as vaccination and the registration of vital statistics.

In striking contrast with this apparent apathy, the developments that have taken place in all Continental countries—including Holland and the Scandinavian group which were neutral in the Great War—are briefly summarized. In Germany, Italy and Russia a standard knowledge of anti-gas precautions is obligatory, and the whole civilian community is compelled to co-operate with the authorities in experiments of different kinds. 'Black-outs' are of common occurrence in all the chief cities, and the most realistic conditions are created, including the intentional bursting of water and gas mains and the daubing with red paint of the 'casualties' before they are

removed in the ambulances, in order to reproduce the situation that may have to be dealt with: everybody must take cover on the air raid warning being given, and even foreign tourists are punished if they disobey any of the orders. Public shelters are being built and municipal buildings strengthened, while in all important business premises and factories the provision of protection for the employees is compulsory. In Italy, instruction in passive defence measures is given from a series of gramophone records which are sold at specially reduced prices; while in Russia, General Eideman, the head of the Air Defence Department, was among the generals who were recently shot in Moscow, the official explanation given being that his organization was 'on the down grade'!

In Czechoslovakia a law has recently been enacted compelling all housing contractors to provide bomb-proof shelters in the cellars for the protection of their tenants; and in France, where the experience gained in the construction of the Maginot line has been of particular value, a Bill has been passed empowering the Government to evacuate the civilian population where necessary, and to build bomb- and gas-proof shelters: in the Seine Department alone, £1½ millions were voted two years ago to finance air raid precautions.

While all these measures are accepted by our neighbours with enthusiastic co-operation, our own lack of interest is all the more remarkable as we are exceptionally vulnerable to attack, and the outstanding characteristic of future air raids is that they may come suddenly and unexpectedly and may well precede any formal declaration of war. (When a practice 'black-out' was suggested in Brighton a few days ago an alderman was reported to have protested against frightening the visitors, while a councillor described the proposals as "this air raid nonsense".)

The authors are, however, by no means alarmist in their conclusions. They consider that poison gas should not be regarded as the deadliest weapon in the hands of a potential enemy; and that the heaviest type of high-explosive bombs against which, we are told, a roof covering of 12-15 feet of reinforced concrete is necessary, are so costly and the number that can be carried by aircraft so small, relatively, that their use in war will be confined to special objectives, and they will not be deliberately employed against the civil population. Incendiary bombs are now believed to constitute the greatest danger to civilian communities, as the agents available are greatly superior to those employed in the early Zeppelin raids on London, which proved to be very disappointing to the attackers in the results achieved. While certain public services, such as central telephone exchanges, must be protected from interruption at all costs, gas- and splinter-proof protection is all that should normally be aimed

at for private houses, after all inflammable materials have been removed from the attics.

This book is written in simple language, and it should be widely read: a great deal of industry has been required to collect the material necessary for its compilation and the matter is well arranged. It is well established that the Italians used mustard gas in their Abyssinian campaign, but it will be news to most people in Great Britain that gas has been used by both sides in the civil war in Spain. The authors seem to have access to sources of information not supplied to, or at any rate not published by, our newspapers, so it is to be hoped that in future editions of their work details will be given of the effects produced and of the types and weights of the projectiles that are being used in the aerial bombardments there, as these are possibly being 'tried out' by nations who may be engaged in the next European conflict, if and when it overtakes us.

C. H. F.

The Problem of the Portolan Charts

Hallucinations scientifiques (les portulans)
Par le Prince Youssouf Kamal. Pp. 96 + 39 plates.
(Leiden: E. J. Brill, Ltd., 1937.) n.p.

PRINCE YOUSSEUF KAMAL is known not only as the owner of an unusually fine collection of early maps, brought together with little regard to cost, but also as a keen student of their history, so that anything written by him on the subject merits attention. His big folio volumes containing, or to contain, facsimiles of all the most important early maps of Egypt or of Africa as a whole (with which, as an Egyptian, he is specially interested) are monuments of sumptuous reproduction. The present work claims no such importance, and one cannot help wishing that he had waited to give a systematic discussion of the old Portolan Charts and their origin, for he should be well qualified to undertake such a study. As it is, the work is somewhat scrappy and disjointed, its main object being to combat the theory put forward by a recent writer, Prof. J. H. Kramers of Leyden, who believes that the nautical charts produced in the Western Mediterranean, which make their first known appearance, already in fully developed form, about A.D. 1300, owed much to previous work of the kind in the East, especially that of the Arab geographers El Bakri and Edrisi. It is this to which the term "Hallucinations" of the title is applied.

One must allow that no convincing arguments have been produced in support of the theory, and Prince Kamal's counter-arguments will no doubt on the whole meet with approval, though perhaps open to criticism in some particulars. He holds that the charts were first produced, in the West, to meet the practical needs of sailors in that part of the world, at a time when trading voyages began to be extended farther afield than previously—to the north coasts of Africa for example. He has no difficulty in showing that the point of view of men like El Bakri and Edrisi was quite different from that of the chart-makers, their descriptions being almost entirely based on land-routes. As to the appearance of Arabic names on the charts—previous Western literature having mostly adopted those of the Greeks and Romans—this was an obvious necessity if the charts were to be of practical value. This may be conceded, but it surely does not follow, as Prince Kamal seems to imply, that nothing in the way of charts, as distinct from sailing directions, had been used in the East previous to about 1300. Similar need might be expected to produce a similar help.

Prince Kamal also rejects the idea that the wind-roses of the charts, with the elaborate system of radiating lines, may be an indication of Eastern (perhaps Greek) influence. He holds that the chief object of the lines was not that of direction-pointers, but of helping the draughtsman to

copy his sources, like the 'squaring' used by modern map-makers. Curiously enough, he seems almost to regard the figures produced by the intersection of the lines as the reason for drawing them, instead of being merely an incidental result.

The general tone of the work, and the occasional long and somewhat involved sentences, make it a little difficult to grasp the writer's motive in producing it, for he begins by stressing the small likelihood there is of arriving at any conclusion—one section is actually headed "Conclusion (sans conclusion)". Similarly, he thinks that no good result can be gained by a detailed comparison of the respective contents of the charts and the Oriental works, yet he is at great pains to supply the material for such a comparison, for the sake

of such as wish to make it. This forms the most substantial part of the work, including not only reproductions of the North African portions of the most important early maps down to and including the Portolan Charts, but also comprehensive lists of names, distances, and geographical co-ordinates derived from the early literature, both Eastern and Western. This part will supply a useful basis for study to those who may not have access to the bigger works in which the field had been covered previously to some extent.

On one point at least one may cordially agree with the author—that relative accuracy in a map is no proof that it is later in date than another, as is too often assumed. It is not to be thought that every map-maker would be conversant with all the best work of his predecessors.

E. H.

Fundamentals of Zoogeography

General Zoogeography

By Prof. V. G. Heptner. (In Russian.) Pp. 548. (Moscow and Leningrad: Gosudarstvennoe Izdatelstvo Biologicheskoi i Meditsinskoi Literatury, 1936.) 13 50 roubles.

THE recent rapid advances in the study of animal ecology, historical geology and palæoclimatology are making inadequate the old formal zoogeography, which consisted mainly in the accumulation of distributional facts and in the parcelling out the earth's surface into rigidly defined zoogeographical regions, provinces, etc. An urgent necessity for revising the fundamental conceptions and methods of zoogeographical research, in order to bring it into line with allied sciences, is felt by all biologists working on distributional problems, whose aim is not merely to register facts, but also to find the most probable scientific theories accounting for their origin. There is no lack of attempts at such revisions, but none of them can be considered sufficiently balanced. Usually there is a distinct bias either towards pure ecology, which is taken to provide a complete explanation of all distributional facts, or the stress is laid on geological history, and very ingenious theories are built on an incomplete foundation.

The book under review represents another attempt of this kind and certainly a very successful one. The first part contains a most instructive introduction to the subject-matter of modern zoogeography and a clear representation of basic ecological principles, namely, factors of existence,

ecological valency, optimum and pessimum, habitat concept, biological types (life-forms) and biocoenoses. The second part is devoted to a more detailed analysis of the environment and of environmental factors, both in water and on dry land, and ends with a classification of the main ecological formations (biotopes) of dry land, with their characteristic faunas. The problems of the dispersal of animals and of the area of a species occupy the longest, and the best, part of the book, where special attention is given to various types of discontinuity and their origin. The final (fourth) part deals with comparative zoogeography, that is, with brief descriptions of the different zoogeographical regions, and has special sections on the fauna of the U.S.S.R., and of the seas.

The most valuable quality of the book is the abundance of reliable and fresh facts most carefully collected from an immensely scattered literature. In this respect, the author can be criticized only for paying too much attention to vertebrates and for neglecting to a certain extent the literature on invertebrates, more particularly on insects, where a great amount of very valuable data has been recently accumulated with the development of modern ecological trends, in entomology.

Amongst other points deserving to be mentioned in a critical review is the omission of the consideration of palæoclimatic factors in the evolution and movements of animal populations. One may not accept without reservation the Koeppen-Wegener schemes of displacements of climatic zones in the

past, but they should be at least mentioned in a book of this kind. Another weak point is the lack of discussion on ecoclimates of the actual animal habitats, which very often enable an animal to survive in a region the general climate of which is wholly unsuitable for it.

On the whole, however, the book represents an outstanding contribution to the development of

biogeographical science, and it is a matter of regret that its language will make it inaccessible to most workers and students outside Russia. Biogeography is now entering a period of intensive development and there is no text-book in any language that could be recommended more thoroughly than the present one.

B. P. UVAROV.

Latin Clarity and the Sciences of Life

Encyclopédie française

Tome 4: *La vie*. Dirigé par André Mayer. Pp. 582. (Paris: Société de gestion de L'Encyclopédie française; Libr. Larousse, 1937.) n.p.

THE great difficulty confronting all those who wish to give a connected account of the sciences of life is that of steering between the Scylla of excessive popularity and the Charybdis of technicality. Where certain special but fundamental sciences are concerned, such as biochemistry and genetics, the relative unfamiliarity of their concepts to the general reader leads to a failure to do them justice and hence to an unfair emphasis. The present volume of the French Encyclopædia, in which some fifty French scientists have collaborated to describe the main outlines of the sciences of life, seems to overcome these difficulties better than any English book. The excellent "Animal Biology" of Haldane and Huxley is very short, while the two-volume "Life" of Thomson and Geddes suffers particularly from the failure just referred to.

The book now under review gives a good initial impression, for its several fascicules are bound in loose-leaf style, suggesting that new ones may be issued as important advances occur, to take the place of some of the present ones. After a quite striking frontispiece, which represents a binocular microscope against the background of a monster Purkinje cell, the book opens with a section on the cosmic setting of life, its chemical actions on the outer world, and such subjects as the cycles of carbon, nitrogen and other elements. The second section deals with the constitution of living organisms. Concise accounts of the colloidal state, of the main groups of chemical substances from which living matter is built up, and of the actions of enzymes, are given. Section 3 is entitled "The Structure of Living Beings", and is devoted to experimental cytology, the equilibrium of the cell with its environment, etc.; Section 4, "The Actions of Living Beings", deals with movement,

adhesion, phagocytosis, luminescence, muscular contraction, ciliary movement and similar topics. In Section 5, "The Forms of Life", a wide survey of comparative physiology shows how morphology and function are intertwined in many groups of animals, and Section 6, "The Maintenance of Life", discusses metabolism, reflexes, the fixity of the internal medium, cicatrization, regeneration, etc. Latent life, radiation effects, chemical agents and immunity have a section to themselves under the head of "Repairs and Alterations in Living Organisms", while the book ends with a section on the transmission of life in which the whole of embryology and genetics are passed under review.

The outstanding impression left by the work is one of clarity and logic. The arrangement of the sections is unusually clearly thought out, and although the comparative anatomy of animals and plants is throughout in the background, this would follow from the predominantly physiological outlook with which the book is written. Where such a broad canvas has so successfully been painted, it would be almost pettifoggish to complain of the confusingly wrong formula for vitamin B₁ on p. 4.12-5 or of the persistent absence of magnification data in the illustrations, so that a guileless reader might obtain almost any fantastic idea of the sizes of the biological objects shown. But it must be admitted that some of the sections, perhaps especially those on oxidation-reductions and fermentation, give the impression of having been written about ten years ago. One might also suggest that the formulæ of substances should be given where their physiological functions are discussed, or at least a cross-reference inserted; for example, adrenaline and acetylcholine on p. 4.36-15, auxin on p. 4.60-9. In general, however, the book will be of immense value to all Frenchmen of reasonable intelligence who wish to gain an accurate view of modern biology, and it is a pity that Englishmen will not be able to share it with them unless someone should attempt the heavy task of a translation. JOSEPH NEEDHAM.

Interracial Marriage in Hawaii :

a Study of the Mutually Conditioned Processes of Acculturation and Amalgamation. By Romano Adams. Pp. xviii+363+11 plates. (New York : The Macmillan Co., 1937.) 18s. net.

STUDENTS of the inter-relationships between groups of people of different racial and cultural origins have long been interested in Hawaii, "the melting-pot of the Pacific", where Americans, Japanese, Chinese, Filipinos, Portuguese, native Hawaiians and others have worked out a *modus vivendi* with, apparently, the minimum of friction. Dr. Adams has given us an elaborate and well-documented analysis of this situation.

An examination of the present racial composition of the population and degree of race mixture is followed by a series of investigations of the component groups and the part they play in the communal life. Valuable correction of census material is embodied throughout. A most interesting section deals with the social background of interracial marriage. There is no general theory of racial inequality or any organized public sentiment against intermarriage between members of the different racial groups. Personal and family sentiment against it is shown to exist, but it is argued that the frequency in practice is so great that it would be difficult for a widespread adverse social sentiment to form. The author attributes this situation to a variety of historical reasons, including the absence of white women at the earlier stages of intermixture, the marital freedom of the native Hawaiians, the advent of the early missionaries from New England and not from the Southern States of America, and the absence of a single "dominant race". He has perhaps underestimated here the importance of the compatibility of the physical traits, temperament and intelligence of the Hawaiians with those of the immigrants, in facilitating intermarriage on a basis of equality (relations between European and Maori in New Zealand may be compared with this).

It is possible also that the low rate of marriage of "Other Caucasian" (mainly non-Latin) women with other groups such as the part-Hawaiian, and the tendency to increasing cultural segregation of the part-Hawaiian group have been minimized by the author in his prediction that, by the end of the present century, the majority of the people of Hawaii will constitute a stable race mixture of hybrids, culturally homogeneous. But fact and inference are clearly separated in the book, which is an extremely valuable study in an important field. One looks forward to seeing more publications on this subject, sponsored, as in this case, by the enterprise of the University of Hawaii. R. F.

The Subject Index to Periodicals, 1936

Issued by the Library Association. Pp. xii+300. (London : Library Association, 1937.) 70s.

THE Library Association and its general editor, Mr. T. Rowland Powel, are to be congratulated on the coming of age of the "Subject Index to Periodicals",

this being the twenty-first year of the existence of the Index. As was also the case last year, the volume for 1936 appeared only five months after the close of the year covered.

The volume for 1936 contains references to more than 27,000 articles selected from no fewer than 597 periodicals. Of these periodicals 547 are English and American, 27 French and Belgian, 21 German and 2 Italian. The articles are arranged under headings such as 'Floodlighting', 'Mural Painting' and 'Radio-activity', but under each heading the order is that of authors' names. The subjects selected for indexing cover a wide range, but verse and fiction are excluded.

With some important exceptions, no attempt has been made to index periodicals covered by the following publications : *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colorists*, *Photographic Abstracts*, *Revue de Géologie*, *Minéralogie et Cristallographie*, *Royal Meteorological Society's Bibliography*, *Science Abstracts* and *Technical Institute Journal*.

These Subject Indexes are much appreciated by those to whom a knowledge of the latest researches on scientific problems is of importance, for without such works of reference at hand it is quite possible that many a valuable paper may be overlooked. We congratulate the Library Association on the promptitude with which these annual volumes are published.

Gravimetric Analysis :

a Laboratory Manual with Special Reference to the Analysis of Natural Minerals and Rocks. By W. van Tongeren. Pp. xi+278. (Amsterdam : D. B. Centen's Uitgevers-Maatschappij N.V.; London : H. K. Lewis and Co., Ltd., 1937.) 14s. net.

THIS text-book, written by one having considerable practical experience, will be welcomed by mineralogists and analytical chemists generally. It gives a critical description of modern gravimetric analytical methods in a very convenient form.

The plan adopted by the author is the logical one based on geochemical principles. The text is well illustrated by useful diagrams, where the technique involves such for clearer explanation, and the tables are clearly set out. The few typographical errors seem to constitute the only minor drawback to the book. There are three indexes, devoted to apparatus, reagents and determinations respectively, and this arrangement makes reference unusually easy.

Assay methods, or as the author prefers to designate them, "docimastic methods", for the noble metals are beyond the scope of this book ; their inclusion would not have added to its value and would certainly have added greatly to its bulk. The bibliography is adequate, accurate and up-to-date, and naturally the names of such well-known workers in this field as Hillebrand, Hevesy and Goldschmidt constantly recur in it. Of all the names mentioned only some six per cent are those of British investigators, indicating that insufficient attention is paid in Great Britain to the scientifically and economically important subject of geochemistry. O. S. G.

The Ohio-Mississippi Floods of 1937

By R. W. Davenport, U.S. Geological Survey

SOME of the recent floods in the United States have indicated that, in any appraisal of the potentialities of a river system for producing floods, more significance than has perhaps been customary should be attached to the magnitude

settlement of the region by white men, thus making a skeleton record going back one to three hundred years, varying with the time of such settlement. The available records may be sufficient to show with considerable reliability the char-

acteristics of a river in respect to the magnitude and frequency of lesser floods, but such records are entirely inadequate for disclosing the expectancy of the rare floods of great magnitude.

In March 1936, floods occurred in the north-eastern part of the United States which caused crests on many rivers that were higher by several feet than had been recorded since the settlement of the country. Similarly, the more recent extraordinary floods of January and February 1937 in the Ohio and mid-Mississippi Valleys were greater than any known since the time of white settlement. Stages higher than previously recorded occurred on the Ohio River from Point Pleasant, W. Va., to its mouth at Cairo, Ill., a distance of about 700 miles, and on the Mississippi River from the

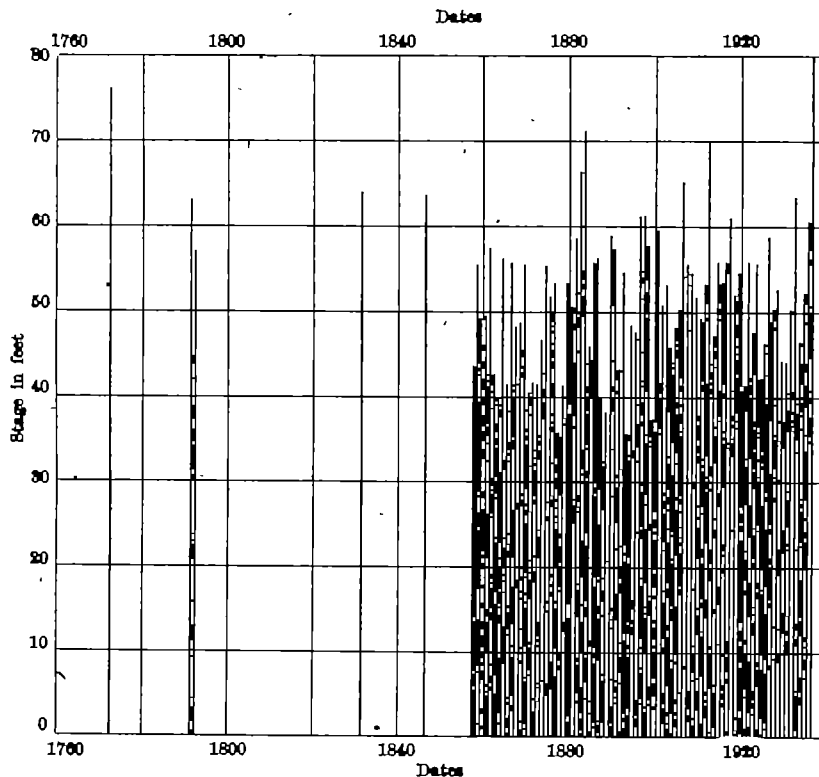


Fig. 1.

MAXIMUM ANNUAL FLOOD STAGES, OHIO RIVER, CINCINNATI, OHIO, 1858-1937.
(CHRONOLOGICAL ARRANGEMENT).

of the great floods of the past, as disclosed by Nature's records of them. A conspicuous part of the work of rivers in the processes of dynamic geology is associated with the occurrence of major floods, and significant information with respect to such floods may be appropriately and reliably interpreted from the flood plains, terraces, earlier river channels, and other evidences of erosion and deposition which record a river's past behaviour.

Systematic records of flood stages on rivers in the United States do not generally extend back more than fifty or sixty years at most. Knowledge of earlier flood stages may cover, with considerable completeness for some rivers but usually without much detail, the outstanding floods since

mouth of the Ohio to a point below Helena, Ark., a distance of more than 300 miles. The excess of the flood crests above the highest previous records was greatest in the vicinity of Louisville, Ky., where all previous stages were exceeded by 10-11 feet. At Cincinnati, Ohio, the flood crest was 8.9 feet higher than had occurred in eighty years of continuous record and 4 feet higher than the highest previously known stage, which is reported to have occurred in 1773. With rare exceptions, the protective levee systems were overtopped and great damage to property and considerable loss of life were caused in cities, towns, industrial establishments and transportation routes that occupied the flood plain.

Fig. 1 shows by bars in chronological order the maximum yearly stages of the Ohio River at Cincinnati, Ohio, continuously for the eighty years, 1858-1937, inclusive, and for certain major floods prior to that period.

Fig. 2 shows, as explained thereon, the maximum yearly stages at this place for the eighty years above specified, arranged in order of magnitude and plotted upon arithmetic-probability paper. The graduations on this paper have the characteristics that if a series follows the laws of normal probability the plotted points will define a straight line. This type of graduation is used because it seems to show the observed data effectively.

In so far as Fig. 2 illustrates the magnitude-frequency characteristics of the Ohio River in the production of floods at Cincinnati, the river does not seem to have departed far from its demonstrated character in producing the excessive stage of 1937. However, on the basis of the records prior to 1937, it is probable that the deduction would have been warranted that such a stage as occurred in 1937 would be of such rare occurrence as to justify little consideration with respect to protective works or occupancy of the flood plains. In the popular mind a flood of such magnitude was considered essentially impossible.

The series of rains which caused these record-breaking Ohio-Mississippi floods began toward the end of December 1936, continued through most of January and were unusually excessive in the latter month. The associated weather conditions resulted from abnormal movements and interactions of air masses over a large region. The distribution of barometric pressure "resulted in a continuous northward and north-eastward movement of tropical air masses over the area roughly from Louisiana and Tennessee eastward to the Atlantic States, New England and New York, while air masses of polar origin moved southward almost continuously over much of the western half of the United States. . . .

"The extremely heavy rainfall over the Ohio Valley, Tennessee and Arkansas and part of the adjoining areas was in general caused by the fact

that this area was so located with relation to the very deep areas of high pressure on either side that at the earth's surface the line of contact between the warm, moist air from the south, and the dense, cold air of polar origin that came in over the Ohio and middle Mississippi Valleys on many days from the north and north-east, lay somewhere over this area much of the time; and the less dense warm air from the south (or south-west) was forced to rise over the cold and denser air. The rapid lifting of the very moist air of tropical origin resulted in abundant precipitation."*

The total rainfall for the month of January

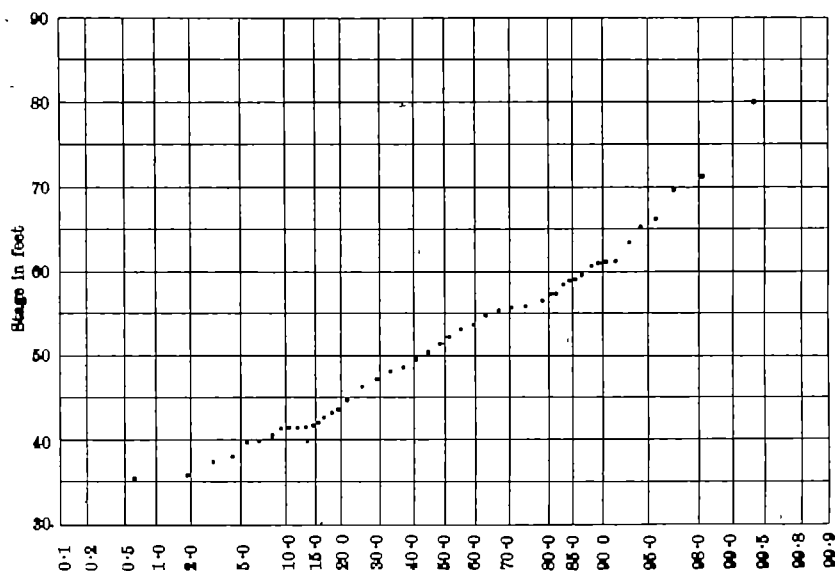


Fig. 2.

MAXIMUM ANNUAL FLOOD STAGES, OHIO RIVER, CINCINNATI, OHIO, 1858-1937. RECORDS PLOTTED IN ORDER OF MAGNITUDE ON ARITHMETIC PROBABILITY PAPER. FOR THE MID-48 YEARS, THE PLOTTED POINTS CORRESPOND TO THE MEANS OF SUCCESSIVE GROUPS OF THREE YEARS IN ORDER TO AVOID CONFUSION CAUSED BY A MULTIPLICITY OF PLOTTED POINTS.

was four times the normal, or more, over approximately 35,000 square miles. The area of heaviest precipitation included the middle and lower Ohio River valley, mainly along the Ohio River and the lower valleys of its tributaries (Fig. 3). The rainfall occurred not so much in a progression of general storms through the region as in a progression of somewhat sporadic storms marked by considerable variation in local distribution, and moving in a general north and north-east direction. The average rainfall in January over the drainage basin (203,000 square miles) of the Ohio was slightly more than 11 inches.

The floods occurred in a season when normally there might have been considerable snow, but, because of the prevalence of exceptionally

*Statement by C. L. Mitchell, forecaster, United States Weather Bureau, *Monthly Weather Review* February, 1937, p. 72.

warm winter temperatures, the snowfall was light and had no appreciable influence on the floods.

The rains in December and early January reduced the capacity for surface storage and absorption by the ground that otherwise would have been available, and filled the channels of lower reaches of the rivers which later were sub-

merged in the tributaries of the upper Ohio River and caused record-breaking stages at Pittsburgh, Pa., and for a distance of approximately 100 miles below that city. The peak which occurred at Pittsburgh on March 18 reached Louisville, Ky., a distance of about 600 miles, 11 days later, on March 29. In contrast, the 1937 flood

reached its crest at Pittsburgh on January 26 and at Louisville on January 27, thus giving evidence of extreme concentrations of flood waters nearly simultaneously in several hundreds of miles of the channel of the Ohio River. The flood was at crest at the mouth of the Ohio River, a distance of 980 miles below Pittsburgh, on February 3. This crest moved down the Mississippi and reached Memphis, Tenn., a distance of 227 miles, on February 10; Vicksburg, Miss., a distance of 602 miles, on February 21; and New Orleans, a distance of 960 miles, on February 28. At Cairo, Ill., at the mouth of the Ohio, the Ohio and Mississippi were higher for a period of nineteen days, from January 24 until February 11, than any previous record. Preliminary computations indicate that the mean discharge of the Ohio River for this nineteen-day period was approximately 1,650,000 c.f.s. from a drainage area of 203,000 square miles—about 8 c.f.s. per square mile. The maximum discharge was about 1,850,000 c.f.s.

Topographic maps show a pronounced flood plain adjacent to the Ohio River, in the middle and lower valley. At the margin of the flood plain the reduction of spacing of the contours is so marked as to produce an effective visual impression as to the location of this margin. A definition by outline of the overflow areas of the 1937 floods indicates the apparent flood plain to have been almost

wholly occupied from the vicinity of Cincinnati to the mouth. Above Cincinnati, as the excess above previous crests decreased, increasingly more of the flood plain appears outside the overflow area.

In order to produce the characteristic topography of this valley, the Ohio in past ages must many times have occupied the flood plain in a degree similar to that of 1937. The evidence and experience seem to demonstrate that there is a place in the planning of flood control works for

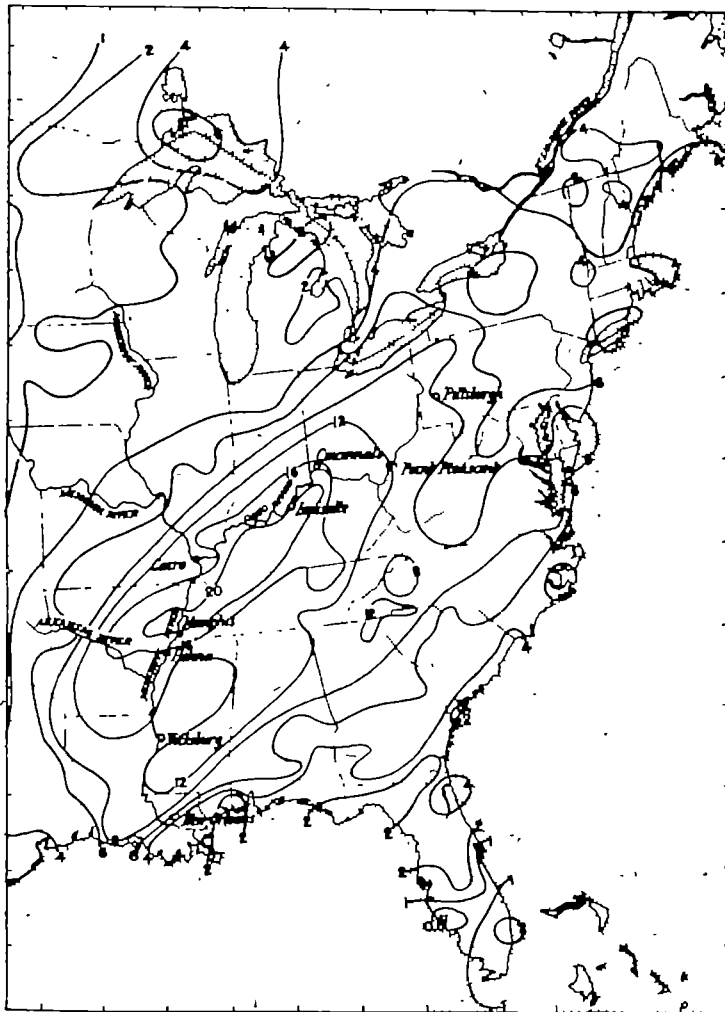


Fig. 3

TOTAL PRECIPITATION IN INCHES, JANUARY 1937, FROM UNITED STATES WEATHER BUREAU *Monthly Weather Review*, JANUARY 1937.

ject to the most excessive rainfall. As a result, an exceptionally large part of the heavy rainfall of January 20-25 ran into the streams. The especially heavy rainfall in the middle and lower Ohio Valleys was essentially superimposed upon full rivers resulting from the preceding days of rain in the upper parts of the basin.

The peculiarities of the floods of 1937 may be illustrated by a comparison with the floods of March 1936 in relation to the progression of flood crests down the Ohio River. The floods of March

appropriate consideration of the recurrence of the great floods which geological evidence shows have occurred many times in the past. Such consideration would serve as a corrective against failure to realize adequately that a series of rains like that which produced the 1937 floods can recur, and also would tend to produce a more sound understanding and befitting humility as to the

limitations of the works of man in effectiveness against all possible floods. Nature can produce floods which it may not be practicable for man to control, and it behoves man in the municipal and industrial development of river valleys not to overlook the need for meeting those events that are associated with flood catastrophes which it is not practicable for him to prevent.

Modern Study of Plants in Relation to Education*

By Prof. E. J. Salisbury, F.R.S.

IF we cast our minds back on the general attitude adopted towards botany in the latter part of the eighteenth century, we cannot but be struck by the almost apologetic phraseology of its votaries and the curious grounds upon which they rationalized its pursuit. Rousseau, for example, described botany as a study of pure curiosity that has no other real use than that which a thinking, sensible being may deduce from the observation of Nature and the wonders of the universe. I venture to think that many otherwise educated people to-day would express similar sentiments, though in more modern and probably less complimentary language.

The teaching of our subject has been in no small degree to blame for the widespread misconceptions as to its aims and content. For long regarded as a harmless and elegant occupation for the female sex, botany only survived as a study of practical utility because of the continued necessity for medical practitioners to acquire some knowledge of *materia medica*. How perfunctory was much of this teaching is indicated in that charming book, "Leaves from the Life of a Country Doctor", where the late C. B. Gunn describes how as a medical student in 1878 "the botany class gave me a 'sounner' at the subject which has lasted ever since".

The old technological significance for medicine has long since gone, but a newer and vastly more important significance remains, both cultural and vocational, which has rarely been stated, let alone stressed. Despite the vastly enlarged content of botanical knowledge since those days, the general conception of botany has remained much what it was then. The high value of botany as an educational subject and indeed its absolute necessity in any system of real cultural development are aspects which botanists have failed to present and emphasize.

The protagonists of compulsory Greek and Latin of the last century valued very highly, and rightly so, the cultural content which a study of the humanities could provide. It is easy for us to be wise after the event, but now that the dust of that controversy has cleared away we can see that failure to apprehend that there are other approaches to the same mental salvation led to an unfortunate insistence upon the means rather than upon the end.

But whilst scientific workers justly claim that cultural value is the monopoly of no one subject and that those brought up in the classical tradition may be as much philistines as any man of science, it is undoubtedly true that the immense cultural potentialities of scientific thought have too often been neglected for the sake of mere erudition. There is a general tendency for university teaching to become more and more vocational as the specialized demands of occupations become increasingly exacting. Thus, not only do technological aspects grow more obtrusive, especially in the final courses of certain subjects, but also there is a trend, in the direction of this change, making its influence felt, further and further back in the student's training, so that we find, for example, certain sections of the medical profession demanding that the preliminary education should have a more direct bearing on the future occupation of the student, despite the fact that this can only be accomplished at the expense of their general education and culture. With the long course of training which most professions to-day require and the financial strain that this often involves upon parents, one cannot but sympathize in the wish to provide some relief, but if this is to be accomplished without detriment to the ultimate standing of the professions themselves, it can only be by an increased concentration on the more general aspects of culture in the schools. So far as biology

* From the presidential address to Section K (Botany) of the British Association, delivered at Nottingham on September 2.

is concerned, there is a widespread recognition for the need of greater attention to training in observation in the schools, allied to what may be termed the scientific study of natural history. Too much attention in this as in other subjects is paid to the acquisition of mere information, especially if recent, too little to the principles which are involved.

This is not intended as a stricture upon the teachers, since, with our present system, earlier and earlier in the students' career they are striving to achieve a dual objective—the training which should be their chief concern, and preparation for university examinations at a stage in mental development which cannot adequately appreciate the educational content of the curricula. Thus the student who has taken the intermediate examination from school is often handicapped in comparison with those who would appear to be starting their university career in a less advanced stage.

Just as the increased demand for material things facilitated the replacement of the products of the craftsman by mass production of machine-made articles, so, too, the rapid increase of population following the Industrial Revolution inevitably led to something analogous to mass production in the education of children and the training of teachers.

Many there are who blame the examination system, which, however, with all its faults, if rightly used, is in reality a fairly efficient sieve for separation where large numbers are involved. But the examination machine is often expected to effect a grading of the human material with which it deals that can only be attained by more individual methods. As a consequence, undue importance is attached to examination results and a wrong emphasis is often laid on their significance. This leads to a premium being placed on mere erudition, and so subjects are liable to be taught not as living realities but, in the forceful phraseology used by Winston Churchill in one of his novels, "Knowledge is presented as a corpse which bit by bit we painfully dissect".

Furthermore, our educational methods are, I fear, too often divided in their allegiance; on one hand we aim at the provision of a liberal culture which will make for the greatest happiness of the individual, considered in terms of mental contentment and an abiding resource in later life; whilst on the other hand we aim at the equipment of the student for the earning of his daily bread to ensure bodily comfort. We are not sufficiently trustful that the provision of the former is, to employ the expressive northern phraseology, the "gainest way" to the latter end, and so we adopt a sort of mental squint, which permits neither of the clear vision of the full beauty of integrated knowledge nor even of keeping our eyes on the main chance.

It is no more possible in education than in ethics to serve both God and Mammon. It is not merely good education but the apotheosis of worldly wisdom to seek first the cultural background and to believe that the vocational proficiency will be added unto you.

The universities cannot be held blameless for the lack of appreciation by the general public of the implications of our subject. May I, in this connexion, quote a passage from an American report on university education which loses none of its cogency on this side of the Atlantic: "Appointing authorities too often place undue stress on specialisation, instead of placing adequate emphasis on scholarly background, versatility of intellectual interest and general culture".

Whilst activity and distinction in research is a necessary qualification of the teacher, the capacity to impart knowledge to others is no less essential. Too often in the selection for university posts, aptitude as a teacher, which should be a first consideration, is entirely subordinated to distinction as an investigator. No one, it is true, can be an inspiring teacher who does not possess intellectual initiative and who is not engaged in a creative pursuit, but most of us have suffered at one time or another from the investigator "whose thoughts are too full for words". Furthermore, we must avoid the undue sacrifice of breadth for depth for other reasons.

The accumulation of data and the provision of information bear much the same relation to the advancement of knowledge as artificial fertilizers to crop production. Just as our fertilizers must be properly balanced, so, too, our information must be so correlated and concerted that ignorance in one department does not become the limiting factor in our utilization of extensive data in others. In these days of extreme and increasing specialisation, such correlation of effort is becoming more and more important, and it is to the universities, old and young alike, that we must look for the maintenance of that contact and synthesis which is essential to real progress. In particular, I should like to urge that the time has come when the curriculum required of those proceeding to a university degree in science should be reconsidered. It is, in the present state of knowledge, as much an anachronism that a student should be able to proceed to a degree in chemistry having no knowledge of biology as that he should proceed to a degree in botany with a mere smattering of either physics or chemistry. Anyone who aspires to a degree in science should in my opinion have an adequate appreciation of the principles of physics, chemistry, mathematics, especially as regards statistical methods and probability theory, and lastly, but by no means least, one biological

subject. It may be stressed that some biological training is to-day an essential to any liberal culture and should be as much an obligatory part of a school curriculum as arithmetic.

One great merit of botanical study from the point of view of general education is that, if properly taught, it provides perhaps the best medium for training in accurate observation. Observation consists essentially of two separate processes, namely, seeing the object or phenomenon and the apprehension of what is seen. The visual perception of the good and bad observer may be alike adequate, but it is in the degree of their

apprehension that they differ. To train such powers it is essential to check the accuracy of appreciation either by means of verbal description or graphic representation. The graphic method is clearly more suited to the adolescent mind, whose limited vocabulary and limited feeling and understanding of the nuances of meaning of words unduly restricts his verbal precision. Drawing, if regarded strictly as a statement of observed facts, offers the best means of such training, and botanical material, because of its well-defined organization, is peculiarly suited for this purpose.

[To be continued.]

Surface Action in Biology

A JOINT symposium including Sections A (Mathematical and Physical Sciences), B (Chemistry) and I (Physiology) was held on this topic at the recent meeting at Nottingham of the British Association.

Since the development of the Langmuir trough in 1917, several new methods have been introduced into our armoury of weapons used for attacking the problems connected with film structure and film reactions. Of these, two have been developed in some detail and have provided us with numerous interesting and novel results, which appear to have far-reaching biological implications.

In the first method, a number of mono-layers of barium stearate are successively built up on a chromium-plated surface. Brilliant interference colours are observed when the film is viewed at a suitable angle in polarized light, conveniently obtained with the aid of a 'Polaroid' screen. The interference minima are so sharp that increments in thickness so small as 1.6 Å. can be detected. If in the outer layer the divalent barium ions be replaced by ions of a higher valency, for example, thorium, the surface is now 'conditioned' in that it will adsorb monolayers of a variety of substances, for example, proteins or cholesterol. On these surfaces in turn adsorption of a second mono-layer can take place, for example, digitonin on cholesterol but not on epicholesterol. It is found that many of these selective adsorptive reactions are highly specific.

By superimposing instead of a series of barium stearate monolayers, mixed films containing barium stearate and stearic acid are employed, the composite mixed membrane may be leached with stearic acid solvents, and a skeleton membrane of barium stearate remains. Such a skeleton can be refilled with various liquids, and the successful penetration followed by observing the changes in

the refractive index of the layers. By sensitization of such a skeleton film and coating with a mono-layer, it is evidently possible to examine the permeability of adsorbed monolayers to different solvents.

This optical method of examination provides us in the first place with an elegant means of determining whether adsorption has taken place or no, for example, in such reactions as the antibody antigen reaction. If in this case the surface reaction is indeed as specific as the bulk colloid reaction, it is evident that the method may well prove an agreeable substitute for the usual precipitation technique. In respect to sensitivity, we may note that one square centimetre (ample for optical examination) requires only 10^{-7} gm. for deposition. In the second place, the optical examination of skeleton membranes permits us to investigate both their permeability and ease of penetration by a variety of solvents. Since such penetration involves not only considerations of pore size but also of the extents of interaction between the penetrating molecular species and the material of the membrane, it is evidently a convenient method for obtaining information on each of these factors.

The second method of investigation involves determination of the force area characteristics, and the modification in the phase boundary potential caused by the presence of the film. Since in general terms the force area values give us information about the non-polar and the phase boundary potential provides us with knowledge about the polar portions of a complex organic molecule, it has been found possible to make fairly detailed analysis about the orientation of even complex film-forming systems. This applies especially to substances existing in what is termed the homallic state, that is, extended on the surface, such as are found in the protein or cellulosic monolayers.

Since chemical action involves an alteration in the magnitude of the dipole moment of at least a portion of the reacting molecule, this method is found most convenient for following rates of reaction which may involve either an interaction between molecules in the film with those in one of the bulk phases, or interaction between molecules existing in the film itself. In this latter case, a more or less continuous polymeric film can be built up. Such polymeric films present interesting properties in respect to their elastic behaviour when solid and in their viscosity when liquid, and merit detailed examination.

Since in many cases the molecular orientation in the monolayer can be affected by a change in pressure exerted on the film, it is possible to examine the effects of molecular orientation in the kinetics of film reactions. Very remarkable changes in reaction velocity can be effected in some cases by a minute change in the surface tension; furthermore, in photo-chemical reactions in films we can control the extinction coefficient and thus the quantum efficiency of surface photo-chemical action.

In addition to such enzyme and chemical reactions, it is also possible to examine those loose molecular associations frequently termed 'complexes' in some detail. We have already referred to the adsorption of digitonin by cholesterol, and similar reactions are involved with other glucosides such as saponin and even with much simpler molecules. Thus long-chain alcohols, especially secondary alcohols, and long-chain acids, form remarkably stable mixed films, although no ester formation is involved. These complexes involve interaction between both the polar head groups and also between the non-polar chain or ring systems of the reactants. Many of the polar head group interactions can be interpreted in terms of a hydrogen bond, but both dipole - dipole and dipole - ion interactions are also involved. The

film technique also permits us to examine the mechanism of penetration of one molecular species into a monolayer of another, and here again both polar and non-polar portions of each molecular species are involved. It is also possible to examine the anchoring together of a number of molecules in the surface monolayer by a polymeric substance introduced into the substrate, for example, the polyphosphoric acid systems on calcium stearate or tannin on a protein.

The method reveals that these molecular associations involving free energy changes of the approximate order of $\Delta F = 10,000$ cal. are extremely common in those relatively complex organic compounds met with in biological fluids, and it does not seem unreasonable to assume that they are actually present in living systems. For example, lipoids and proteins form lipoprotein films possessing interesting properties, and we might anticipate the presence of such lipoproteins in sera containing both proteins and lipoids. We might emphasize the remarkable degree of specificity obtainable not only by a change in the orientation of a polar group, but also by a similar change in orientation, for example, by movement of a double bond in the non-polar portion of the molecule.

Whilst it is possible to examine the polar and non-polar interaction separately by this method, much further work is required before a definite statement as to the actual number of bonds and the individual bond energies involved can be made. This goal is important in that it will then permit us to calculate, as Eyring has pointed out, the absolute reaction rates. But it is at least interesting to note that in a protein 'complex' we are satisfied by this experimental technique that a large number of bonds are involved. The process of denaturation must involve, according to theory, the breaking of a large number to form the activated state for denaturation. ERIC K. RIDGAL.

French Society of Chemical Industry

SEVENTEENTH CONGRESS IN PARIS

UNDER the presidency of Sir Robert Mond, member of the Institut de France, the Société de Chimie Industrielle held its seventeenth Congress and at the same time celebrated the twentieth anniversary of its foundation by the late M. Paul Kestner, between the dates of September 26 and October 3. Arrangements made by various committees presided over by M. J. Gérard, M. J. Bougault and M. G.-J. Painvin, were appreciated by a large gathering of French chemists and about

two hundred and fifty delegates from different countries, including more than twenty from Great Britain. British delegates bearing congratulatory addresses were sent by the Royal Society, the various chemical societies and the Institute of Metals.

After the proceedings had been opened in the large hall of the Maison de la Chimie by the Under-Secretary of State for Commerce, Sir Robert Mond gave an address on the evolution of the

nickel industry, and in the same hall, throughout the Congress, were delivered important addresses on such subjects as the chemistry of silicates, by M. Artigas (Madrid), corrosion of metals, by Prof. W. J. Müller (Vienna), sterols, by Prof. I. M. Heilbron (Manchester), and the influence of fundamental research on daily life, by Dr. I. Langmuir (United States). In the Hall of the Sorbonne, M. Georges Claude gave a two hours' lecture with experimental demonstrations on the part he had played in utilizing acetylene, liquefying gases, separating the rare gases, and an account of his attempts (illustrated by a film) to obtain by pumping cold water from great depths of the sea such a temperature difference as would enable an engine to be worked.

Sectional meetings were held in numerous branches of applied chemistry, and to these contributions were made by the following British chemists: J. Muir, on dyeing of fabrics; Prof. C. S. Gibson, on the production of gold mirrors; Sir Robert Robertson, on some of the work of the Water Pollution Research Board; and Dr. F. S. Sinnatt, on hydrogenation.

At the closing session, the President of the French Republic being present, addresses were given by Sir Robert Mond and others on the history and influence of the Société de Chimie Industrielle, and at this ceremony were presented new honorary members of the Society. These included Prof. F. G. Donnan, president of the Chemical Society.

It will, of course, be readily believed that the occasion was marked by characteristic French ceremonial and hospitality, both official and offered by Sir Robert and Lady Mond, who entertained all the delegates to a banquet. The banquet in the Exhibition will remain in the minds of those who were present on account of the artistic and colourful spectacle afforded by a boat

anchored in the Seine and under the windows of the dining-hall, for from it rose jets of water coloured by internally reflected lights, governed by a manual on which the executant played as on an organ.

Apart from the excursions to works and laboratories, including one to the Palais de la Découverte in the Exhibition, which is surely its most notable feature for a scientific man, a three days' excursion attended by about a hundred members was arranged to Mulhouse, where the founder, Paul Kestner, was born in 1864, and thereafter to Lausanne, where he died early this year. Sir Robert Mond, having by his side M. Emile Dollfus, president of the Société Industrielle de Mulhouse, paid homage to Paul Kestner, describing his career and his achievements in chemical industry, such as his apparatus for dealing with corrosive liquids, his evaporators, his plant for maintaining constant humidity and temperature and his foundation in 1917 of the Société de Chimie Industrielle, mentioning also his award of the medals of the British Society of Chemical Industry and the honorary membership of the American Chemical Society. But he also made mention of the features of his fine personality and helpfulness, by which he is remembered by many in Great Britain. It was pleasing to see Madame Kestner at this celebration. At Lausanne, Sir Robert laid a wreath on Kestner's grave.

During this part of the programme, visits were made to the potash mines of Alsace and the chemical works of Thann and Mulhouse, where the production of various salts of potassium, of heavy acids, of titanium compounds and much else of interest was shown to the visitors.

In all its aspects, this Congress proved both instructive and enjoyable to the many delegates who attended it.

R. R.

Obituary Notices

Prof. M. Maclean

PROF. MAGNUS MACLEAN, emeritus professor of electrical engineering in the Royal Technical College, Glasgow, who died on September 2 last, was born in 1858.

If there was one feature about Prof. Maclean which distinguished him from his academic colleagues, it was his outstanding position in non-academic circles. From a humble beginning in Skye he worked his way to the University of Glasgow and became Kelvin's assistant, lecturer in physics to medical students (1892), and in pure and applied electricity to engineering students (1895), whence he was promoted to the chair of electrical engineering at the Royal Technical College, Glasgow (1899). During this progress, he

showed his love of his native Gaelic language by his writing and teaching of its literature. If, therefore, Maclean was pre-eminent as a "great Highlander", he earned his position; and the same admiration which he earned among his fellow clansmen and islanders he gained in all his other activities, whether masonic or professional. Indeed, wherever Maclean was seen, he was in high places. Should these remarks appear to under-estimate his scientific work, it should be remembered that it is not easy for an outsider—especially for an Englishman—to appreciate his local influence, no matter whether it be called esteem, hero-worship or what else.

Maclean's appointment to the Royal Technical College preceded the present fine building in George

Street, where his influence and wisdom succeeded in carving out a magnificent suite of laboratories and lecture rooms—and no part of them on the "Box and Cox" principle. For this fine department—probably the best in the kingdom—his successors will ever be grateful.

Although Maclean published numerous papers and books on electrical subjects and practice, he stands out in the memory as a mathematical physicist—indeed the very man whom Kelvin could appreciate. Maclean was extremely loyal to his old chief and to his Alma Mater, and he carried with him to the Royal Technical College the methods and traditions he had learnt in his youth. The autocracy of the department so evident in Scottish and German universities, the restricted outlook, the traditional lecturing to the junior students, together with many traits more closely associated with Kelvin, all showed themselves in his strong personality. It was during his professoriate that the Royal Technical College became affiliated with the University.

As an engineer, the limitations of his surroundings must be borne in mind. Glasgow never was, is not, and possibly never will be, a centre of electrical engineering. In Scotland, electrical engineers are largely agents and factors of English concerns, and there is not the creative atmosphere which is so marked a feature in manufacturing districts. The close band of salesmen would not be primarily interested in local production, and electrical engineering did not flourish like mechanical engineering and shipbuilding. To-day most of the leading electrical engineers in Scotland are Englishmen. Personally, Maclean held a high place in the regard of his electrical associates.

Maclean had high academic distinctions—D.Sc. and LL.D. of Glasgow—the latter honour being conferred on him in 1919, as a leader and a first-rate authority in electrical science, and distinguished alike in the Gaelic language and literature. He was a member of the Institutions of Civil and of Electrical Engineers, and of many of the learned bodies.

In his private life Maclean suffered deep sorrows in the loss of his wife and of two of his sons. He was an elder in the Westbourne Gardens Church, Glasgow. Maclean loved open-air recreation—he was a keen and good golfer and he enjoyed a game of bowls. His death has left a gap which will not be filled.

S. P. S.

Sir Herbert Sloley, K.C.M.G.

THE death is reported from Cape Town of Sir Herbert Sloley, formerly resident commissioner of Basutoland, which took place on September 22 at the age of eighty-two years. His successful rule of the turbulent Basuto, like that of his predecessor Sir Godfrey Lagden, was based upon an intimate knowledge of Sesuto language, beliefs and customs. He was a pre-eminent example of the type to which anthropologists, Sir William Ridgeway and Sir Richard Temple, for example, were accustomed to point when urging upon the Governments of their day the advantages of a training in anthropology

for the administrator of backward races in obviating the long apprenticeship, which had been a necessary foundation of their successful work.

Sir Herbert Sloley was helped by his personal characteristics, but even he went through a long apprenticeship. Nearly the whole of his working life was passed in Basutoland, which under the rule of Sir Godfrey Lagden and himself was transformed from the most disturbed to the model native territory of South Africa, the crowning achievement being the formation of a Native Council, which brought the commissioner and natives into direct touch and co-operation in matters of administration.

Sir Herbert was born in Calcutta on February 4, 1855, and was educated in England at the Greenwich Proprietary School. After a brief period in a bank, he went to South Africa and joined the Cape Mounted Rifles in 1875. He was appointed captain in a native contingent in the Basuto War of 1880–81. Seizing the opportunity to make a career in Basutoland, he became sub-inspector in the Basutoland Mounted Police in 1884, inspector in 1886, assistant commissioner in 1889, and Government secretary in 1898. On the retirement of Sir Godfrey Lagden, who had accepted the office of commissioner of native affairs in the Transvaal, Sloley was appointed resident commissioner in 1900 and held that office until 1916, when he retired and took up his residence in Cape Town.

Dr. A. C. Fryer

WE regret to record the death of Dr. A. C. Fryer, Local Government Board inspector and a distinguished antiquary, which took place suddenly at Bristol at the age of eighty-two years at the beginning of September.

Dr. Fryer was born at Manchester in 1855 and was educated at Queenswood College, Owens College, Manchester, and the University of Leipzig, where he graduated D.Ph. in 1882. On his return to England he was appointed assistant to Dr. Angus Smith, chief inspector of alkali works under the Rivers Pollution Acts. On the death of Dr. Smith, Dr. Fryer was sent to Bristol as inspector of alkali works for south-west England, and continued to hold that office until his retirement in 1920.

Dr. Fryer was a versatile writer, his published work covering a variety of topics, including verse, stories for children and collections of folk and fairy tales from the north of England and the Hartz Mountains. As an antiquary his interests lay mainly in the early Middle Ages. He published many communications dealing with the classification of fonts and medieval monumental effigies in *Archæologia*, the *Archæological Journal* and the *Transactions of the Bristol and Gloucestershire Archæological Society*. He was the author of an illustrated volume on "The Wooden Monumental Effigies in England and Wales", of "Llantwit Major", a fifth century university, and of lives of Outhbert of Lindisfarne and St. Aidan, the apostle of the North Country. Dr. Fryer was a member of the Advisory Committee for the care of churches of the dioceses of Bristol and Bath and Wells.

News and Views

Sir Harold Carpenter, F.R.S.

At its general meeting in Düsseldorf, Germany, on October 10, the Verein deutscher Eisenhüttenleute awarded its Carl Lueg Gold Medal to Sir Harold Carpenter, while Mr. James Henderson was elected an honorary member of the Association. The Carl Lueg Gold Medal was founded in 1904 to celebrate the uninterrupted period of twenty-five years during which Dr. Carl-Lueg had held the presidency of the Association. The last occasion on which the Medal was presented was in 1934, and Sir Harold is the first Englishman to receive the Medal. Sir Harold Carpenter is professor of metallurgy at the Royal School of Mines, Imperial College of Science and Technology, South Kensington, London. From 1898 until 1901 he was a research fellow and demonstrator of Owens College, Manchester; in 1901 he was one of the first to join the staff of the newly founded National Physical Laboratory, being appointed head of the Chemical and Metallurgical Departments. From 1906 until 1913 he was professor of metallurgy in the Victoria University, Manchester. Sir Harold's researches have covered a field too wide for individual mention, but reference may be made to his pioneer work on the determination of the freezing point of iron and the complete iron-carbon equilibrium diagram (in collaboration with B. F. E. Keeling), to his investigations on high-speed cutting tools and other special steels, on the growth of cast-iron on repeated heating and on the constitution of alloys and to his classical researches on the growth of single crystals in metals and their properties. Sir Harold is the great-great-grandson of Henry Cort, the inventor of the puddling process and of the use of grooved rolls for rolling metals.

Mr. James Henderson

HONORARY membership of the Verein deutscher Eisenhüttenleute is likewise a mark of great distinction. Since 1881, when the Association was founded, only sixteen honorary members have been elected. Of these, only one was an Englishman, namely, Sir Hugh Bell, who was accorded that honour in 1910. Mr. James Henderson's enrolment in the list of honorary members of the Association is thus a very high tribute. Born in Glasgow in 1868, Mr. Henderson's first appointment was in the laboratory of the Glasgow Iron and Steel Co., Ltd., at Wishaw. At that time, 1886 roughly, a plant for the making of steels by the basic Bessemer process was being laid down under the supervision of Mr. Maximilian Mannaberg, who had come from Gebrüder Stumm, Neunkirchen. This association with Mr. Mannaberg was renewed when, in 1889, Mr. Henderson moved to Frodingham in North Lincolnshire, where the basic open-hearth process was being developed and where he was to remain for the rest of his active business life. Starting as chief metallurgist, he passed through various departments before eventually becoming

managing director. For forty-five years he has been associated closely with a number of significant developments. The Frodingham Works adopted the Talbot direct metal process as early as 1906; towards the end of the last century experiments began at Frodingham in the use of blast-furnace gas in gas engines and culminated in the installation of one of the first Cockerill (Seraing) gas-engined generating sets: the application of blast-furnace gas to blowing and power engines was continued consistently, and represents to-day a major item of economy at Frodingham: the Appleby plate mills which, on their completion in 1927, represented the last word in plate rolling practice in Europe, were a landmark in Mr. Henderson's term as managing director. He joined the Iron and Steel Institute in 1892, has been a member of Council since 1925, and honorary treasurer since 1934. In September 1936, he officiated as acting president at the Autumn Meeting of the Iron and Steel Institute held in Düsseldorf.

Dr. F. W. Eurich and Anthrax Research

THE Council of the Textile Institute has decided to award its medal to Dr. F. W. Eurich, on the occasion of his retirement from the Anthrax Investigation Board for Bradford and District, to mark its appreciation of his services to the wool industries. The medal was founded in 1919 and has hitherto been awarded mainly for services to the Institute. In 1905 the Home Office, in co-operation with the Bradford Chamber of Commerce, constituted the Anthrax Investigation Board for Bradford and District, and Dr. Eurich was appointed bacteriologist. The investigation involved the bacteriological examination of about 14,000 samples of wool and hair. The virulent nature of the anthrax bacillus was a constant and serious danger to the investigator. Dr. Eurich was the first to cultivate anthrax organisms from the wool. He also found that, contrary to expectation, wools might be as dangerous when clean as when dirty. The infection was through the blood stream of the animals, and the tenacious adherence of the blood serum throughout processing, hitherto unsuspected, was exposed as a significant factor in the problem. Dr. Eurich discovered that many varieties of wool and hair are liable to infection and listed them roughly in order of danger. The nature of the anthrax bacillus, the mode of infection, and the conditions under which it persisted were discovered. With Mr. Elmhurst Duckering, Dr. Eurich succeeded in killing anthrax spores and bacilli in a wool sample with formaldehyde, and this was found to have no deleterious effect on such processes as spinning and dyeing. In addition, Dr. Eurich introduced improved treatment of the disease when contracted, and effectively reduced its fatality. Workers in wool owe a large debt of gratitude to him for his long-sustained work on the dreaded "Bradford disease".

Mr. R. H. Hodgkin

MR. ROBERT HOWARD HODGKIN, who has been elected provost of Queen's College, Oxford, to succeed the late Canon Streeter, had retired from Oxford at the end of last term, relinquishing the position of senior history tutor of Queen's College, which he had held since 1910. Mr. Hodgkin is now in his sixty-first year. He was born at Newcastle-upon-Tyne on April 24, 1877, the son of Dr. Thomas Hodgkin, a banker and distinguished historian of Europe in the Middle Ages. Mr. Hodgkin was educated at Repton, Leighton Park School, Reading, and Balliol College, Oxford, taking first-class honours in the Final School of Modern History. He was appointed lecturer in modern history of Queen's College in 1900; and was University lecturer in modern history in 1928-34. His most considerable contribution to historical literature is his "History of the Anglo-Saxons" (1935), in which the scientific data of anthropology and archaeology are drawn upon to the full to serve the purpose of historical research. Although a member of a distinguished Quaker family, Mr. Hodgkin held a commission in the 1st V.B. Northumberland Fusiliers for some years, and thereupon was obliged to withdraw from the Society of Friends. During the Great War he served as captain in the Seventh Battalion of his old regiment, and on the General Staff (Operations) at the War Office.

Evans' Biological Institute

A COMPANY of some seventy-five medical men attended the Evans' Biological Institute at Runcorn, Cheshire, on October 7, when an extension was formally opened by Lord Derby. In introducing Lord Derby to the company, Mr. T. Edward Leescher directed attention to the fact that the organization known as Evans' Biological Institute is the result of continuous development during the last twenty-five years, and that it originated as a laboratory and farm station in connexion with the Liverpool Institute of Comparative Pathology under the aegis of the University of Liverpool. It was in 1903 that Prof. (afterwards Sir Rupert) Boyce, professor of pathology, and Prof. (now Sir Charles) Sherrington, professor of physiology, together with Dr. H. E. Annett, then lecturer on comparative pathology, conceived the idea of establishing a farm station at Higher Runcorn for the study of comparative pathology. Included in the committee of management was Mr. J. J. Evans, the first chairman of Evans Sons Leescher and Webb, Ltd., and his son Mr. J. H. E. Evans, who is the present chairman of the company. Shortly before the Great War, the University was compelled to relinquish activities at Runcorn, and the laboratories and farm station and laboratory personnel were taken over by the above firm. Although to some extent the activities were restricted during the War and for some years afterwards, valuable work was done and much experience gained. Gradually the scope of the work carried on was extended and accommodation increased, and in 1928 a commodious new building, containing up-to-date laboratories and equipment, was erected. Additional stables were

erected in due course, and this year another new building has been completed.

DURING all these years, the work originated by the Liverpool Institute of Comparative Pathology has been continued at Runcorn along similar lines. A close study is made of the vital processes of living organisms, in the hope of evolving measures for the prevention of disease rather than the introduction of new palliative measures for use in treatment. In recent months the scope of the research work carried on at the Institute has been extended to chemotherapy, as it was discovered in 1935 that it is possible to control streptococcal infections by means of an important new drug intended for use in the treatment of various bacterial infections. The Institute is licensed under the Therapeutic Substances Regulations and thus is intimately linked with the Ministry of Health administration. Under these regulations, practically all the products with which the Institute is associated must maintain a very high standard. It has always been insisted upon that research and production should be conducted on strictly ethical lines, and no consideration has allowed any alteration to this policy. Lord Derby said that he felt it was a privilege to be associated with the opening ceremony, especially as in his office as chancellor of the University of Liverpool he knew those who were originally connected with the work. He looked forward to the research activities of the present staff leading to the introduction of still better ways of dealing with disease.

Historical Relations of Pharmacy and Physic

THE historical relation of pharmacy and physic was the subject of Sir Humphry Rolleston's address at the opening of the ninety-sixth session of the College of the Pharmaceutical Society. He showed how, in the field of medicine, as in most other fields, evolution has brought with it specialization, and that among the roots of the tree of medical knowledge is the legend of Cosmoes and Damian, the patron saints whom pharmacy shares with medicine, surgery, barbering and midwifery as evidence of their common origin. The process of decentralization and specialization of medicine has been repeated at very different dates in the world's chronology. In Egypt medical specialism had reached its acme in the fifth century B.C. when every medical man confined his activities to one disease. On the other hand, in Europe it is difficult to trace a distinction between medical practitioners and the representatives of modern pharmacists until the approach of the Renaissance. In Great Britain, the process of specialization and separation was slow and painful. From so early as 1447, the Grocers Company in the City of London had the right of inspecting shops for the sale of drugs, ointments and plasters, and its members were the recognized drug sellers of the day. From the specialist grocer the apothecary developed and in due time became a thorn in the flesh of the physicians, so that in 1540 the Royal College of Physicians obtained the power to "search, view and see the apothecaries' wares, drugs and stuffs". The apothecaries, balancing

between trading and professionalism, temporarily came down on the wrong side of the fence, being united with the Grocers Company by charter in 1606. But this inconvenient marriage was dissolved in 1617, when the Society of Apothecaries obtained its own charter, James I saying that the apothecaries practised an art as well as a mystery, whereas the grocers were merely merchants.

The apothecaries used their new freedom for still further specialisation. They enhanced their reputation by devotion to the sick at the time of the Great Plague and rapidly developed into the general practitioners of medicine, a position ultimately recognized by registration under the Medical Act. They gradually abandoned pharmacy for physic and left the way open for the pharmacist as he is known to-day to take their place. Sir Humphry Rolleston did not follow the progress of specialisation in recent years. Had he done so he might have shown how to-day, with the progress of medical science, specialisation advances apace in both the medical and the pharmaceutical professions. In medicine, the physician and the surgeon find at their elbow the bacteriologist, the pathologist, the radiologist, the psycho-therapist. In pharmacy, the pharmacologist, the biochemist and the serologist are supplanting the galenical pharmacist. It is well for the patient, for whose benefit alone these 'mechanized troops' take the field, that so far they remain auxiliaries and have not yet displaced the 'private of the line'—the general practitioner and the pharmacist at the corner of the road.

Flints and Flint-Working

A SPECIAL exhibition to remain for three months has been arranged at the British Museum, Bloomsbury, at the head of the main staircase, to illustrate the changes in flint, and the various methods of chipping it into implements. This supplements the permanent series in the Prehistoric Saloon (Case R), and is intended to make the grammar of the subject clear to those with restricted opportunities of observing or collecting specimens. Patina has not yet been scientifically explained, but the examination of its varieties is a necessary step in solving the problem, and attention has been paid to the depths attained by patina on several specimens. Some old pieces have been re-chipped by living practitioners; and among those whose skill is exemplified may be mentioned Mr. J. Reid Moir, Mr. J. H. Sewall of Saskatoon, M. Courtier of Paris and Prof. A. S. Barnes. Some peculiar forms assumed by flints when fractured by man or natural forces are exhibited, and the technical terms used in prehistory are illustrated by typical specimens. Drawings of flaking methods presumably practised in the Stone Age are reproduced from Warren K. Moorehead's "Stone Age in North America", and a special feature is the wood-technique (blows delivered by a wooden baton) which is believed to have been adopted by St. Acheul man, the long narrow flake-scars due to this method helping to distinguish work of that date from the preceding Chelles or Abbeville culture.

Origins of Civilization and the Hittites

THE early history of Anatolia and of the races from which the Turkish people is held to be derived was given due prominence in the communications presented by the numerous foreign members attending the second session of the Historical Congress at Istanboul. In particular, it is stated by the correspondent of *The Observer* in the issue of October 11, much importance was attached to a discussion by Prof. E. Pittard of Geneva of the origin of the early brachycephalic racial type, which, first appearing in Europe in the Mesolithic age, introduced to that continent the domestication of animals and agriculture. He pointed out that nowhere except in the Near East and in the region extending eastwards to Afghanistan were cereals to be found growing in the original wild state, while the same habitat was assigned to the wild prototypes of the domesticated animals. Prof. Pittard then went on to show that a close study of the Hittites indicated that all these elements of civilization were well known to them from early times, this leading to the supposition that we are indebted to this people for their evolution. Recent discoveries and excavations indicate a possibility of demonstrating that Anatolia possessed, just like Europe, a palaeolithic period, from which the mesolithic was evolved, and that the remotest origins of civilization may be found in Anatolia. As the views put forward by Prof. Pittard are said to coincide with the point of view of the Turkish Society for Historical Research, it is possible that they will stimulate much-needed intensive study of Hittite origins. It is eminently desirable, however, that this should be extended to include the Caucasus regions to the north of the Hittite area, with which certain of the evidence, especially of philology, appears to indicate a cultural affinity.

Maiden Castle, Dorchester

TWO discoveries are announced at the close of the season's excavation of Maiden Castle, Dorchester, by the Society of Antiquaries and the Dorset Natural History and Archaeological Society under Dr. R. E. Mortimer Wheeler and Col. C. D. Drew. The first is that of a long barrow of remarkable size, no less than eight hundred feet long, overlying the neolithic town, of which the remains have been identified at various points in the eastern part of the site. Evidently the village must wholly, or largely, have ceased to be occupied when this enormous tomb was constructed. Consequently, as is pointed out by Dr. Wheeler, according to a report in *The Times* of October 11, the discovery is of importance. The superposition of the neolithic barrow over the earlier neolithic town will make it possible to classify the successive phases of neolithic civilization in this part of Britain with greater precision than is possible at present, and it will thus afford a standard of chronological comparison for the interpretation of other neolithic settlements and mounds in this part of the country. The second discovery, which was made not far from the point at which the dismembered neolithic skeleton, previously reported, was found, was that

of the grave of a Saxon warrior of the early part of the seventh century. Its importance lies in the fact that the body had been interred with full battle equipment. A *scramasax* or outlass-knife lay across the thighs, and two knives and the remains of a spear-head were by the side. The burial is one of the few found in England which include this type of sword, commonly held to be a characteristic weapon of the Saxon tribesmen. The end of this season's work at Maiden Castle closes the fourth and final year's excavation of the site as a joint undertaking by the two societies; and the trenches are now being filled in. Excavation will, however, be continued on a small scale for some time to come.

Population Policy in Germany

WE have received, through the courtesy of Baroness von der Goltz, two papers, written by members of the "Reichsbund der Kinderreichen" of Berlin, dealing with the present population policy of the German authorities, both Government and municipal. These papers are interesting as showing the reasoned approval of the measures taken in Germany in recent years, on the part of many—perhaps of most—Germans who have studied the legislation in question. The first paper is entitled "Birth Policy and the Problem of Space", and is written by Dr. Danzer. The author stresses the view that national existence is bound up with the question of the birth-rate, and that neglect of the obvious tendency in western Europe must lead to disaster. He thinks that the world at large is too apt to consider that Germany is over-populated and that a large population is only desired for imperialistic purposes. He points out that England and Belgium have double the population density of Germany; and he remarks that unemployment is not necessarily caused by overcrowding, as is clearly evidenced by the case of the United States. As to space, the resources of Germany are not exhausted, and the more diligent and efficient a people is, the higher the birth-rate can safely be; and, in any event, it is impossible to lay down a theoretical optimum density, which must vary with varying conditions. He makes the point that there is no instance of the decline of any country being caused by a high birth-rate. In spite of the Great War, it has been found possible to increase agricultural production, so that Germany is now nearly self-sufficient, and only has to import eggs and fats. As to the Colonies, Germany only wants these back as a source of raw materials, and not for population purposes. He ends by saying that the white race is seriously threatened, and that the day will come when every able-bodied white man, German, French, British or Italian, will be asked to save the civilization which they have built up in a millennium.

THE second paper, by Dr. Alfred Moritz, describes briefly the measures which have been taken by national socialism to relieve the economic burdens on the German family. The main purpose of these measures is the support of the financially weak.

Years ago, the Führer said that large, healthy families are the real wealth of the nation. The two-child family is mainly the result of egotism, or lack of courage to take responsibility. The policy of the "Reichsbund" is to relieve parents with at least four children. As is well known, a good deal has been done officially to encourage an increase in the birth-rate, and this policy seems to be meeting with some success. By the law of October 16, 1934, account is taken of the circumstances of those with many children. Thus, a worker with an income of 250 marks a month, with three children, pays no taxes; if unmarried he would pay 30 marks, and so on. Then there is the well-known system of wedding loans of 1,000 marks, the loan being reduced by 250 marks for each child. Then steps are being taken to provide better accommodation for large families; the houses will be provided with gardens, where this is possible. It is considered that, generally speaking, life in the big towns is unhealthy. There is a building programme for five million homes, with gardens, and easy access to the towns. Special financial help for large families is being considered in this connexion, including reduction of train fares; and much else is being done to improve the financial position of parents with large families.

New Form of Saccharimeter

THE saccharimeter, as constructed for many years, differs from the polarimeter in that it contains a system of dextro- and lævo-rotatory quartz wedges between the polarizer and analyser, the adjustment of the wedges replacing the rotation of the analyser. Monochromatic light must be used for polarimetric readings, but with the quartz wedge saccharimeter bichromate-filtered white light can be used since the rotation dispersions of quartz and carbohydrate solutions are almost the same. Until recently it has not been practicable to obtain monochromatic light of sufficient intensity and constancy for use under ordinary laboratory conditions, and the saccharimeter with white light illumination has almost universally been used for sugar analysis. A very satisfactory source of monochromatic light is now obtainable, however, in the form of an electric sodium lamp, and its introduction has led Messrs. Bellingham and Stanley, Ltd., to construct a saccharimeter, without the quartz wedge device, for use with sodium light; the instrument is identical in principle with the polarimeter and differs from the latter only in being provided with a sugar scale, reading from -30 to $+110$ International sugar degrees. This scale, like the angular degree scale of the polarimeter made by the same firm, is etched on a glass circle and, unlike the ordinary saccharimeter scale, requires no magnification; the Vernier attachment, also, is etched on a glass plate. The elimination of the quartz wedge system has several advantages. It obviates any error due to want of optical homogeneity of the quartz, it renders unnecessary the exact adjustment of the temperature of the apparatus to that of the observation tube and the reading is taken, not by reflected, but by transmitted light.

Coloured Light for Motor-Car Headlights

As many motorists use headlights giving coloured lights, an authoritative and scientific statement as to whether coloured light is better than white light for night driving or during fog has for long been desired. A report by an illumination committee of the Department of Scientific and Industrial Research (Technical Paper No. 20. London: H.M. Stationery Office) has now practically settled the question. Adequate evidence is given that in conditions of slight or thick fog the range of visibility of objects seen in the beam of the headlight is not increased by the use of coloured light obtained from the original white light by means of a filter. One investigator has put on record that in clear weather the range of visibility of an object is increased about 6 per cent by the use of a yellow filter. This result was obtained at a distance of about 900 feet; but at shorter distances, at which the motorist is more concerned to see objects, the advantage of the yellow filter, in any event small, is still smaller. There is no experimental evidence that the power of the eye to perceive contrasts of brightness in the presence of a dazzling light is enhanced if similar colour filters are placed over the dazzling light and over the light illuminating the objects viewed. The evidence as to whether the use of coloured light obtained from white light by means of a coloured filter enables the eye to detect contrasts of brightness more easily is conflicting. Recent investigations have shown that there is a slight advantage, but this is inconsistent with the measurements of earlier workers. There is evidence for a slight increase in the power of the eye to perceive the details of a pattern in 'black and white' by the use of yellow light obtained from white light by means of a filter.

Technical Development and Manual Labour

In a paper read before the Royal Society of Arts on March 17 on "The Displacement of Labour by Machinery" and recently made available, Mr. H. D. Henderson discussed the subject of the effect of technical progress on employment. The contention that invention is now flowing in a direction which merely leads to the introduction of machinery so automatic that scarcely any labour is needed to operate was described as plausible but devoid of substance. The distinction, on which it rests, between mechanization which is in the main co-operative with labour and that which is in the main competitive with it is illusory, since all mechanization diminishes the amount of labour employed per unit of output, while the inventions which have done most in the past to stimulate economic activity have entailed an especially large economy in this respect. He believes that the old economic argument, which sought to prove that technical progress serves in the long run to expand rather than to contract the demand for labour, is still valid. Owing to change in population trends, however, the process of technical development is likely to be accompanied in the future by greater difficulties and more awkward problems of adjustment. These problems cannot be escaped

by slowing down the rate of technical progress, so far as this depends on the extended use of machinery. Such action would only intensify our difficulties while depriving us of the benefits of mechanical advance.

Organization of Human Society

In his Herbert Spencer Lecture at Oxford on May 27 entitled "Integrative Levels: a Revaluation of the Idea of Progress" (Oxford: Clarendon Press; London: Oxford University Press, 1937. 2s. 6d. net), Dr. J. Needham discusses Spencer's treatment of sociological problems in relation to the evolution of social organizations to meet the needs imposed by mechanization and the impact of science to day. He suggests that a democracy which produces is the form of society most in accord with what we know of the biological basis of human common life. Evolution is not yet finished, organization has not yet reached its highest level and we can see the next stage in the co-operative commonwealth of humanity, the socialization of the means of production. Every transition from the unconscious to the conscious implies a step from bondage to freedom from lower to higher level of organization, and Dr. Needham emphasizes that our present civilization is not in a state of stable equilibrium. The enormous advances in scientific knowledge and practical technique have made the economic system of Spencer an anachronism. He is of opinion that nothing short of the abolition of private ownership of resources and machines, the abolition of national sovereignties and the government of the world by a power proceeding from the class which must abolish classes will suit the technical situation of the twentieth century. The organization of human society is only as yet at the beginning of its inevitable triumph.

Preservation of Salcombe Hill

It has been agreed between the Rev. J. G. Cornish and the Sidmouth (Devon) Urban District Council that South Down Farm on Salcombe Hill and the adjacent South Combe Farm should be preserved in perpetuity as private open spaces. A similar agreement has been made with Dr. Vaughan Cornish concerning the eight hundred yards of cliff frontage to this property. Dr. Vaughan Cornish has also undertaken to maintain a right of way along the cliff even if falls of cliff destroy the existing path. These engagements have been made voluntarily by the Rev. Cornish and Dr. Cornish, and they ensure that the fields of the Salcombe Regis Valley will be preserved as an open space for all time. The Norman Lookyer Observatory is on the top of Salcombe Hill, and it is gratifying to know that, by one of these generous gifts, the fields on the south side of the road opposite to the Observatory are never to be used for building development.

Further Gifts to Oxford from Lord Nuffield

LORD NUFFIELD has offered £1,000,000 to the University of Oxford (including a site valued at £100,000) for the building of a new college to be devoted to the collaboration, particularly in social

(including economic and political) studies, of theoretical students and practical men of affairs. The site is situated to the west of Oxford between Worcester College and Pembroke College. Two further bequests by Lord Nuffield include £100,000 for the erection and equipment of a new laboratory of physical chemistry and £200,000 for the erection of buildings at hospitals associated with the medical research scheme endowed by him in 1936.

Discovery of Teeth of *Australopithecus*

At the time of going to press, we have received a further communication from Dr. R. Broom, dated October 5, supplementing his letter under this title which appears on p. 681. He writes: "Since the above letter was written two weeks ago, four more teeth of *Australopithecus* have been discovered. Two are teeth of a very aged animal with the crowns almost completely worn off. One of these is a lower premolar, and the other a third left upper molar, but these are of little scientific value. The third tooth is a first upper incisor. Unfortunately, part of the crown is broken off and part of the root, but enough is preserved to show most of the structure. It is remarkably human. The width of the crown is about 10 mm. and the whole length of the tooth probably about 32 mm. The fourth tooth is the beautifully preserved crown of a right third upper molar. It agrees closely with the wisdom tooth of the type, but it is slightly more worn and has fewer corrugations. It probably belongs to the same individual as the third right lower molar tooth."

Announcements

The Lord President of the Council has appointed Dr. G. M. B. Dobson, Lieut.-Colonel J. H. M. Greenly and Mr. S. K. Thornley to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Prof. A. Fowler, Sir Clement Hindley and Dr. T. Franklin Sibly have retired from the Council upon the completion of their terms of office.

The first Radford Mather Lecture of the British Association will be given by the Right Hon. J. Ramsay MacDonald on Friday, October 22, at the Royal Institution, Albemarle Street, London, W.1, at 5 p.m. Mr. MacDonald will take as his subject "Science and the Community". The Norman Lockyer Lecture, on "Origins of Town Life in Britain: an Illustrated Review of Recent Evidence", will be given by Dr. R. E. Mortimer Wheeler in the Goldsmiths' Hall, Foster Lane, Cheapside, London, E.C.2, at 4 p.m. on Wednesday, November 24. Further information can be obtained from the Secretary, British Association, Burlington House, London, W.1.

The Iron and Steel Institute and the Institute of Metals have arranged to hold their 1938 autumn meetings in the United States, opening in New York jointly with the corresponding American Institutes on October 3. Technical sessions will be held on

October 3 and 4, and from then until October 21 visits will be made to various centres of technical interest in the United States. Further information can be obtained from the Secretary, Iron and Steel Institute, 28, Victoria Street, London, S.W.1.

The Federation of Progressive Societies announces a series of fourteen lectures being given in the Conway Hall, Red Lion Square, W.C.1, at 8 p.m. Among the subjects and lecturers are: November 3, eugenics and the class struggle, J. B. S. Haldane; November 10, sex and censorship, Norman Haire; January 5, 1938, the failure of intellectuals, Dora Russell; February 2, the cultural basis for unity, John MacMurray. Particulars may be obtained from the hon. secretary of the Society, 4 Fitzroy Street, London, W.1.

The following appointments and promotions have recently been made in the Colonial Service: B. de L. Inniss, agricultural superintendent, Gold Coast; A. B. Lucy, agricultural officer, Malaya; A. F. Posnette, botanist, Agricultural Department, Gold Coast; D. H. Welch, agricultural officer, Nigeria; H. B. Burgess, assistant conservator of forests, Nigeria; J. H. Nelson Smith, assistant conservator of forests, British Honduras; P. R. Page, assistant conservator of forests, Nigeria; C. L. Turner, veterinary officer, Malaya; G. K. Argles, manager, Fruit and Vegetable Development Scheme, Jamaica; E. G. A. Benson (assistant agricultural superintendent), agricultural superintendent, British Guiana; D. L. Blunt (director of agriculture, Cyprus), director of agriculture, Nyasaland; W. E. Freeman (late tobacco breeding officer, Mauritius), botanist, Agricultural Department, Nigeria; E. F. S. Shepherd (botanist and mycologist, Agricultural Department, Mauritius), plant pathologist, Gold Coast; J. P. Edwards (senior assistant conservator of forests), conservator of forests, Malaya; M. Crawford (Government veterinary surgeon), deputy director (animal husbandry) and Government veterinary surgeon, Department of Agriculture, Ceylon; G. B. Simmins (veterinary research officer), senior veterinary research officer, Department of Agriculture and Fisheries, Palestine; M. A. Crane (chief draughtsman), research officer, Mechanical Engineering Department, Nigerian Railways; C. G. Fannin (district surveyor), chief surveyor, Kenya; J. H. Halebian (assistant chemist), chemist, Department of Antiquities, Palestine; A. S. McKinnon (assistant livestock officer, Veterinary Department, Tanganyika), agricultural officer, Veterinary and Agricultural Department, Somaliland; J. H. Nield (computer), district surveyor, Kenya; J. G. Reece (first assistant surveyor), deputy surveyor and deputy sub-intendant, Trinidad; H. Smith (assistant mechanical engineer, Public Works and Electricity Department, Zanzibar), inspector of machinery, Mines Department, Gold Coast; J. A. R. Stoye (Government analyst, Mauritius), assistant Government analyst, Nigeria; W. G. W. Wilson (superintendent of workshops), chief mechanical engineer, Nigerian Railways.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

* NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 685.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Discovery of a Lower Molar of *Australopithecus*

ABOUT a year ago I announced the discovery of a new specimen of a fossil anthropoid from a cave at Sterkfontein, near Krugersdorp, Transvaal. The specimen consists of the nearly complete brain cast, most of the base of the skull, with both maxillae in fair preservation. Of the teeth we have on the right side the second premolar and the three molars, and on the left side both premolars and the first and second molars. In addition we have the socket of the right canine, and those of the left canine and both incisors fairly well preserved. It is thus possible to make a satisfactory restoration of the whole upper dentition.

I referred the ape to a new species of *Australopithecus*; as though certainly allied to the Taungs ape it is evidently considerably later in time. Owing to the great importance of *Australopithecus* as a fossil anthropoid with teeth much more like those of man than those of any of the living anthropoids, and to its thus possibly being nearly related to the anthropoid from which the human stem arose, it seems necessary to get as much new light on this remarkable form as we can.

Explorations of the Sterkfontein cave and of other caves in the neighbourhood have resulted in a satisfactory knowledge of the animals that were contemporaneous with *Australopithecus transvaalensis*, and the fauna shows that the climatic conditions were probably not unlike those of to-day. A full account will be given elsewhere of the associated fauna. It seems to be of Upper or possibly Middle Pleistocene age.

On September 15 I was fortunate in discovering a beautifully preserved third lower molar of *Australopithecus*. As fossil anthropoids are better known by their lower molars than the upper, it was felt that we could scarcely decide the affinities of the ape until we got a lower jaw or at least a good lower molar. The tooth was quite isolated. It is from the same cave as the skull and from about the same level but from a spot about six yards from the other. It cannot, I think, belong to the same individual, but it is the tooth of a young adult, not improbably a male. The crown is slightly worn.

The tooth is very large, the greatest antero-posterior length of the crown being 17.7 mm. and the greatest breadth 15.2 mm. It is thus comparable in size with that of the gorilla and very much larger than the corresponding teeth in the chimpanzee or man. The crown pattern will be seen from Fig. 1 to be a modification of the well-known *Dryopithecus* pattern. There are three large cusps on the outer side, and three almost as well developed on the inner side. As will be noted, there are clear indications

of a rudimentary external cingulum such as we find in *Dryopithecus*, and in the small fossil anthropoids, *Bramapithecus* and *Sugricapithecus*, recently discovered by Lewis in the Siwaliks. Indications of the cingulum are usually seen in the molars of the gorilla, but they are usually lost or only represented by pits in the chimpanzee and man. There is a well-marked anterior fovea—a characteristic generally present but not much developed in the gorilla. A fovea is often present in man, but is usually lost in the chimpanzee.

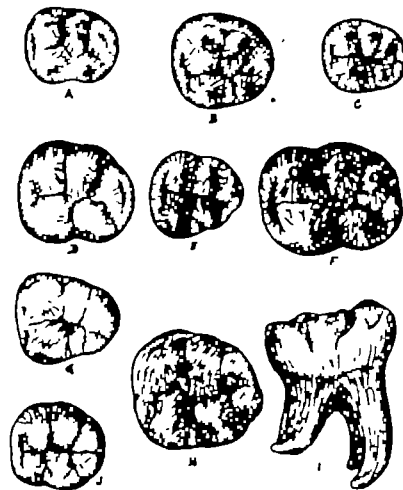


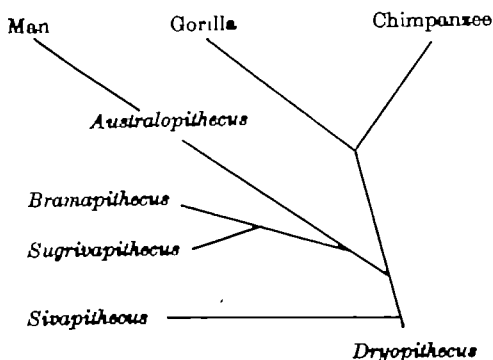
Fig. 1.

THE THIRD RIGHT LOWER MOLAR TOOTH IN *Australopithecus transvaalensis* BROOM, AND IN ALLIED ANTHROPOID APES AND MAN. ALL FIGURES NATURAL SIZE.

A. *Dryopithecus fontani* Lartet; B. *Dryopithecus darwini* Abel; C. *Dryopithecus rhomanus* (Pohlig); D. *Dryopithecus chinjiensis* Pilg. (= *side* Lewis *Sicapithecus indicus*, Pilg.); E. Chimpanzee; F. Gorilla; G. *Bramapithecus punjabicus* Lewis; H. *Australopithecus transvaalensis* Broom (occlusal surface); I. *Australopithecus transvaalensis* Broom (outer view); J. Australian native woman. All figures except G, H and I are after Gregory, a number reversed.

From the illustrations it will be seen that the tooth in its crown pattern agrees more closely with that of an Australian native than it does with that of any of the known anthropoids. It may be regarded as a form evolved from that of *Dryopithecus*: the molar of man may be regarded as derived from that

of *Australopithecus*, but reduced in size and degenerate. The molars of the gorilla and chimpanzee are probably evolved from a pre-*Australopithecus* type.



All the available evidence would seem to indicate that the higher anthropoids and man may be related as shown in the accompanying diagram.

R. BROOM.

Transvaal Museum,
Pretoria,
South Africa.
Sept. 21.

Detection of α -Particles in the Disintegration of Thorium

THE nuclear process ($n\alpha$), that is, the expulsion of an α -particle by a neutron, has hitherto been observed only for light nuclei; it probably takes place also in the case of heavy, unstable nuclei. Hahn, Meitner¹ and Curie, v. Halban and Preiswerk² assumed the reaction $^{232}\text{Th} (n\alpha) ^{228}\text{Ra}$, and the existence of the radium isotope was established by the latter three by chemical identification.

We have made an attempt to detect directly the presence of these α -particles, which we expected to be of high energy. We used an ionization chamber in conjunction with a linear amplifier. When thorium was bombarded by neutrons from a radium-beryllium source, α -particles were detected, which must be ascribed to the reaction $^{232}\text{Th} (n\alpha) ^{228}\text{Ra}$. Preliminary measurements with absorbing screens have shown that these α -particles possess an energy greater than 9 million electron volts.

A full account of these experiments will appear in due course in *Helv. phys. Acta*.

A. BRAUN.
P. PREISWERK.
P. SCHERRER.

Physikalisches Institut,
Eidgenössische Technische Hochschule,
Zürich. Aug. 31.

¹ Hahn und Meitner, *Naturwiss.*, **23**, 220 (1935).
² Curie, v. Halban and Preiswerk, *C.R.*, **208**, 1841 and 2079 (1936); *J. Phys.*, **6**, 361 (1935).

Production of Showers by Heavy Particles

Carlson and Oppenheimer¹ and Bhabha and Heitler² have proposed a very ingenious explanation of showers by a multiplicative production of photons, electrons and positrons. The greater part of the showers observed can in this way be regarded as originated by electrons, positrons or photons penetrating from the atmosphere. Such showers are absorbed if the layer of lead is sufficiently

thick. It is known, however, that at sea-level and especially under earth, the frequency of showers with increasing thickness of lead layer does not diminish but tends to a limit. We wish to point out that this phenomenon does not require a new concept of showers, but can be explained by irradiation with heavy particles, which easily penetrate through such layers of lead.

A more rigorous treatment of showers³ shows that a shower has a certain range given by the formula

$$L = 0.25 \frac{\lambda_0}{\sigma^2} \left(\frac{mc^2}{\epsilon} \right)^2 \frac{1}{ZN} \log \frac{E}{\epsilon},$$

where λ_0 , c , σ have the usual meaning; m is the electronic mass; N is the number of electrons per cm.²; $Z = \frac{\sum N_s Z (Z+1)}{\sum N_s Z}$ (N_s is number of atoms with charge Ze); E is the energy of the incident particle and ϵ a critical energy of the order of magnitude 750/ Z million volt.

If we combine this formula with the well-known formula for radiation probability for a heavy particle, we get for the probability that a shower produced by a photon emitted by a heavy particle gets out of the layer of sufficient thickness:

$$W = 0.8 \left(\frac{m}{M} \right)^2 \left(\log \frac{E}{\epsilon} \right)^2 \log \frac{E}{(Mc^2)^{2/4} \epsilon^{1/4}};$$

where M is the mass of the heavy particle and E its energy, which is assumed $\geq Mc^2$. If we take for M the value of some tens of electronic mass proposed by Anderson and Neddermeyer⁴, we get a fair agreement with the observed order of magnitude.

Details of the calculations will be published elsewhere.

L. LANDAU.
G. RUMER.

Physical Institute,
Academy of Sciences of the U.S.S.R.,
Moscow.
Sept. 1.

¹ *Phys. Rev.*, **51**, 220 (1937).

² *Proc. Roy. Soc., A*, **159**, 432 (1937).

³ *Phys. Z. Sowjetunion*, in the Press.

⁴ *Phys. Rev.*, **51**, 887 (1937).

The Zodiacal Light at a Total Solar Eclipse

AN interesting observation made by Mr. M. Honda in Hokkaido at the total solar eclipse of June 19, 1936, has just been reported and is well worth mention.

Seated in a lightproof bag, which covered his head also until totality had commenced, Mr. Honda observed the sky round the sun, with a large black disk blotting out an area of radius about three solar diameters with the sun at the centre. He saw and plotted the boundaries of the band of zodiacal light from close to the sun, where it had a width of 44°, along the ecliptic to a point about 40° away where it was cut off by clouds. To see the zodiacal light, on what is effectively a moonlit sky, is difficult, but the band must be very much brighter near the sun. Mr. Honda's observation is well worth repeating by other experienced zodiacal light observers at the next eclipse, and if possible some quantitative measure of the intensity of the band should be obtained along with measurements of coronal intensity.

F. J. M. STRATTON.

Solar Physics Observatory,
Cambridge.

Excretion of Nitrogen by Leguminous Plants

WITH reference to Prof. P. W. Wilson's communication upon this subject¹ I wish to make the following comments.

In our laboratory, where the excretion of nitrogen compounds from the leguminous root nodules has been for the first time definitely proved with a sterile culture system, hundreds of experiments have been carried out during the last ten years. In all experiments—both in sterile and in ordinary pot cultures—distinct excretion has practically always been detected, when suitable bacterial strains have been used for inoculation of red clover, white clover and pea, and the experimental conditions have been natural. Our experiments have not been restricted only to sand cultures, but similar experiments have also been carried out in clay and sandy loam soils, in kaolin medium, etc. The excretion of nitrogen compounds from the root nodules is therefore no incidental phenomenon which would appear only under certain artificial laboratory conditions. On the contrary, it occurs in experiments carried out under most natural conditions.

When Prof. Wilson could find no excretion in his numerous experiments during three years and now at last finds the phenomenon occurring in certain experiments, in others not, his experimental conditions must in some way differ from the natural ones. So far as is known to me, Prof. Wilson is using very coarse quartz sand as the substrate and the pot cultures are watered many times a day. According to our investigations the excretion depends greatly on the absorptive capacity of the medium. For example, with water cultures as well as with those containing glass beads, we have as a rule not been able to show any distinct excretion. Nor can any noticeable excretion be expected if the quartz sand particles are big.

From cultures grown on such media no conclusions can be drawn with regard to practical agriculture. Our experiments have been carried out partly in very fine quartz sand, which has a great absorptive capacity, partly in different soils. On the basis of these experiments, and particularly of those carried out in soil, it can be definitely concluded that the excretion is a phenomenon which must occur in the field and plays an important part in practical agriculture. The benefit to non-legumes in associated cultures with legumes, a fact which has been known in practical agriculture for thousands of years, has been explained through the excretion phenomenon. I refer to our publication concerning the associated cultures appearing in the October issue of the *Journal of Agricultural Science* and also to my paper presented before the Fourth Agricultural Grassland Congress at Aberystwyth in July this year.

The extent of excretion varies considerably even in parallel experiments and depends, as I have often emphasized, on many factors, of which so far only a part is known to us. Such factors are, for example, bacterial strain, amount of nodules, host plant, medium and nitrate content of the medium².

At least with the plants employed by us, the excretion can always be shown, and with our recent knowledge of the factors affecting the excretion. In associated cultures of lucerne and rye-grass, Thornton and Nicol (1934), in Rothamsted have detected distinct excretion. If some species of legumes (for

example, soy) should differ in this respect, it certainly does not mean that the excretion phenomenon has no importance in agriculture. However, I consider that, even with soy, thorough investigations must first be carried out using different bacterial strains in inoculating different species of soy and natural media, before anything definite can be stated.

ARTTURI I. VIRTANEN.

Biochemical Institute,
Helsinki.
Aug. 31.

¹ NATURE, 140, 154 (1937).

² See *J. Agr. Sci.*, July 1937.

A PREVIOUS communication¹ referred to experiments with inoculated soybeans (variety "Manchu") growing under normal conditions in sand culture, in which I was unable to detect any excretion of nitrogenous substances from the nodules into the rooting medium, as demonstrated by Virtanen² and his collaborators in other legumes, especially the pea. Further experiments, in which the sand from the culture pots was submitted to direct Kjeldahl analysis without previous drying, have also yielded negative results. The maximum difference between nitrogen contents of the sand from inoculated and control pots was only 2.5 mgm., after four months' growth, during which time 350 mgm. of nitrogen was fixed within the nodules of the five plants of the inoculated pot. Barley plants grown in the same pots as nodulated soybeans derived no benefit from the association, confirming the absence of excretion. Three different strains of bacillus have been tried, including two of the most efficient in fixation from the Wisconsin collection, all with negative results. It is therefore clear that certain measurements of fixation and transfer of nitrogen made in a previous investigation³ under similar growth conditions are complete in themselves and do not require amendment.

Negative results have also been obtained with broad bean (*Vicia Faba* L.) variety "Longpod", both from sand analyses and from examination of test plants grown with the nodulated beans. The fixation here amounted to 275 mgm. for two plants.

It is impossible to say at present whether these negative results arise from the absence of excretion from these particular legumes under any conditions, or from the lack in the present experiments of certain undefined conditions necessary for excretion to proceed. Ludwig and Allison⁴ and Wilson⁵ have also been unable to find excretion in a number of legumes. The plant cultures of the present experiments were not strictly sterile in the sense that some of Virtanen's were, but since the latter author finds excretion in both sterile and ordinary open cultures, it is clear that absence of complete sterility is not a reason for negative results. It is possible that differences in anatomical details of the outer nodule tissues may account for any variations in excretion between different legumes that may finally be established.

With the pea (*Pisum sativum* L.) variety "Gradus", we have obtained a maximum excretion of 7 mgm. nitrogen per pot of three plants, the fixation being 60 mgm. (bacillus strain Virtanen HX). Barley

plants associated with similar peas showed no measurable uptake of nitrogen, confirming that the excretion was small.

Mr. J. Boyes collaborated in some of this work.
G. BOND.

Dept. of Botany,
University,
Glasgow.
Sept. 10.

¹ Bond, *NATURE*, 136, 675 (1937).

² Virtanen, *J. Soc. Chem. Ind.*, 54, 1015 (1935).

³ Bond, *Ann. Bot.*, 50, 559 (1936).

⁴ Ludwig and Allison, *J. Insect. Biol.*, 31, 93 (1936).

⁵ Wilson, *NATURE*, 145, 154 (1937).

Attitude and Concealing Coloration

I FOLLOWED with much interest and amusement a controversy in *NATURE* concerning the origin of species, which involved the meaning of protective coloration in insects. One correspondent asserted that insects placed themselves in special locations with which their concealment devices blended. I am submitting a further example of this.

We have in New Zealand a tree-lily or palm-lily, *Cordyline australis*, related to the dragon-trees, and known to us as the cabbage-tree. A looper caterpillar lives in and on its green erect crown, and the moth, *Venusia corriculata*, from this caterpillar lies concealed by day in the dead, strap-like leaves that hang like a rustling skirt around the trunk.

Other observers have noted that whenever they have found the moth thus at rest, it was so oriented on the leaf that its brown parallel markings lay along the parallel veins of the dead monocotyledonous leaf. But last summer I was lucky in finding so many on one particular tree that I could stir them up with a straw, and observe that whether they flew or just crept to another leaf, they always, after a few compass-like vacillations, lay down finally with the body across the leaf, so placing wing-lines along leaf-veins. The body is pressed very close, and the antennae bent in under the forewings. The moth in the photograph (Fig. 1) was coaxed on to a length of leaf, and moved into a pre-focused position. It has not closed its wings quite as perfectly as usual, but it can be seen that their lines would otherwise be continued straight across thorax and abdomen and just about parallel with the leaf-veins, which they match very well in colour.

This is, so far as I can find, the first time the actual movement, appearing strikingly purposive, has been observed, or even the live insect photographed more or less *in situ*.

J. J. S. CORNES.

Dominion Laboratory,
Scientific and Industrial
Research Department,
Wellington.
Aug. 5.



Fig. 1.

Venusia corriculata RESTING ON DEAD LEAF OF THE 'CABBAGE TREE'. APPROX. $\frac{1}{2}$ NATURAL SIZE

THE part played by living insects in adopting attitudes which increase the effect of the colour and pattern is often overlooked in discussing the relation of coloration of insects to natural selection. Mr. J. J. S. Cornes has given a striking new example from New Zealand of a phenomenon recorded by Mr. A. H. Hamm¹, for English moths when resting on the bark of trees. It was recorded that the vast majority of the individuals of the common winter moth, *Hybernia leucophaea*, rest with the body horizontal, so that the lines of pattern on the wings are brought into parallelism with the dark shadows in the abundant vertical cracks of the bark on which they rest. If the wings were spread horizontally, as is so often the case with moths of this group, the main lines of the pattern would cut across the main lines of the background.

The same principle was shown to apply to the resting attitudes of other species in a later paper². It is quite obvious when one witnesses such a case that the insect is under the influence of a strong instinct and that until it has adopted the attitude described it is uneasy. The same thing has often been noted with the butterfly *Eronia deodora* in Africa, of which the underside resembles the blotched green, yellow and brown appearance of a partially dead leaf³. Specimens disturbed from rest among vegetation have been seen to settle among the leaves on a plant which show the same mottled coloration rather than among healthy and entirely green leaves.

G. D. HALL CARPENTER.

Department of Entomology,
University Museum,
Oxford.

¹ *Proc. Ent. Soc. Lond.*, p. xv (March 19, 1903).

² *Trans. Ent. Soc. Lond.*, 433-85, Plate xxix (1906).

³ Longstaff, G. B., "Butterfly Hunting in Many Lands" (London, 1912), p. 194 and frontispiece.

Excretion of Vitamin C in Sweat

ON the Witwatersrand gold mines, where the Bantu mine labourers work under hot humid conditions, cases of scurvy and sub-scurvy occur with some frequency, despite the fact that the diet provided has been shown to contain adequate amounts of vitamin C (some 20-30 mgm. daily). The explanation given is that the high energy requirement increases utilization of the vitamin. However, on testing sweat samples collected from recruits undergoing a 'heat tolerance' test under conditions approaching those encountered underground (shovelling gravel at 97° F. dry and 90° F. wet bulb for one hour in a surface chamber), it was found that sweat reduced indophenol dye under conditions regarded as specific for the vitamin¹.

The vitamin C content of a series of samples varied between 0.5 mgm. and 1.1 mgm. ascorbic acid per 100 c.c. Since the average weight loss during the test is about $\frac{1}{2}$ lb., representing chiefly sweat loss, excretion of vitamin C by this route amounts to some 2 mgm. per hour. Further, examination of the urinary excretion of vitamin C both before and after the heat chamber shows no change. Hence severe exercise produces an increased elimination through the sweat mechanism.

We found² that the average urinary excretion of Bantu miners was 10 mgm. vitamin C daily and did not differ from boys resting. As Orenstein³ has shown that a miner may lose 2½-5 lb. weight after

an eight-hour shift underground, excretion of vitamin C through sweat must play an important part in vitamin C subnutrition in miners, who cannot afford a liberal diet (20-25 mgm. vitamin C daily has been regarded as the indispensable minimum to prevent subcorbutic symptoms under normal conditions⁴).

R. E. BERNSTEIN.

Department of Physiology,
University of the Witwatersrand,
Johannesburg.
Sept. 16.

¹ Emmerie, A. and van Bokelen, M., *Biochem. J.*, **23**, 268, 1153 (1934); **24**, 15 (1936).

² Bernstein, R. E., and Weiner, J. S., *S. Afr. J. Med. Sci.*, **2**, 37 (1937).

³ Orenstein, A. J., *Africa*, **9**, 218 (1936).

⁴ Heinemann, M., *Biochem. J.*, **30**, 2299 (1936).

Hexaco-ordination of Tellurium, Molybdenum and Tungsten

THE Raman spectra of telluric acid and several molybdates and tungstates have been examined in the crystalline state and in aqueous solutions, particular care being taken to record their complete Raman spectra. Some of the results are given below:

Telluric acid solution— Δ 644(10), 619(1), 532(3).
Ammon. molybdate crystals—937(7), 881(4), 862(1), 823(3).
" " solution (ammoniacal)—895(5), 820(3), 826(3).
Potass. " (alkaline)—891(10), 823(3), 819(8).
Sodium tungstate " (alkaline)—929(5), 834(1), 830(3).
Potass. tungstate " (")—924(4), 835(1), 820(3).
(Figures in parenthesis indicate relative intensities, estimated visually).

In contrast with the results for sulphates¹ and selenates² (and of solid ammonium molybdate), the total number of Raman lines in each of the spectrograms of aqueous solutions is three, and not four, which is the number of lines expected from a tetrahedral molecule. On the other hand, the relation $\nu_1^2 = \nu_2^2 + \frac{1}{3} \nu_3^2$, which is the relation between the frequencies of an octahedral molecule, is strikingly obeyed, the deviations (2 per cent for molybdate; 0.1 per cent for tungstate) being very much less than what has been observed in some accepted octahedral molecules like the hexafluorides of sulphur, selenium and tellurium³ (10-17 per cent). The intensity relations of the lines are also in agreement with an octahedral structure.

It is therefore concluded that, like telluric acid, the molybdates and tungstates, which are known from studies of the phase systems to exist at ordinary temperatures as dihydrates⁴, are octahedral units in aqueous solutions, two oxygen atoms being co-ordinated to the central atom from the two water molecules of hydration.

A detailed discussion of the subject will be published elsewhere.

JAGANNATH GUPTA.

University College of Science
and Technology,
92 Upper Circular Road,
Calcutta. Sept. 15.

¹ Niki, *Jap. J. Phys.*, **7**, 3 (1932).

² Ganssen, *Proc. Ind. Acad. Sci.*, **1**, 156 (1934).

³ Yost, Steffens and Gross, *J. Chem. Phys.*, **2**, 311 (1934).

⁴ Funk, *Ber.*, **22**, 3700 (1900).

Points from Foregoing Letters

DR. R. BROOM reports the discovery of a molar tooth having the characteristics of *Australopithecus* in a cave at Sterkfontein, South Africa, a few yards from the recently found skull belonging to the same species. The author gives diagrams comparing this tooth with the third right lower molar in allied anthropoid apes and in man, and submits a diagram of a possible relationship between man and the higher anthropoids.

By bombarding thorium with neutrons from a radium beryllium source, A. Braum, Dr. P. Preiswerk and P. Scherrer have detected alpha particles of energy greater than nine million electron volts, which they ascribe to the transformation of thorium of mass 232 into radium of mass 239.

The frequency of ionizing showers at sea-level and under the earth does not diminish with increased thickness of protecting lead, but tends to a limiting value. Dr. L. Landau and G. Rumer suggest that this is due to heavy particles which penetrate easily through lead. They submit a formula for the probability that a shower produced by a photon emitted by a heavy particle gets out of a layer of sufficient thickness, and this, they state, gives fair agreement with observed data.

Commenting on a previous communication by Prof. Wilson on nitrogen excretion by white and red clover and pea, Prof. A. I. Virtanen states that his experiments were carried out in very fine sand and in various soils approximating to natural conditions. He explains Prof. Wilson's failure to confirm the excretion as possibly due to the use of coarse quartz sand, which lacks absorptive capacity. A number of other factors, such as bacterial strain, amount of

nodules, host plant, medium and nitrate content of the medium also affect the amount of nitrogen excreted. Dr. G. Bond now reports experiments with sand cultures of inoculated soybeans which failed to show that nitrogen is excreted from their root nodules. This may be due, he thinks, to lack of as yet undefined conditions necessary for excretion. A small excretion of nitrogen in the case of a pea culture was observed.

In connexion with the discussion on protective coloration in insects, J. J. S. Cornes submits a photograph of an Australian moth, *Vernicia verruculata*, resting on a dead leaf of the palm-lily, *Cordyline australis*, with its wings so oriented that their brown parallel markings lie along the parallel veins of the dried palm leaf, which they match in colour. This position they always take up. Prof. G. D. Hale Carpenter recalls a similar phenomenon recorded by Mr. Hamm in the case of the common winter moth, *Hybernia leucophaea*, and another in the case of the African butterfly, *Eronia cleodora*.

The amount of vitamin C excreted in the sweat in the case of Bantu labourers working at a temperature of 96-97° F. in the Witwatersrand gold mines is 0.5-1.1 mgm. per 100 c.c., or about 2 milligrams per hour, according to R. E. Bernstein. This loss of vitamin C may account for the relative frequency of scurvy or sub-scurvy amongst those miners.

The Raman spectra of aqueous solutions of telluric acid and of several molybdates and tungstates show only three lines, and their characteristics indicate that these substances exist at ordinary temperature as dihydrates in octahedral units, two oxygen atoms being co-ordinated to the central atoms from the two water molecules of hydration.

Research Items

Pomo Culture

A FURTHER statistical study of cultural elements among the Indians of California by Mr. E. W. Gifford and Prof. A. L. Kroeber deals with the Pomo as a whole (*Univ. Calif. Pub. American Archaeol. and Ethnol.*, 37, 4). The Pomo form a nationality speaking recognized related languages, or dialects, and are mainly distinguished by directional terms, such as 'south', 'eastern', etc. They are divided into a number of small groups, which, at one time or another, have been called tribes, villages, village-communities, or tribelets. Each was completely autonomous and possessed a main settlement, or central village, ordinarily in some valley, which was the residence of the chief or chiefs. Here was also situated the earth-lodge or dance-house, around which all the community gatherings centred. There was no Pomo culture, except as an ethnological abstraction; but there was a series of highly similar, but never quite identical, Pomo cultures, each carried by one of the independent communities. The aim of the present study is to discover how far the elements of this series, within the framework of a nationality, varied and how they were related. The number of communities is estimated to have been seventy-five; but in all probability this figure is too high. The number may have been about fifty, with an average population of possibly two hundred. The data for statistical treatment comprised 15,000 comparable factual items. From their analysis it emerges that generally it would appear that there existed a high level of uniformity between adjacent minimal territorial entities. The generic picture of Pomo culture accords with a numerical finding of around ninety-five per cent of cultural uniformity ordinarily shared by strictly neighbouring communities. All this presupposes a population always narrowly localized, as well as ordinarily peaceful—as we know it to have been.

Radiation and Cell Division

THE work of Spear has shown that the first effect of small doses of gamma rays on chick fibroblasts in tissue culture is an inhibition of cell division due to an action on the early phases of this process. A paper by Tansley, Spear and Glücksmann (*Brit. J. Ophthalmol.*, June 1937, p. 273) has extended the observations to a mammalian tissue (rat retina) and has presented much additional evidence as to stage of cell division at which the effect occurs. This tissue was chosen because it is still undifferentiated, and actively dividing, for some days after birth, and because it is easily accessible to radiation. Exposure to a small dose causes a diminution in the number of cells in the prophase of division, which reaches a minimum in a little less than two hours. This is followed by a minimum, first of the number of cells in metaphase, and then of those in telophase. If the dose is very small, the counts then rise to maxima which may be greater than the normal value, probably because cells which would have divided during the inhibitory period are added to cells which would have divided in this later period. When the dose is increased, this maximum does not occur and the

proportion of degenerate cells increases. A further increase of dose delays the onset of degeneration. These observations confirm the view that the effect is on the very early stages of cell division, and elucidate an apparent anomaly in connexion with degeneration. If observations had been confined to twelve hours after exposure, an increase of dose would have appeared to diminish the amount of degeneration.

Control of Nematodes of Horses and Sheep

CONTINUING his studies of the control of burrhead nematodes, I. W. Parnell has tested the lethal effects of ten of the more common nitrogenous artificial fertilizers upon the free-living stages of sclerostomes (*Canadian J. Res.*, 15, 127, July 1937). The three nitrogenous fertilizers which lost most ammonia when mixed with faeces were found to be most deadly—pure ammonia water has already been shown to be lethal. In general it was shown that the proportion of fertilizer to faeces necessary to effect sterilization would, in farming practice, be too high to be used if all faeces had to be treated. But in a well-built manure heap only the bottom and outer surfaces of the heap would have to be treated, for sclerostome larvae are unable to survive the heat of fermentation, associated probably with lack of oxygen and harmful products of decomposition, in the centre of a manure heap.

Amphibia of Connecticut

IN order to help teachers and students, biologists in schools and colleges, and the plain naturalist, the State Geological and Natural History Survey has published a popular bulletin describing the Amphibia of Connecticut (Conn. State Geol. N. H. Survey, Bull. 57, 1937, pp. 50). The State harbours ten species of frogs and toads, nine species of salamanders and newts, and a few species have been introduced, including *Necturus maculosus*. The bulletin describes each species, indicates its distribution, and gives a short account of its habitat and habits. Identification is simplified by a key to characters and by twenty plates of uncoloured photographic reproductions.

Parasitic Copepods of the North Sea and Baltic

G. M. VAN OORDE-DE LINT and J. H. Schuurmans Stekhoven, jun., give a good account of the parasitic copepods in this most useful series ("Die Tierwelt der Nord- und Ostsee", 31, Teil X.c. Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936). Fish parasites are specially dealt with, and a large number of these have been recorded from the area covered. Dr. Stekhoven has recently described several parasitic copepods from the Belgian coast (*J. Bull. Mus. Roy. d'Hist. Nat. Belgique*, 1936) and worked at the physiology of *Lepocithierius*, *Acanthochondria* and *Lernaeocera*: a large amount of work has also been done by other authors on this favourite group. The copepod family Calanidae is the only one without parasitic species. Even the Harpacticoidae include, according to Sars, a species probably parasitic for part of its life on whales, although it is not recorded from the area. A useful register of species, 214 in all,

and their hosts, both vertebrate and invertebrate, occupies thirteen pages, showing the parts of the body parasitized. Of the invertebrate hosts the Mollusca, especially nudibranchs, are the most numerous, Crustacea coming second, and there are a few in or on annelids, echinoderms and tunicates. This section of "Die Tierwelt" will be very useful for reference to those working on the group. It is well and clearly written, and the illustrations are numerous and well chosen. The same part includes Decapoda (Nachträge und Berichtigungen) by H. Balas (X.h.3), and Pantopoda (2 Nachtrag) by H. Helfer (XI.a.3).

Ciliary Currents on Lamellibranch Gills

MR. ALASTAIR GRAHAM makes some interesting observations on the gill currents of certain members of the Tellinacea (Proc. Roy. Soc. Edin., 57, Part 2, No. 8). He has noted previously that the outer gill of *Solecurtus scopula* is peculiar in the absence of a groove along the free edge which is usually present in lamellibranchs. He has also shown (1934) that *Solecurtus* is almost certainly related to the Tellinacea. In his new investigation he finds that the ciliary mechanisms of the outer gill agree with other members of the Tellinacea (*Gari*, *Scrobicularia*, *Tellina*) and thus a further argument is produced in favour of this relationship. In discussing the homologies of the outer gills of the Tellinacea, the author puts forward various views, the most favourable, which he appears inclined to support, being that the outer gill of *Solecurtus* is not homologous with the outer gill of other lamellibranchs, but is a new structure formed from the supra-axial extension of the outer lamella. There are, however, certain arguments against this view, and the question remains unsettled.

Effect of Moulds upon Tanning Liquors

SEVERAL trees growing in the Philippine Islands yield liquors suitable for tanning purposes. The betel nut, *Areca catechu*, the black wattle, *Acacia decurrens*, kalumpit, *Terminalia edulis*, and kamaohile, *Pithecolobium dulce*, are four of the most important trees. Tanning liquors prepared from them are, however, subject to attack by common mould fungi, and Messrs. Luz Baens and F. M. Yenke have investigated their action (*Philippine J. Sci.*, 61, No. 4, 417-428; Dec. 1936). They found that the activities of the fungi *Penicillium glaucum* and *Aspergillus niger* gradually reduced the tannin content of prepared solutions. A rise in the relative acidity of the liquid was usually accompanied by a large decrease in tannin content. Variations in susceptibility of the liquids to attack by the fungi appeared, for extracts of betel-nut kernel and black wattle bark were susceptible to *A. niger*, but somewhat resistant to *P. glaucum*, whilst kalumpit bark extract allowed *P. glaucum* to increase more than *A. niger*. Both moulds would find their way to the liquid when natural infection took place during practical tanning operations.

Oceanography of Davis Strait

AN important contribution to the oceanography of the north-west Atlantic is contained in the Scientific Results (Part II) of the Marion and General Greene Expeditions to Davis Strait and the Labrador Sea 1928-1931-1933-1934-1935 (Washington: U.S. Treasury Department, 1937. 75 cents). One of the most interesting of many conclusions reached is in

regard to the vertical distribution of water in the Labrador Sea. The intermediate water between 500 and 2,000 metres appears to be derived from the warm, saline West Greenland current. The bottom water is formed by the winter-time chilling of the surface, intermediate and deep water in the northern part of the Labrador basin in the area off-shore from rapid currents. In that area it seems that convection currents occur down to the bottom. On the other hand, in summer the bottom water is isolated from the cold surface water by the intermediate warmer water. Part of the bottom water escapes into the Atlantic basin eastward of long. 38° W., and part may enter round the southern end of Greenland. The report points out the necessity for mid-winter observations in these seas in order to test this theory of vertical movements of water within the Labrador Sea.

Soil Erosion in the United States

A WELL-ILLUSTRATED article by Mrs. E. Huxley on this topic in the *Geographical Magazine* of September reveals some striking facts regarding the devastation of natural resources by over-cultivation, especially in areas of poor soil and steep slopes. It is estimated that more than ten per cent of the total land area of the United States has lost more than three-quarters of its top-soil and that a further thirty per cent can be regarded as moderately eroded. In the Mississippi valley alone, 400,000,000 tons of good rich top-soil are swept annually into the Gulf of Mexico, and in that area twenty-five per cent of the cultivated land has been stripped down to the subsoil and rendered useless for cultivation. A reduced yield of crops is the first sign of soil erosion, and this is generally countered by the use of fertilizers, which are, however, only a temporary remedy. A change in agricultural practice is required, and this is being carried out in some areas. Terracing, strip cropping, embankments along contours and other devices are being used, but most important of all is the reversal from one-crop cultivation to crop rotation and mixed farming. This, of course, will reduce the output of cash crops and mean a greater production of livestock products. The tendency will be to put American agriculture on a basis of home food production rather than intensive export production.

Haboobs in the Sudan

A PAPER read at the Royal Meteorological Society on June 18 entitled "Haboobs and Instability in the Sudan", by J. S. Farquharson, dealt with the cause of disturbances that are distinct from sandstorms and sand-devils, although associated with increases of wind and an atmosphere unpleasantly charged with dust. Recent observations of sand-devils were described in NATURE of January 30, p. 201. Sandstorms, according to Bagnold, are clouds of flying sand that rarely extend more than two metres above the ground. The haboob is very much greater in vertical extent than this, contains much smaller particles and in general structure is very different from the slender column of the sand-devil. In this paper a detailed description of all the haboobs observed in 1936 brings out the main characteristics of this phenomenon. A sample of dust in a haboob at Khartoum was collected with the aid of a pilot balloon from a height of 50 feet above the ground and it was found that the greatest length of a particle was generally between 0.01 and 0.07 mm. The observed changes of wind, temperature, etc., seemed

to indicate clearly that the necessary wind is associated with a thunderstorm or at least with a cumulo-nimbus cloud and is of the nature of the outrushing squall of the thunderstorm. The evaporation of rain from such a cloud before it can reach the ground was often observed near Khartoum, this process being very favourable for the development of a high degree of instability, seeing that the descending air in which the rain is evaporating would warm up dynamically at only the saturated adiabatic lapse-rate, while the environment would have a dry adiabatic lapse-rate. The instability resulting in the cumulo-nimbus development appears to occur near the boundary between the south-west monsoon and the north-east trade winds, and this year was more often associated with an advance of the relatively cool air from the north than with a northward extension of the warmer monsoon wind. Photographs of some of the haboobs showed the advancing storm to have a wide lateral extension across the direction of its advance, giving it something of the nature of a line-squall.

Preparation of Germanium and Gallium

THE presence of small quantities of the rare metals germanium and gallium, in coals and flue dusts has been known for some time. Sir Gilbert Morgan and Dr. G. R. Davies (*Chemistry and Industry*, 56, 717; 1937) have recently made a systematic investigation of British coals and flue dusts and find that, with the exception of certain South Wales coals, all contained some germanium, although the ash from Kentish coal contained only a trace. All gas-works' dusts contained both germanium and gallium, irrespective of the coal used, and these flue dusts constitute a valuable potential source of germanium and gallium, so that by suitable and probably minor alterations in working conditions, a material could be obtained which would be much richer in these metals than anything hitherto examined. It was found that loss of germanium occurs when a coal is burnt, so that its presence in flue dusts is explained. The method used for the extraction of the germanium and gallium was the distillation of the volatile germanium tetrachloride by heating the material with hydrochloric acid in a still, and the extraction of gallium trichloride from the residue by means of ether. The authors calculate that very large quantities of germanium and gallium are annually dissipated into the atmosphere or discarded as useless dust by the combustion of coal. F. Sebba and W. Pugh (*J. Chem. Soc.*, 1371, 1373; 1937) also describe an improved method for the extraction of gallium and germanium from the mineral germanite. The usual method of acid extraction leads to a troublesome separation from copper, iron, lead and zinc, and the extraction of gallium is probably incomplete. The new method consists in digesting the finely powdered mineral with sodium hydroxide solution. In this way both the rare elements are concentrated in a single operation. The authors also describe the electro-deposition and purification of gallium. Conditions for the electro-deposition of quantities of the order of 10 gm. of the metal are specified.

Carbon-Carbon Bond Distances

L. Pauling and L. O. Brockway, in considering the dependence of interatomic distances on resonance, have assumed that the C-C single bond is characterized by the distance 1.54 Å., as in diamond, and

the shorter distances observed in several compounds have been attributed to partial double bond character resulting from resonance. It might, however, be questioned whether this interpretation is justified, as the single bond radius for aromatic carbon might well be different from that for aliphatic carbon. These authors have now (*J. Amer. Chem. Soc.*, 59, 1223; 1937) determined the configuration of thirteen hydrocarbons by the electron diffraction method and have arrived at the conclusion that the value assumed for the carbon double bond covalent radius, obtained by linear interpolation between the single bond and triple bond radii, is 0.02 Å. too large. They now give corrected values for covalent radii as follows:

Bond	C	N	O	F	Si	P	S	Cl
Single	0.77	0.70	0.66	0.64	1.17	1.10	1.04	0.99
Double	0.67	0.61	0.57	0.55	1.06	1.00	0.96	0.90
Triple	0.60	0.55	0.51	—	0.90	0.83	0.88	—

In the case of other atoms than the first four, it is supposed that the factors converting single to double and triple bond distances are somewhat different from 0.87 and 0.78 adopted in the above table. The curve drawn by the authors connecting interatomic distances and bond types is somewhat altered. It does not differ appreciably from the old one up to 50 per cent double bond character; in the region between 50 per cent and 100 per cent double bond character the new curve makes it possible to determine bond type, whilst the old one was useless because of its small slope. They also show that the curve may be represented by an equation based on a potential function for a resonating bond as given by the sum of two parabolas, representing single bond and double bond potential functions.

Bright Solar Eruptions and Radio Fadings in 1935-36

Messrs. H. W. Newton and H. J. Barton have produced a very comprehensive paper (*Mon. Not. Roy. Astro. Soc.*, 97, 8, June 1937) in which a comparison is made between sudden radio fadings and bright eruptions observed on the sun in hydrogen light or in that of ionized calcium. In 1936, when rapidly increasing solar activity took place, 29 close associations of radio fadings with bright solar eruptions were recorded, and in those cases where the origin of the solar eruptions was observed, the radio fadings took place 7 minutes before the observed time of the solar eruption. There is no doubt that the fadings are due to a solar agency, travelling with the approximate speed of light from a limited part of the sun's chromosphere. The data are insufficient at present to show any correlation between terrestrial magnetic effects and radio fadings, and, in addition, are insufficient to establish a tendency for fadings to recur in intervals of 27 or 54 days.

The Orbit of OE 79

Mr. L. T. S. SYMS has published a paper with this title (*Mon. Not. Roy. Astro. Soc.*, 97, 8, June 1937). The preliminary orbit was computed by Russell's method, largely a graphical one, and then the method of Innes and van den Bos was applied for a more definitive orbit. The period of this binary is 89.20 years, the semi-axis major 0.53", and the inclination $\pm 51.6^\circ$. It is interesting to notice that the elements give a dynamical parallax of 0.021", as compared with the spectroscopic parallax 0.023" determined at Mt. Wilson and the trigonometrical parallax $0.046'' \pm 0.06''$ found at Allegheny.

Universities and Education

THE discussion in Section G (Engineering) of the British Association at Nottingham on September 2 on the training of university graduates for the engineering industry, which was opened by Prof. F. G. Baily, was notable not only for the high level sustained, apart from one or two lapses, but also for some stimulating remarks on the functions and character of university training in general which merit the attention of a wider audience.

In his introductory paper, Prof. Baily reviewed the scope and subject-matter of the various courses at present followed, and urged that for most men the practical training should follow the college course. He does not consider that the theory of commerce or industry should be included in the three-year curriculum, but should preferably be studied after some practical experience has been acquired. It is also doubtful whether a fourth year of study repays all students for the time spent. Prolonged study of theory may be of slight benefit to students of medium capacity and of little use in several branches of employment. Prof. Baily also stressed the value of the sandwich system and the perspective which some manual training gives as well as the closer contact with the workmen. The latter, rather than the acquisition of manual skill, are the most valuable results of manual training.

Dr. W. Jackson, who presented a joint paper with Dr. A. P. M. Fleming, stressed the need for a more effective co-ordination of the resources of the universities and of industry. The task of educating and training for engineering careers those who will ultimately occupy positions of high technical and administrative responsibility is a joint responsibility between the universities and industry, and Dr. Fleming and Dr. Jackson pleaded for a broader interpretation of industry's share in this responsibility. They made the somewhat revolutionary suggestion that the large industrial organizations should accept the responsibility of training such men for the country as a whole, and that the smaller concerns should no longer recruit direct from the universities. The tendency to include industrial administration and an increasing amount of specialized technological information in university courses was again adversely criticized, Dr. Jackson pointing out that this overloading or undue specialization is detrimental to their educational value. Opportunities for independent reading and thinking, and the exercise of originality, may be unduly restricted, and too high a premium placed on memory and the ability to reproduce information in the exact form in which it has been communicated in the lecture. The undergraduate stage is much too early a stage at which to encourage intensive specialization.

Dr. Fleming and Dr. Jackson suggested that the universities might now reasonably expect the large industrial firms to undertake, both independently and in co-operation with adjacent technical colleges, the necessary systematic instruction in the specialized branches of engineering technology with which they are concerned. If facilities for combined practical and technological training could be made available on a wide scale, the opportunity for a liberal education at the university and the effectiveness of the overall training could be increased considerably. Moreover, if released from technological obligations, the universities could

do much to stimulate in the embryo engineer the development of broader interests and participation in wider fields of activity. If engineers are to make their full contribution to the solution of the complex problems of modern life, their interests cannot be limited to technical matters, and the opportunities for humane studies and for participation in the corporate life of the university are two of the most important attributes of a university education.

Finally, Dr. Fleming and his colleague, referring to the universities and industrial research, urged that men of outstanding ability should be given the opportunity to return for one or two years to an appropriate university, either at home or abroad, to learn more effectively the method and art of research and to enhance their fundamental scientific knowledge. A regular stream of such men from industry, endowed by adequate joint scholarship provision, would exercise a very stimulating effect on the research and teaching activities of the universities. In addition, the engineering departments of the universities have an excellent opportunity for co-operative research with the physics, chemistry and metallurgical departments on borderline subjects in which industry is keenly interested but which an industrial research laboratory may be unable to tackle. Industry should also afford facilities in its research laboratories for members of university staffs to carry out or supervise supplementary work beyond the scope of their financial resources, thus assisting them to keep in touch with outstanding industrial problems.

Many of the points made in these two papers were strongly endorsed in the discussion which followed. In a written communication describing the training of engineer recruits for the Post Office service, Sir George Lee referred to the stress laid on personality, judgment and character in candidates rather than on technical knowledge, and emphasized the importance of a wider cultural education with, if possible, two foreign languages. A general education which equips the engineer to take some part in everyday affairs is much to be preferred to the present over-specialized education.

Mr. S. V. Goodall, who dealt with the Admiralty system of recruitment and training for the Royal Corps of Naval Constructors, referred particularly to the Admiralty's efforts to obtain university graduates who have not had any experience in shipyard work but have attained a high standard in mathematics and naval construction.

Sir T. Hudson Beare, after emphasizing the value of instruction in design as affording a means for expressing creative ability, asserted that the fundamental task of the university is to turn out trained minds able to absorb knowledge readily later on in life when left to their own resources, and to take their proper place in the life of the nation. The only specialization at a university should be specialization in the fundamental principles of the science. Mr. H. A. Ward, of Messrs. Rolls-Royce, Ltd., described a recent experiment in the employment of university graduates which is giving promising results, and Prof. C. H. Buleid endorsed a number of Prof. Baily's and Sir Hudson Beare's remarks regarding premature specialization and the place of university training. Prof. E. W. Marchant also strongly endorsed the value of a university training for an engineer,

stressing particularly the importance of association with other students, and paid tribute to the work done by Dr. Fleming to encourage the employment of university graduates in industry.

Other speakers in the discussion reiterated the importance of concentration upon fundamental principles and humanitarian studies in a university training, while in regard to research it was pointed out that the greater expensiveness of engineering research, as compared with research in the physical sciences, is often a great handicap to the universities in initiating such work. Prof. R. V. Southwell suggested that the time is ripe for a drastic revision of engineering curricula, and a further speaker urged an inquiry into the whole question of scientific education, with the view, among other things, of eliminating the overlapping which at present exists between the technical schools and colleges and the universities.

The educational functions of the university were also touched upon from a different aspect in discussions before Section L (Educational Science). Incidental reference was made to the part of the university in the discussion on education for the community on September 3, although Prof. A. M. Carr-Saunders did not present his paper on this subject. A special session on September 6 was, however, devoted to the educational function of the university. Sir Richard Livingstone, who opened the discussion, took as his main theme the need for a new type of adult education which the universities are pre-eminently qualified to impart.

If the university sends out graduates with a thorough mental training and a background, it has done what it can to prepare them for life. When, however, education ceases at the age of twenty-two or twenty-three years, in our swiftly changing world a man is very liable to lose intellectual energy by the time he is forty and fail to keep up with advancing knowledge. Sir Richard urged that everyone engaged in routine or practical work, especially if he occupies a directing or controlling position, needs periods of systematic study to refresh, re-equip and re-orientate his mind. There is no occupation or profession in which the resumption of systematic education in later life would not be profitable, and there are few who would not greatly profit by it. Already in medicine and in teaching, refresher or vacation courses are being arranged, and Sir Richard referred to experiments in the same direction in civil and local government service. The Commonwealth Fund awards three fellowships for study in the United States to civil servants to enable them to carry out inquiry or research on problems akin to those which come within the scope of the Department in which they are serving. A summer school in colonial administration has been organized by the University of Oxford with the encouragement and help of the Colonial Office and Colonial Governments, in which detailed problems of native administration are placed in a wide general and comparative setting. A third instance is the growing practice of granting officers leave for part-time study in such courses as the diploma course in public administration at Oxford.

This type of adult education, which enables the student to place his special subject against the background of modern civilization, can only be supplied by the universities, and an extension of the practice of seconding promising officials for systematic study at the university would do much to break down the dangers which routine continually threatens. Moreover, this practice would tend to remedy the serious

neglect of the social sciences. Bringing back to the university in this way the civil or municipal servant, the medical or other professional man and the business man, with the first-hand knowledge of social conditions which they possess, would not only add to the data on which the social sciences depend and stimulate the cross-fertilization of theory and practice which is such a fruitful source of advance, but also assist to prevent disastrous mistakes in the study of these sciences, which aim at directing the policy of Governments and the conduct of millions of human beings.

The functions of the universities in regard to the social sciences were discussed in still greater detail by Prof. M. Ginsberg, who condemned the divorce of the teaching of the social sciences from that of social philosophy. This separation is the more unfortunate because the problems of deepest interest to layman and student alike are those in which questions of value and questions of fact are closely interwoven, and to see them in their proper relation is of the most vital importance. The training at present provided in the universities is not well calculated to achieve this object, for students, while trained in marshalling and correlating facts, have no parallel experience in weighing values or in disentangling values in complex social situations. Social science has two functions to fulfil, both of special relevance and urgency at the present time. The first, or critical function, is concerned with the pre-suppositions or assumptions underlying common-sense and scientific thought about social phenomena and with the nature and validity of the methods employed in investigating them. It is urgently necessary that philosophy should attempt to provide a critical apparatus for scrutinizing and evaluating the methods and assumptions made by the social sciences, and particularly the fundamental conceptions from which a synthesis of the social sciences may proceed. A philosophical analysis of the conceptions of social change, which are in fact employed, for example, in the different social sciences, would greatly help in clarifying the present confusion. Similarly, the philosopher could do much to guard against confusions which may arise out of misunderstandings regarding the logical character of the laws and the relations between necessity, freedom and law. The relation between purely deductive studies and the more concrete or inductive handling of economic data also requires elucidation.

That function of social philosophy which is concerned with the problem of values is, however, of even greater importance to-day and Prof. Ginsberg considers that in economic questions the moral issues involved at present most urgently require clarification. In many cases our moral judgments of particular institutions would be transformed if we had fuller knowledge of the ends actually attained in relation to the ends they are intended to serve. The effective handling of social problems involves a synthesis, but not a fusion of social science and social philosophy, and co-operation is even more important in the teaching of political science and especially of international relations. The present neglect of philosophy is due partly to the little attention devoted to social problems by philosophers, and particularly to the failure to bring the teaching of ethics into relation with present needs. Prof. Ginsberg considers that great changes are required in the teaching of both social science and social philosophy if the universities are to make their rightful contribution towards the rational ordering of society.

National Smoke Abatement Society

ANNUAL CONFERENCE AT LEEDS

THE ninth Annual Conference of the National Smoke Abatement Society was held in the Philosophical Hall, Leeds, on October 1-2. The morning session on October 1 began with the annual meeting of the Society, during which Dr. H. A. Des Vœux delivered his presidential address, which was entitled "Idealism".

After reference to the high ideals of cleanliness, both personal and civic, possessed by the ancients, and to the lack of hygiene in the Middle Ages, Dr. Des Vœux passed on to consider present-day standards. He asked whether we can pretend to-day to have recovered the ancient Greek ideal of clean and open cities. We still tolerate slums in our midst; we are yet content to live in cities periodically blotted out by fog and permanently wasted by sulphur-bearing fumes. Were every citizen an idealist, the City Fathers would have the authority and could exercise the power to clean the atmosphere.

Prof. R. W. Whytlaw-Gray (University of Leeds) presided over the discussion on town planning and smoke abatement which followed, and referred to results of recent research on the nature of atmospheric pollution. All smokes are in the process of natural coagulation, and the form of the deposit from polluted air depends on the degree of coagulation. Measurement of the size-range distribution of the particles probably affords the best means of assessing the injurious nature of polluted air, and it seems that fine particles, for example, of radius less than 0.5μ , are mainly responsible for the harmful effects. Such particles ($0.3-0.1 \mu$) often form 50 per cent by weight of the solid matter in Leeds air.

Papers on town planning and smoke abatement were then read by Mr. J. E. Acfield (city engineer and surveyor, Leeds) and Mr. C. Gandy, of Manchester (chairman of the Executive Committee of the Society). Mr. Acfield discussed the doubts which exist regarding the possibility of creating smokeless zones under existing planning powers. The sections of the Act relating to 'zoning' appear to mean that enforcement of restrictions on present users regarding the fuel to be used would involve payment of compensation, and asked what possibility there is of action being taken under these conditions. Speaking of the present position in Leeds, he said that in the case of 27 buildings of any magnitude erected in the central area since April 1, 1930, the type of fuel used for central heating is in 18 cases coke, 3 coal, 5 oil and 1 gas; and in all cases where the fuel for cooking is known it is gas, electricity or steam. If the Corporation had possessed powers to require the change, subject to compensation, it would probably have achieved little more and might have been at considerable cost to do so. In a light industrial zone adjoining a large rehousing area, however, the Corporation has insisted on smokeless methods of generating power. There are now 4,200 municipal houses equipped with coke-burning ranges, yet despite an adequate supply the quantity of coke used by the tenants is deplorably small (85 tons for the 12 months ending in June 1937).

Mr. Gandy said that the time has come to consider the smoke problem as an integral part of the task of the town planner. Present restrictions on smoke emission are practically confined to factory smoke; attention should now be directed to the control of non-industrial smoke. He put forward a strong plea that legislation should be established empowering local authorities to make by-laws or schemes under which the emission of smoke would be declared a statutory offence in certain areas selected for that purpose. He gave reasons why the central areas in many cities would probably prove most suitable for selection in the first instance.

The two papers provoked a lively discussion, in which the need for appointing specially qualified whole-time smoke inspectors was emphasized. Duties in this respect usually fall to the already overworked sanitary inspector. Whilst an educational campaign for the general public is obviously required, it is imperative that the local administrators should be the first to be made 'smoke-conscious'.

In the afternoon session, devoted to the discussion of the reports from the regional committees of the Society, opinions were divided regarding the necessity for further legislation to advance the cause of smoke abatement, but it was suggested more than once that the fullest use is not being made of existing powers.

On October 2, Mr. Arnold Marsh, general secretary of the Society, presented a report on behalf of the Executive Committee on "Education and Smoke Abatement". Prof. J. W. Cobb (University of Leeds) who presided, referred to the prime necessity of arousing the public conscience to the harm done by smoke. For this it is necessary to look to education all the time, to education of different grades, all seeking the same end: the efficient utilization of fuel for the generation of heat, light and power with the minimum of atmospheric pollution.

Mr. Marsh stressed that information on the value of a pure atmosphere should be given in schools. It need not form an additional subject, but appropriate aspects of it should be incorporated into the normal course of such subjects as hygiene, domestic economy and general or elementary science. He outlined the contents of booklets which might be distributed to teachers to provide the necessary information.

In the ensuing discussion, Dr. F. A. Mason, representing the Board of Education, said that the children must be made conscious that the veil of fog and murk which prevents their enjoying the welcome warmth and health-giving rays of the sun is not an act of Nature but of man's own handiwork. The Board of Education is quite prepared to favour the introduction of some instruction on the smoke evil.

The views of a science school-teacher were expressed by Mr. Pixton, who said that smoke abatement is an excellent subject for the school curriculum and offers scope for interesting and informative experiments. He urged that in pressing for the introduction of the subject into school courses, the co-operation of the teachers' unions should be secured.

A. L. ROBERTS.

Larvæ of Decapod Crustacea*

THE first contribution to the study of the decapod larvæ of the "Discovery" expedition deals with the Stenopidea, Amphionidea and Phyllosoma. The whole collection is so large that the easiest and best way to treat it is by taking the groups separately irrespective of systematic order. The three sections chosen are of peculiar interest, and their elucidation has entailed an enormous amount of labour, eminently worth while.

Most of the plankton samples were taken far out to sea, and one of the features of the collection is the abundance of late larvæ, whilst early larvæ are comparatively scarce. For this reason, it is rarely possible to complete a life-history of any form. In Part 1, Stenopidea, the author was fortunate in obtaining larvæ hatched from the egg of *Stenopus hispidus* from Bermuda (previously somewhat inadequately described by Brooks and Herriek), which has enabled him to recognize later larvæ and to establish certain generic characters. Two further species (presumably) of *Stenopus* are described and six more belonging to the Stenopidea, and a key is given to the stenopid larvæ described.

Part 2, on the Amphionidea, is of special interest, for *Amphion* is a form which has led to much controversy both as to its systematic position and as to whether it is a larval or adult animal. There can be now no doubt that the oldest specimens known are immature, and Dr. Gurney is almost certainly right in referring *Amphion* to the Caridea (as Korschelt and Heider had previously suggested). Given that it is a carid, then he believes that the only known

genus to which it can be referred is *Amphionides*, three specimens of which were found in the "Discovery" material, from a depth of 2,500–2,700 metres. This most extraordinary decapod is so tender that in all instances known it is much damaged; but a construction of one of them certainly shows a distinct likeness to *Amphion*. Zimmer, who first described *Amphionides*, regarded it as a larva and observed that it closely resembles *Amphion*. Dr. Gurney remarks that he might have gone further and claimed it as an adolescent post-larval stage in the development of that crustacean, for, as he shows, *Amphionides* is certainly a post-larval form. All this is most interesting and suggestive.

Part 3 deals with the Phyllosomas, and here the work is remarkable, for no fewer than four hundred specimens have been examined and measured, and about a dozen forms recognized. No series, unfortunately, is complete, and no very early stages are present. Nevertheless, generic larval characters are described which distinguish *Palinurus*, *Panulirus*, *Jasus*, *Squilla* and *Squilla* and, probably, *Palinurellus*, *Thonua* and *Parribacus*. A very large amount of information is given in connexion with these Phyllosomas which will help enormously in future work.

This first section of the expedition's decapod larvæ promises well for future parts.

* Discovery Reports, vol. 12, pp. 377–440. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Larvæ of Decapod Crustacea (1) Stenopidea (2) Amphionidea (3) Phyllosoma. By Dr. Robert Gurney (Cambridge: At the University Press, 1936.)

Forestry in Great Britain

THE progress of the afforestation work being carried out by the Forestry Commission in Great Britain for the year ending September 30, 1935, is detailed in the sixteenth annual report (London: H.M. Stationery Office, 1936). During the year, the programme of work was that laid down by Government at the time of the financial crisis of 1931. In January 1935, the Commissioners reported to Government that it was desirable to review the position generally and to extend the current five-year programme, so that the work might be organized to the best advantage.

The Commissioners consider that a steady development is preferable to a sudden large increase of work which might lead to waste. They suggested therefore: (1) that the acquisition of land and the supply of plants should be speeded up; (2) to work up the annual planting programme from 21,000 acres to 30,000 acres over the next four years; (3) to continue expanding the programme up to 45,000 acres per annum. Of interest are the remarks made upon Jubilee forests, unemployment training camps, national forest parks and home timber trade.

With the permission of the late King George V,

three forests have received Royal designations to commemorate the jubilee, namely, the King's Forest in Suffolk, the Coed-y-Brenin (the King's Forest) in Wales, and the Queen's Forest in the Cairngorms.

In co-operation with the Ministry of Labour, sites of training camps and work such as road-making, etc. have been provided. During the year there were in all thirteen permanent camps and fifteen summer camps, with accommodation for 5,000 men. The camps were distributed at different centres throughout Great Britain.

The question of the formation of national parks has been under consideration by various bodies and individuals for some years past. The Commissioners appointed a committee, under the chairmanship of Sir John Stirling-Maxwell, to consider a specific example. The Commissioners have already, as a result of their land purchases, a considerable area of unplanted land. The Committee took a Scottish example consisting of unplanted land in the Forests of Ardgartan, Glenfinart, Benmore and Glenbranter in the County of Argyll. This area, including the adjacent Ardgool Estate belonging to the Glasgow Corporation which the Corporation is willing to

bring into the scheme, extends to 100 square miles and has now been earmarked as a national park to be used for campers, the youth movement body, and so forth. Funds have been obtained to provide camping sites, alpine huts and for the acquisition of Ardgartan House and policies.

A record is being prepared of the exceptional May frosts of the year 1935, which did a serious amount of damage in different parts of the country. The chief frosts occurred between May 13 and 19. The record of the susceptibility of the numerous species, conifer and broad-leaved, given in the report corresponds with previous statistics in this matter.

During 1935, the question arose as to whether afforestation could be of use in assisting the Special Areas. As a result of investigations, it has been found that a certain amount of land could be purchased for forestry purposes within fifteen miles of certain Special Areas, and that, as a preliminary, 1,000 forest workers holdings could be established and a certain amount of work provided. Grants have been made by Government both to speed up the afforestation programme and to assist the schemes in connexion with the Special Areas.

The information on the 1934 seed crops is of interest. During that year, the Sitka spruce crop was only moderate in Canada and the United States, and therefore the Commissioners (and others) were unable to obtain their full requirements. Douglas fir was good and Japanese larch seed abundant in Japan. In Europe, Norway spruce, European larch and Corsican pine were not too plentiful. Oak seed was in fair quantities, but beech was scarce. Of home-collected seed, the supplies of the chief forest species were sufficient to abundant.

Of the net total area of land acquired by lease, feu and purchase in Great Britain to September 30, 1936, 498,146 acres were classified at the time of acquisition as plantable, and of this area 301,133 acres (60 per cent) were in England and Wales and 197,013 acres (40 per cent) in Scotland. In addition to the above-mentioned areas, Crown woodlands extending to about 120,000 acres (of which some 60,000 acres are plantable) have been transferred to the Forestry Commissioners. The total area of land in the Commissioners' control thus approximated to 929,000 acres.

The Commissioners' seventeenth report for the year ending September 30, 1936 (London: H.M. Stationery Office, 1937) recently issued, shows the progress made. The Argyll National Park was inaugurated and a camping ground, car park and buildings for the use of campers were formally opened at Ardgartan. The question of instituting a similar park in Wales is now under consideration. The Special Area afforestation scheme received the sanction of Government and the Commissioners were authorized, as a first instalment covering three years and largely as an experiment, to acquire and begin to plant 100,000 acres and to establish 500 holdings. These plans were made public in February 1936 and the remaining months of the year under report were concerned with the preparatory work—acquisition of land and staff and provision of the necessary trees for planting purposes. Steps were being taken to cultivate a larger area of nursery ground. By May 1937, says the report, some progress had been made.

Owing to the wet year there were fewer fires. The total area of land under the Commission amounted to 954,500 acres and the area planted to 296,452 acres.

Science News a Century Ago

The Franklin Institute

THE fifty-fifth quarterly meeting of the Franklin Institute, Philadelphia, was held on October 19, 1837, when the usual quarterly report of the managers was read. Although the period covered by the report had not been marked by any new undertakings, the several sub-divisions of scientific and practical subjects had been encouraged with all the means at the disposal of the Society.

The interesting investigations on the cause of explosions of steam boilers had been concluded and the Government and the community had been put in possession of the results of the experiments and of ample directions tending to prevent the occurrence of accidents. The final report of the committee on the value of water as a moving power was expected to be ready shortly. The experiments made under the authority of the Institute were of the most perfectly practical character, and the application of a sound theory, deduced from practical results, would be put at the command of those interested.

The committees on science and the arts had sedulously prosecuted inquiries desired by inventors and others; the department of instruction had arranged for regular courses in chemistry, natural philosophy and mechanics. In addition to the usual augmentation to the library, "about one hundred volumes have been received from our esteemed member, Professor Bache, President of the Girard College, now in Europe. These books have been purchased out of a fund placed in the hands of Dr. Bache by the subscriptions of the members, and have been selected by a mind distinguished by its discrimination and devoted to practical science. . . ."

Launch of S.S. *Liverpool*

ON October 18, 1837, the wooden paddle-wheel steamship *Liverpool* was launched in the Mersey. The largest vessel built at Liverpool up to that time, she was constructed for Sir John Tobin, but became the property of the Transatlantic Steam Ship Company. She was built by Humble and Milcrest, and was 235 ft. long, 35 ft. beam and about 1,150 tons. Her engine, made by Forrester and Co. at the Vauxhall Foundry, had two cylinders, 75 in. diameter and 7 ft. stroke, and was of 468 horse-power. She is said to have cost £45,000. The *Liverpool* was the fourth of the steam vessels by which, in 1838, regular steam communication was maintained with America. The *Sirius* and *Great Western* made their first passages in April 1838, and the *Royal William* first crossed in July 1838. The *Liverpool* sailed from Liverpool on October 22, 1838, had to put into Queenstown, and finally reached New York on November 23. Her return voyage began on December 6 and ended on December 21.

Civilization and Insanity

THE *Gazette médicale de Paris* of October 21, 1837, contains the following information: At a meeting of the Academy of Sciences on October 10, M. Brière de Boismont dealt with the different countries in which he had been able to obtain information as to the figures of insanity. "What we have shown," he said, "gives us the right to regard insanity as a product of civilization. We have seen it reach its greatest development in the most enlightened nations, diminish as we penetrate into despotic governments

or into recently emancipated countries and disappear almost entirely when our researchers have taken in any savage people." M. Brière de Boismont then submitted tables showing the number of the insane in the principal European capitals with the population of each capital and the population of the different European countries and New York State, with the number of insane interned in each country.

Encouragement of Vaccination

AN editorial in the *Lancet* of October 21, 1937, contains the following information and suggestion: "At the last meeting of the Royal Academy of Medicine, Paris, there were distributed by order of the French Government for the encouragement of vaccination rewards of £80 to three medical men who had shown themselves most active in the propagation of that inestimable benefit during the course of the preceding year. Four gentlemen received handsome gold medals; and no less than a hundred persons were rewarded with silver medals. It would be highly desirable that our own Government should adopt some similar method of encouragement. Numerous accounts from correspondents inform us that small-pox prevails to a very great extent in some of the poorer districts, where we are sorry to say, vaccination seems to have been neglected in a deplorable manner".

University Events

BIRMINGHAM.—At its last meeting the Council of the University was informed that the vice-chancellor and principal (Sir Charles Grant Robertson) had placed his resignation in the hands of the pro-chancellor (Mr. Walter Barrow), so that in accordance with the statutes of the University it may be considered at a meeting of the Court of Governors, which will have before it also the nomination of Dr. Raymond Priestley, of Melbourne, as his successor.

OXFORD.—At Merton College Dr. G. M. B. Dobson has been elected to an official fellowship and Prof. R. Campbell Thompson, formerly research fellow, to a professorial fellowship.

At Balliol College Dr. Simon Flexner (George Eastman visiting professor) and Dr. J. A. Gunn (on appointment as director of the Nuffield Institute of Medical Research) have been elected to supernumerary fellowships. Dr. J. H. Burn has been elected to a professorial fellowship and J. St. L. Philpot, formerly tutorial fellow, to a senior research fellowship.

Dr. A. A. Bake, of the University of Utrecht, has been appointed to a senior research fellowship at Brasenose College for research on the religious songs and music of India. Dr. Bake is working under the guidance of Sir Rabindranath Tagore. He has already been engaged in research in India on the Sanskrit theory of music and the folk-music of India in 1925-29 and 1930-34.

READING.—Sir Samuel Hoare has been elected Chancellor of the University and will be installed on November 29.

ST. ANDREWS.—At a graduation ceremony on October 8 the honorary degree of LL.D. was conferred upon Dr. W. T. Calman, former president of the Linnean Society, and lately keeper of the Zoology Department of the British Museum (Natural History).

Societies and Academies

Paris

Academy of Sciences, August 9 (*C.R.*, 205, 345-380).

LOUIS DE BROGLIE: The quantification of the field in the theory of the photon.

PIERRE LEJAY: The general characters of the acceleration of gravity in the Levant. A map of the countries of the Levant under French mandate is given, showing the anomalies in the value of g .

CHARLES EDGAR WINN: Some reducibilities in the theory of charts.

LUBOMIR TCHAKALOFF: A problem of Laguerre and its generalizations.

RAYMOND JACQUESSON: The variations of the internal friction of solids under the influence of thermal and mechanical treatments. The influence of a traction.

SANTIAGO ANTUNEZ DE MAYOLO: The charge e of the electron and the materialization of the photon.

MME. IRÈNE MIHUL and CONSTANTIN MIHUL: The ionization of the lower part of the ionosphere. A theory is proposed based on the ionizing action of the sun varying with the latitude: this is regarded as explaining all the known facts.

JULES FARINEAU: The spectrographic study of the conductivity electrons in the alloys of magnesium and aluminium.

JEAN BERNAMONT and MICHEL MAGAT: A new method for separating isotopes.

ANDRÉ DEBIERNE and LAURENCE GOLDSTEIN: The new transformations produced at low temperatures (*frigadreactions*). Correction of an error of printing in note of August 2.

ALFRED REIS: The measurement of the angular domain of reflection of the X-rays in polycrystalline substances by a new statistical method.

JACQUES GILBERT: The indirect experimental verification of the logarithmic increase of wind velocity starting from the ground. The method is based on the quantity of hoar frost deposited on a vertical rod exposed to the wind.

MARCEL AVEL: Experiments on the role of the complex digestive tube plus non-cutaneous mesodermic tissues, in the regeneration of the head in worms.

LOUIS GALLIN: The masculinizing action of testosterone propionate in the differentiation of sex in *Rana temporaria*.

ALBERT PEYRON, BERNARD LAFAY and GUY POURCEAU-DEUILLE: The regression of the papillo-epithelioma of the rabbit (Shope's tumour) under the action of colchicine.

August 18 (*C.R.*, 205, 381-396).

MARTIN FRIEDER: The structure of the order of statistical series of the exponential type.

AUGUSTE GOSSEHIES: Study of the hydrolysis of solutions of cobalt chloride.

V. M. MITCHOVITCH and G. STEFANOVITCH: The reduction of glycerides by the Bouveault and Blanc method.

ROGER GUY WHIBNER: Cryptogamy and phyto-geography.

EMILE F. TERBOINE and MME. SIMONE SYNEPHIAS: The relative participation of the proteins and lipids in meeting the energy losses in starvation.

MME. DIGNA VAN STOLK and ROLAND LEROY: Folliculin and dihydrofolliculin in the urine of pregnant mares.

Rome

National Academy of the Lincei (*Atti*, 25, 75-100; 1937).

G. SANBONE: Cesaro's summability of the Laplace series.

B. FINZI: Propagation of movement in threads.

G. PROCARDI: Molecular spectra and spectroscopic analysis (6). Detection of samarium.

A. C. BLANCO: *Hippopotamus* fauna and palaeolithic industries in the deposits of the littoral grottoes of Monte Circeo. Grotto delle Capre (1). Grotto del Fossellone (2).

L. CALIFANO: Investigations on the glycolysis of the retina.

Atti, 25, 101-144; 1937.

G. ROVERBERO: New tectonic synthesis of the western Alps.

R. CALABRO: Systems of lines of a surface which are invariant with respect to a transformation for a W congruence.

I. POPA: Asymptotic transformations of oblique curves.

G. SASTINI: Translo-circulatory current in presence of an arc of circumference with an eccentric source.

O. ZANABONI: General proof of the principle of De Saint-Venant.

L. LABOCCETTA: Potential energy and curvature in gravitational fields.

A. LANDULLI and E. BOTTEI: Crystal structure of the compounds of the rare earths with the metalloids of the fifth group. Nitrides of lanthanum, cerium and praseodymium (2).

B. L. VANZETTI and P. DEHYFUS: Configuration of olivil and of iso-olivil.

F. CENDRANGOLO: Amilase activity of the adipose tissue.

A. CAVINATO: Valentinite from the Ballao mine.

Sydney

Royal Society of New South Wales, August 4.

T. G. ROOM: The virtual genus of a curve with a multiple point.

S. J. HAZLEWOOD, G. K. HUGHES, F. LIONS and others: Pyrroles derived from acetylacetone. The Paal-Knorr synthesis of pyrroles from amines and 1:4-diketones has been studied for acetylacetone, and 37 new N-substituted 2:5-dimethyl pyrroles described. Pyrroles could not be obtained from o-nitraniline, tribromaniline, methyl anthranilate or o-aminobenzamide. On the other hand, anthranilic acid reacts readily to form N-o-carboxyphenyl-2:5-dimethyl pyrrole. Methyl anthranilate also fails to form pyrroles with ethyl phenacylacetoacetate and with phenacylaevulinic acid.

G. K. HUGHES and F. LIONS: Derivatives of higher catechol ethers. Attempts to sulphonate catechol di-n-butyl ether led to dealkylation. Hence, some reactions of catechol di-n-butyl ether and catechol di-n-amyl ether have been studied in comparison with veratrole. The higher ethers and derivatives appear to behave normally except in presence of sulphuric acid or chlorosulphonic acid.

K. J. BALDIUK and F. LIONS: Derivatives of 6:7-dimethoxybenzoparathiasine. Treatment of 1-sulphydryl-3:4-dimethoxybenzene in alkaline solution with chloroacetic acid gives 3:4-dimethoxyphenylthioglycollic acid, which nitrates in cold glacial acetic acid to 2-nitro-4:5-dimethoxyphenylthioglycollic acid (I), but in the hot is converted into 2-nitro-4:5-dimethoxyphenylsulphoxide acetic acid (II). Both I and II can be oxidized to 2-nitro-4:5-dimethoxyphenylsulphone acetic acid (III). Reduction with tin and hydrochloric acid of I gives 3-ketodihydro-6:7-dimethoxybenzoparathiasine and of II gives 3-ketodihydro-6:7-dimethoxybenzoparasulphazone.

Tokyo

Imperial Academy (Proc., 8, No. 7, July 1937).

GUMMYO ONO: Subhakarasiṃha's Rta-saṃgraha. "Compendium of Truth" introduced into China by the Indian priest Subhakarasiṃha (716-735).

TADAO DOI: Researches in the Japanese language made by the Jesuit missionaries in the sixteenth and seventeenth centuries. Grammatical and lexicographical works showing the development of the language.

AKITSUGU KAWAGUCHI: Theory of connexions in a Kawaguchi space of higher order.

UNAI MINAMI: An extension of the Phragmén-Lindelöf's theorem.

SHIJI IRIE: A theorem of Beurling.

JIUCHI OBATA and RYUJI KOBAYASHI: A direct-reading pitch recorder and its applications to music and speech. Apart from recording simultaneously the intensity of sound and pitch variation in music and speech, it is suggested that the apparatus described can be used for industrial purposes, such as determining the number of revolutions of a rotating machine.

HANTEBO NAGAOKA and TSUNETO IKEDA: Magnetic variation during an explosion of Asamayama, and its mechanism. During the eruption of the volcano, magnetic disturbance, mechanism of explosion, tilts and role of water were studied.

NAOMI MIYABE: Results of re-levelling in Kyōto, Japan. During re-levelling, details of the chronic deformation which is taking place were examined.

TSUNESUKI KIMURA: An improvement on cyanin synthesis (mixed solvent process) and the reaction of orthothioformic ester. Several new trinucleo carbocyanins were synthesized by the mutual actions of orthothioformic ester with cycloammonium quaternary salts.

FUMIO HIRATA: Rigidity and constitution of a thermo-reversible gel.

YASUO TAZAWA: Splitting of glycol glutamine acid anhydride by means of crystalline trypsin.

IOHRO ITAKA: A new equilibrium diagram for the system Fe-C (see NATURE, 140, 462; 1937).

SANEHI IMAI: An edible Mongolian fungus, 'pai-mo-ku'. This proved to be a new species of the genus *Tricholoma*, and the name *T. mongolicum* Imai, sp. nov. is proposed.

YO K. OKADA and YOSHIKI MIKAMI: Inductive effect of tissues other than retina on the presumptive lens epithelium.

Forthcoming Events

Monday, October 18

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Arthur Hurst: Harveian Oration.

ROYAL GEOGRAPHICAL SOCIETY (in the Connaught Rooms), at 7.45.—Annual General Meeting.

Thursday, October 21

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Sir George Lee: Presidential Address.

Friday, October 22

BRITISH ASSOCIATION (at the Royal Institution), at 5.—The Right Hon. J. Ramsay MacDonald, F.R.S.: "Science and the Community" (Radford Mather Lecture).

PHYSICAL SOCIETY, at 5.15.—Guthrie Lecture.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir John Thornycroft: Presidential Address.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICER at the Forest Products Research Laboratory, Pinewood, Rickmansworth—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1 (October 30).

TECHNICAL OFFICER and ASSISTANT (grade III) for work in illuminating engineering at the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (October 23).

PERMANENT ASSISTANT (male—grade III, metallurgy) in the Admiralty Technical Pool—The Secretary of the Admiralty (O.B. Branch) (quote O.B. 7851187) (October 23).

RESEARCH OFFICER (grade III) in the Agricultural Economics Research Institute, University of Oxford—The Secretary of the Committee for Rural Economy, School of Rural Economy, Oxford (November 1).

DIRECTOR of the Institute for Research in Agricultural Engineering, University of Oxford—The Secretary of the Committee for Rural Economy, School of Rural Economy, Oxford (November 15).

TWO ASSISTANTS in the British East African Meteorological Service—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, S.W.1.

JUNIOR ASSISTANT for abstracting and library work at the Imperial Bureau of Fruit Production, East Malling, Kent—The Deputy Director.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 59: Variation in Thickness of the Tin Coating of Tinplate, and its Effect on Porosity. By W. H. Hoare. Pp. 11+22. (London: International Tin Research and Development Council.) Free. [309]

University of Leeds: Department of Leather Industries. Report of the Advisory Committee on the Work of the Department during the Seasons 1935-36 and 1936-37. Pp. 8. (Leeds: The University.) [110]

Colonial Office. A Summary of Legislation relating to the Introduction of Plants into the Colonial Dependencies of the British Empire as at the end of December 1936. (Colonial No. 141.) Pp. 65. (London: H.M. Stationery Office.) 1s. net. [410]

Institution of Mechanical Engineers. General Discussion on Lubrication and Lubricants. Group 1: Journal and Thrust Bearings. Pp. 300. 2s. 6d. Group 2: Engine Lubrication. Pp. 216. 2s. 6d. Group 3: Industrial Applications. Pp. 162. 2s. 6d. Group 4: Properties and Testing. Pp. 236. 2s. 6d. (London: Institution of Mechanical Engineers.) [410]

Other Countries

League of Nations. Report of the Committee for the Study of the Problem of Raw Materials. (Official No. A.37.1937.II.B.) Pp. 62. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. [399]

Bulletin of the National Research Council. No. 100: An Experimental Study of the Problem of Mitochondrial Radiation. By Alexander Hollaender and Walter D. Claus. Pp. 66. (Washington, D.C.: National Research Council.) 1 dollar. [289]

Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig. Zweite Serie: Spezialarbeiten aus dem Geophysikalischen Institut und Observatorium. Band 8, Heft 2: Thermische Untersuchungen in Waldfelschen. Von Johannes Herzog. Pp. 77-133. Band 8, Heft 3: Die Strömungen der Atmosphäre über Teneriffa. Von Fritz Müller. Pp. 133-180. Band 8, Heft 4: Beiträge zum Ozonproblem; Die Rolle des Ozons im Wärmeaustausch der Stratosphäre. Von Rudolf Penndorf. Pp. 181-286. Band 8, Heft 5: Messungen mit dem Bergmannschen Sichtmesser. Von Rudolf Stange. Pp. 287-340. Band 9, Heft 1: Stratosphärische Steuerung und Wellensteuerung. Von Karl Schmiedel. Pp. 103. Band 9, Heft 2: Stagerak-Zykklonen. Analysen der Wetterlagen vom 25-27 März 1936 und vom 2-4 März 1931. Von Hans Georg Machk. Pp. 103-218. Band 10, Anhang 1: Untersuchungen über die von Maschinen, Fahrzeugen und Wind hervorgerufenen Boden- und Gebäudeschütterungen nach Begleiterscheinungen eines Benioff-Vertikal-Seismographen. Von Gerhard Fritzsche. Pp. 82. (Leipzig: Geophysikalisches Institut der Universität.) [299]

Proceedings of the American Academy of Arts and Sciences. Vol. 72, No. 1: Postulates for American, Conjunction, Negation and Equality. By Edward V. Huntington. Pp. 44. 50 cents. Vol. 72, No. 2: Polymorphic Transitions of 35 Substances to 50,000 Kg/Cm². By P. W. Bridgman. Pp. 45-136. 1.45 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [299]

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 7: Student Health Services in Institutions of Higher Education. By Dr. James Frederick Rogers. Pp. v+61. 10 cents. Leaflet No. 84: State Library Agencies as Sources of Pictorial Material for Social Studies. By Miss G. Bathurst, Miss Katz and Edith A. Lathrop. Pp. 9. 5 cents. Pamphlet No. 72: Status of Rural-School Supervision in the United States in 1935-36. By W. H. Gammit. Pp. 11+20. 10 cents. Pamphlet No. 76: Safety and Health of the School Child; a Self-Survey of School Conditions and Activities. By Dr. James Frederick Rogers. Pp. 29. 10 cents. (Washington, D.C.: Government Printing Office.) [289]

U.S. Department of Agriculture. Miscellaneous Publication No. 251: A History of Agricultural Experimentation and Research in the United States, 1607-1925; including a History of the United States Department of Agriculture. By Alfred Charles True. Pp. vi+331. (Washington, D.C.: Government Printing Office.) 25 cents. [299]

Proceedings of the United States National Museum. Vol. 84, No. 3081: Observations on the Birds of West Virginia. By Alexander Wetmore. Pp. 401-443. (Washington, D.C.: Government Printing Office.) [299]

Smithsonian Miscellaneous Collections. Vol. 96, No. 4: Indian Sites below the Falls of the Rappahannock, Virginia. By David L. Bushnell, Jr. (Publication 3441.) Pp. v+65+21 plates. (Washington D.C.: Smithsonian Institution.) [299]

Carnegie Institution of Washington. Principles and Methods of Tree-Ring Analysis. By Waldo S. Hook. (Publication No. 486.) Pp. viii+100+14 plates. (Washington, D.C.: Carnegie Institution.) [110]

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 154: Notes on the Lift and Moment of a Plane Aerofoil which touches the Ground with its Trailing Edge. By Susumu Tomotaka and Isao Imai. Pp. 519-571. (Tôkyô: Kôkyô Toshô Kabushiki Kaisha.) 60 sen. [410]

Journal of the Indian Institute of Science. Vol. 20A, Part 1: Contributions to the Study of Splice Disease of Sandal (*Santalum album* Linn.). Part 17: Some Factors relating to the Abnormal Accumulation of Carbohydrates in Diseased Tissues. By A. V. Varadachari's Tyengar. Pp. 14. (Bangalore: Indian Institute of Science.) 1.3 rupees. [410]

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Lord Nuffield's New Gifts to Oxford

AN Oxford that had made up its mind not to be surprised by Lord Nuffield's almost daily giving to hospitals and other institutions was agreeably staggered last week to learn that the University had been offered by him approximately £1,300,000 for three important purposes. The first of these is the erection and endowment of wards in connexion with the Radcliffe Infirmary and the other hospitals associated with the School of Medicine, particularly the wards for the special use of the new Nuffield professors. The sum promised for this is £200,000, so that Lord Nuffield's endowment of the medical school within the past twelve months amounts to the munificent sum of £2,200,000. The second is the erection of the new laboratory of physical chemistry on a site between the Organic Chemistry Laboratory and the Department of Pathology in South Parks Road. For this a sum up to £100,000 is promised. The third and, to the general public, the most interesting, is the founding and endowment of a new college for post-graduate work in social studies, to be erected near Worcester College on the canal wharf that lies below St. Peter's Hall. For this, Lord Nuffield has given the valuable site itself, and a sum of about £900,000, about £250,000 of which will be required for the buildings.

The Oxford appeal launched last February aimed at £500,000 for definite and immediate needs, and a further £500,000 for the endowment of new developments in any subject that looks promising. It has now reached the sum of £423,000. As the physical chemistry laboratory is one of the immediate needs, this sum now becomes £523,000, and so as regards these needs the appeal has been successful. The first major step in the ordered development of the science area in the

Parks has accordingly been taken—to proceed with the erection of the new physics laboratory for Prof. F. A. Lindemann at a cost of about £80,000; and soon will follow the second, for which already provisional plans have been prepared—the erection and equipment of the University's first laboratory for physical chemistry with the sum given by Lord Nuffield, and the sums earmarked for it in the appeal fund.

The great majority of senior members of the University welcome these gifts as, of course, they deserve to be welcomed. A few complain that they will alter the character of the University considerably and, probably, for the worse; a few wish the offer had been entirely unconditional or, alternatively, that their own department or subject had been in the position of medicine, physical chemistry or social studies. As regards the last, it is realized that the success or failure of the new college will depend much on the start it gets and, in particular, on the first warden and fellows. A long and carefully drafted letter from Lord Nuffield to the Vice-Chancellor gives some ideas of the intended college and its fellows, and others have been got from some of the principal Oxford men who are concerned. The new college is to be mainly a post-graduate one, like All Souls', with accommodation for, say, fifty residents, and principally for research and investigation. It need not be entirely devoted to social studies; other subjects may be considered. It is not intended that it be a teaching institution in the ordinary sense or that it should train undergraduates for business careers, still less that it should be a place where the newly graduated may start to research according to their fancy. It is hoped that the fellows will be mature workers,

brought back after they have been out in the world for some years, to do large-scale team work on those social subjects on which research is urgently needed. The new college, it is hoped, will not merely be a centre for these activities in economics, politics, anthropology, sociology and the like, but also a place where men of business and affairs, by residing there, will have an opportunity of contributing their experience to the common fund. This co-operation of academic and

non-academic persons in attacking problems in the social sciences is regarded as valuable by those who, with Lord Nuffield and the Vice-Chancellor, have been thinking of the welfare of the new college. It remains to be seen how Oxford makes use of these gifts, which bring, of course, their difficulties and responsibilities with them. That it will rise to the occasion no one who knows the temper of young Oxford at the present time will question.

African Agricultural Problems

(1) *Moisture and Farming in South Africa*
By W. R. Thompson. (South African Agricultural Series, Vol. 14.) Pp. 260. (Johannesburg: Central News Agency, Ltd; London: Gordon and Gotch, Ltd., 1936.) 21s.

(2) *The Earth Goddess: a Study of Native Farming on the West African Coast*. By G. Howard Jones. (Royal Empire Society Imperial Studies, No. 12.) (Published for the Royal Empire Society.) Pp. xii + 206 + 8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 12s. 6d. net.

THE great diversity of African agricultural problems is well illustrated by these two volumes. In South Africa moisture dominates the situation, and, on the west coast, anthropology

(1) Mr. Thompson has assiduously collected a mass of information on the alleged drying up of South Africa and has critically examined the numerous explanations that have been advanced. They include the drying up of the inland Kalahari lakes, by head-stream erosion of rivers discharging into the ocean; the substitution of indigenous vegetation by exotic types such as wattle and eucalyptus with higher transpiration coefficients; the destruction of natural vegetal cover by veld burning, and the increase in cultivated crops, both of which are alleged to lead to increased evaporation from the soil and to erosion; and finally, the gradual rising of the earth's crust in South Africa, which in effect lowers the water-table and accelerates the run-off as the rivers cut deeper and deeper.

With the obvious exception of the last, all these theories predict a suitable remedy. The most widely known is Schwarz's scheme for greatly increasing the area of the inland lakes by dams across rivers that now drain the area. Although

Mr. Thompson patiently and fairly discusses this and rival proposals, he points out that discussion is somewhat academic unless the country is really drying up. He has examined this crucial question in great detail and can find no convincing evidence for the allegation. It is, in fact, the old story: the abnormal is noted and the account preserved just because it is unusual; and, in course of time, a series of such records presents a superficial appearance of normality to the uncritical mind. It seems clear that the popular idea that South Africa is drying up is not based on any evidence of change during historic times, but is an erroneous deduction from the peculiar meteorological conditions of the country. These may be summarized as follows: only 35 per cent of the surface receives more than 24 inches of rain annually; the total rainfall is variable, its distribution is unreliable, and it is markedly seasonal; the intensity is high and evaporation losses are heavy especially in summer-rainfall areas; the run-off is also high.

Evidently, rainfall imposes limitations on South African agriculture; droughts are common and losses severe. The cultivated land is also liable to extensive erosion, and Mr. Thompson discusses its increased incidence following more intensive farming practices, and urges the paramount importance of control measures, lest South Africa should follow the same unhappy path as other countries. No visitor to the country can fail to understand the concern that is felt about erosion dangers, for, whether he travels north from the Cape to Rhodesia, or east to Natal, the signs of drastic erosion are written large in those unique and beautiful panoramas that make a visit so memorable. The main strokes of this giant chisel cannot be stayed or altered; but the surfaces it leaves can be smoothed by the prevention of sheet erosion and gulleying on cultivated and

grazing land, and by the control of veld burning. Veld burning is a very old practice, and although at first sight indefensible is considered by responsible authorities to possess advantages that justify its judicious use as a part of veld management. It is often the only economical way of removing old fibrous vegetation of low feeding value; moreover, unburned veld often deteriorates after an extended rest.*

Mr. Thompson supports the conclusions from his survey by data from his own experiments on transpiration, evaporation and erosion. These experiments would well repay further examination and separate development by soil physicists. Although the author stresses the tentative character of his conclusions, they carry conviction in all essentials. Farmers are now more numerous and farms are smaller; the present-day farmers are anchored to their land; they can no longer move their stock elsewhere during droughts as was possible only fifty years ago; the farming system must be adapted to the climatic conditions of the area instead of gambling on occasional good seasons; and finally, as efficient a vegetal cover as the climatic conditions allow must be maintained. The last point is most important, and one on which much more research is imperatively needed.

The book can be confidently recommended not only to agricultural scientists but also to the public, for it deals with matters that have a wide appeal. A more flexible style, an astute publisher to provide the right 'blurb', and it might easily have ranked with certain dissertations on relativity and the more speculative portions of astronomy as a best-seller.

(2) Mr. Thompson fluked his shot close to the bull; Mr. Howard Jones seems to have taken deliberate aim, but his score looks suspiciously like an outer. There are signs that the hope for popular success was at the back of his mind. The chapters have been forced into a musical analogy: the themes of the fugue; a digression on scale; the full-score fugue; a recital. The device is rather pointless and mildly irritating in its inevitable suggestion of pretentiousness. Two or three of the illustrations would be better omitted, and the absence of any photographs of native agriculture requires comment. The long account of rural organization in Denmark is unnecessary: as strong drink is to the dipsomaniac, so is the admittedly great achievement of the Danes to most amateur—and not a few professional—economists. The book would have been far better for a more objective treatment. The facts are interesting enough to speak for themselves, and wherever the author lets them do so, he holds the reader's attention.

Mr. Jones is a mycologist but, wisely, does not wish to work only in the narrow rut of a specialist. His book is a record of five years' experience of the agriculture of the west coast of Africa. There is an interesting if somewhat discursive opening chapter on Ala, the earth goddess, and the pervading influence of religious beliefs on the agricultural practices of the natives.

The author shows that much of what European observers would rightly classify as careless or worse, is explicable on historical and social grounds. The oil palm provides an excellent example. It has always been a standby of the native, providing oil, wine, kernels, thatch, string and ornaments, and in addition, now provides the main export revenue. So long as the West Coast had a monopoly of palm oil and kernels, the wasteful native methods of extraction did not matter. But a new standard has been set up by modern extraction factories elsewhere and, so far, the West Coast has not responded to this dangerous competition, mainly because of an overriding social problem. The present practice is that the men extract the oil from the fruit, and the women have the nuts, which they crack as a spare time job, selling the kernels for pin money; but the factory requires the complete fruit, so the men would receive all the money and the women nothing. That, as Mr. Jones says, would mean the destruction of a simple automatic system of domestic economy. When difficulties like these have to be met, the gospel of economic efficiency that is based on the standards of European industrial civilization loses most of its force and all its attraction.

Mr. Jones is at his best in discussing the immediate future of West Coast agriculture. He believes the planter system, and *métayage*, in which landlord and tenant each take an agreed share of the crop, to be less suitable than peasant farming. Although the nucleus of peasant farming already exists, the author recognizes and discusses the obstacles that must be removed to put it on an effective basis. Co-operation, the provision of credit facilities, education for the children, and the great difficulty of finding men who can combine the power of leadership with an understanding of the native outlook, are only a few of the problems. But the author believes that the choice of method in tackling the problems is as important as the problems themselves. He would impose a minimum of the direct methods which European administrators and technicians naturally adopt. The direct method is easier and will produce more material advance in a given time; the indirect course is slower, more difficult, and has only one virtue: it will take the people along their own natural road to the goal. B. A. KENN.

Conditioned Reflexes and Psychology

Pavlov and his School: the Theory of Conditioned Reflexes

By Prof. Y. P. Frolov. Translated from the Russian by C. P. Dutt. Pp. xix + 291 + 16 plates. (London: Kegan Paul and Co., Ltd., 1937.) 12s. 6d. net.

FEW physiologists can read Russian, and most of them have to depend for their knowledge of Pavlov's work on reviews and summaries published in other languages. Two comprehensive books in English on conditioned reflexes were published in 1927 and 1928, and since then most of us have had to depend on scattered sources of information. The new book by Prof. Frolov is welcome because it gives a general review of the subject up to the time of Pavlov's death. We are indebted to C. P. Dutt for the English translation.

Compared with previous works it is short, and it is attractively produced, containing 26 illustrations and an account of Pavlov's life and methods of work. The author first met Pavlov in 1911, became a disciple, and himself made discoveries about conditioned reflexes. The book is written in a spirit of reverence for the master, whose methods are always right because they are always "physiological". These methods led to conclusions which did not always agree with the conclusions reached by those whose methods were not physiological, and it is evident that in the last ten years Pavlov devoted much thought to the relationship between his own conclusions and those of Freud, Kretschmer, Köhler and others. Pavlov recognized that many of Freud's results were similar to his own, and sometimes found Freud's conclusions helpful in the interpretation of his own results. He created a complex in a dog's brain, which was made to concentrate for two years on problems connected with a metronome and a trumpet. This complex interfered with the dog's subsequent reaction to a sound produced by a telephone receiver, which appears to have become symbolic of the trumpet. The complex was eventually cured, as Freud would have cured it, by a return to the trumpet. On the other hand, "the Ego and the Id . . . encountered the most energetic resistance and rejection on the part of Pavlov".

"Kretschmer's classification of nervous types, which has obtained almost universal recognition, especially among psychiatrists, must be regarded as mistaken or inadequate." Pavlov's classification, which is based on an experience of many thousands of dogs, is more complicated, but is

probably a closer approximation to the truth. Dogs are either strong or weak according to the ease with which they develop reflexes; they are either excitable, balanced, or inhibitable according to the relative strengths of excitation and internal inhibition; and both excitation and inhibition may be either labile or inert according to the ease with which they can be modified. This gives twenty-four possible types. This classification corresponds in some ways with that of Hippocrates. The choleric temperament is excitable, the melancholic inhibitable. The sanguine temperament is strong, balanced and labile, the phlegmatic strong, balanced and inert. The strong excitable type and the weak type were found to be particularly liable to pathological disturbances. These two types are thought to correspond to Kretschmer's manic-depressive and schizophrenic types.

Köhler's experiments with anthropoid apes have been repeated, and largely confirmed, in Russia, but his conclusions are "far from the order of thought of Pavlov". Tantalizingly, Frolov gives no details of Pavlov's interpretation of these results, but contents himself with the statement that it is essentially different from, and at the same time simpler than, Köhler's interpretation. Further discussion of this point would presumably have thrown light on what seems to many to be the chief obstacle to those who seek to explain all behaviour in terms of reflexes—the question of intelligent behaviour. This question is briefly discussed in another part of the book. A dog which had been fed whenever its paw was held in a slightly flexed position not only developed a salivary response to the proprioceptive sensation of having a flexed paw, but also deliberately flexed its paw when it saw the experimenter. This response is attributed to the establishment of a well-beaten track from the proprioceptive area of the cortex to the food centre along which impulses eventually pass in the reverse direction so that excitation of the food centre causes movement. When flexure of the paw was followed by the pouring of acid into the dog's mouth, the sight of the experimenter caused extension of the paw. Frolov gives no clear explanation of these facts, and his statement that as a result of these experiments "the mechanism of voluntary movement, at any rate in animals, was for the first time clearly revealed", is unconvincing.

It is possible that the reinforcement of the action which has been followed by food is comparable with the development of reaction in a

circuit containing a thermo-electric valve. In the electric model the amplified electric changes are reintroduced to the valve, and so travel round a circuit, being amplified again and again. In the same way one might suppose that the excitation of the food centre by the presence of the experimenter causes a sub-threshold excitation which spreads over the whole cortex. When this excitation reaches the area corresponding to the movement which has been followed by food, the conditioned reflex increases the excitation of the food centre, and this excitation then reinforces the excitation of the centre corresponding to the appropriate movement because that centre is

already excited. The impulses thus travel round a circuit until the excitation rises above its threshold value in the motor centre, and the appropriate movement is made. In order to explain the response to acid, one might suppose that the presence of an experimenter who was accustomed to place acid in the dog's mouth excited a defence centre which, besides causing salivation and other defence actions, caused sub-threshold inhibition to spread over the cortex, and to be reinforced in the same way as the excitation spreading from the food centre. Such a mechanism would account for a great variety of intelligent actions.

J. H. GADDUM.

The Science of Astrology

Dekane und Dekansternbilder :

ein Beitrag zur Geschichte der Sternbilder der Kulturvölker. Von Wilhelm Gundel. Mit einer Untersuchung über die Ägyptischen Sternbilder und Gottheiten der Dekane, von S. Schott. (Studien der Bibliothek Warburg, herausgegeben von Fritz Saxl, Band 19.) Pp. x + 452 + 33 plates. (Glückstadt und Hamburg : J. J. Augustin, 1936.)

IN the Warburg Library, still all too little known, London has an important centre of curious learning. Great erudition backed by ample means went to the making of it. Dr. Warburg's hobby was to study the countless survivals of ancient religion in modern faith and symbolism, and his great library grew up around this fine farrago of learning. The library is organized and arranged with exceptional skill, its doors stand open to every scholar, and its books are only waiting to be read. It publishes studies of its own under the general editorship of the learned librarian, Dr. F. Saxl, and one of these, a volume of more than four hundred pages, lies before us. It is by a well-known student of ancient astronomy, Dr. Wilhelm Gundel of Giessen, and it deals with the 'decans' and their stars, a subject dear to the heart of the founder of the Library.

What is a 'decan' ? When the year (of 360 days) had been divided into its twelve months and put under the zodiacal signs, each of the twelve was again divided into three parts, of ten days each ; and these thirty-six 'decans' had their thirty-six gods, or rulers, or dynasts, watchers of the hours ('horoscopes'), servants or messengers of the greater gods, or of Horus himself in his holy name spelled with thirty-six letters ; each had his own 'face' or *ἑσώπρυον*, which might chance to be

(in Egypt) the face of a bull or of an ibis, or of an eagle or of a man. These were the angels and archangels, - the demons and archi-demons, of Hellenistic writers. Each had his own name ; in mummy-cases and papyri, in obscure and fragmentary works like *Hermes Trismegistus* or the *Testimonium Salomonis*, in Celsus and Firmicus, in the traditionary learning of men like Kircher, Salmasius or Scaliger, we find the names of Chont-har, Chont-chre, Siket, and the thirty-three others, in all kinds of variants and corruptions. Egyptian they were in the beginning, but the true form and meaning of many are long lost. These names form a large part of astrognostic science, but they are very hard to discover ; for the simple reason that the demon had to do the bidding of whomever called him by his name, and he took great pains to hide it !

The decans play their part in every aspect of astrology. A man's body, always a microcosm of the heavenly body, had its thirty-six parts each under the governance of its god or demon, and the knowledge of these formed the science of iatro-astrology. The decans had their place in magic and in prophecy ; they ruled the weather, and it was in the first decan of the year that Sirius brought about the inundation of the Nile ; heaven itself was divided into thirty-six regions, and earth, once again a microcosm, had its corresponding mystical geography. A man's life was ruled by his 'horoscope', for in the instant of his birth he assumed the qualities and came under the rule and guidance of the god or demon of his decan : as Manilius has it, *cujus signi quis parte creatur, Eius habet mores atque illo nascitur astro*.

Nothing can be more unlike what we now call science ; but almost all our science is but of

yesterday, and this astrology occupied the minds of men of learning for some four thousand years. Scaliger was an astrologer in his younger days, and was the last of the great scholarly astrologers; for astrology came at last to its death-bed, in the century of Galileo and of Newton. There must be many a thing in antiquity which we should all the better understand with some help from a science so ancient and so universal; and every now and then the study of the decans throws light into strange and unexpected places. There can be little doubt (and I have none) that these rulers of the decans are no other than the genii or daemons in whom Socrates so firmly believed, whom "God, in His love of mankind, placed over us to take care of us and give us peace"—words which recall still more familiar words, "He shall give His angels charge concerning thee".

We know the story well of the man whose child

was lunatic and sore vexed, and how the devil threw him down and tore him. "Sometimes he falleth into the fire, and often into the water"; and just so we read in the astrological texts that the demon of the seventeenth decan would lay hold of a man in his bath, or cast him to the ground. It happens that this decan was associated with Thoth, as a moon-god, and we know that the epilepsy from which the child suffered was a 'lunacy', or moon-disease. Jesus rebuked the devil, and he departed out of him. "He was of a kind that goeth not out but by prayer and fasting"—that is to say, by the appropriate formula and the ascetic life of the exorcist.

Dr. Gundel has written an admirable book, beautifully illustrated. It will take its place by Bouché-Leclercq's "*Astrologie Grecque*", and a few other similar works of exceptional learning.

D. W. T.

The Theory of Metals

The Theory of Metals:

based on an Essay awarded the Adams Prize in the University of Cambridge, 1931-1932. By A. H. Wilson. Pp. viii + 272. (Cambridge: At the University Press, 1936.) 18s. net.

THIS careful study of the electron theory of metals is intended in the first instance as a critical survey of the general principles of the theory and of the approximations made in working out its applications. No attempt is therefore made to give a full account of the applications of the theory to individual metals, and such applications as are given serve as illustrations for the use of the general methods.

Such a critical investigation is highly desirable in a field in which, owing to mathematical complications, one could until quite recently find different results derived by different authors from the same assumptions. Mr. Wilson's book was awarded the Adams Prize for 1931-32, but it has been brought up to date by taking into account a great deal of literature published since then.

The book starts with a historical introduction, giving an outline of the old Lorentz-Drude theory of metals, together with Sommerfeld's theory, which is based on Fermi statistics and free electrons. This chapter also contains a commendably clear definition of the notion of a 'mean free path', and it is made quite clear that a mean free path in this sense need not in every case exist.

Chapter ii discusses the influence of the periodic field of force on the motion of the electrons, while

the following chapter deals with the applications of this general theory to equilibrium properties of metals, such as the electronic specific heat, the distinction between metals, semi-conductors and insulators, cohesion forces, magnetic properties and the like. The optical properties are separately treated in chapter iv, while chapter v treats the electric and thermal conduction on the assumption that a mean free path exists. For simplicity it is further assumed that the mean free path is independent of the energy. While this simplification is unimportant for most of the formulæ obtained, it is of considerable importance in the formulæ for the thermo-electric coefficients, and it is regrettable, therefore, that it was not stated explicitly.

The main question as to the existence of a mean free path and its order of magnitude is taken up in chapter vi. It is made clear why a mean free path exists at temperatures above the Debye temperature θ of the crystal lattice and that it does not exist for lower temperatures. The usual methods for calculating the mean free path at high temperatures and the electric and thermal conductivities at low temperatures are summarized and their validity is discussed. On this point, Mr. Wilson is (one may hope, unduly) pessimistic. He finds an objection to the usual Bloch calculation of the conductivity at low temperatures and shows that a more rigorous calculation would not lead to reasonable results for the conductivity if one retains the assumption that the electrons in the metal are very nearly free. He thus concludes

that this assumption ought to be abandoned, but he is very reluctant to do so, because this would mean abandoning many calculations which have led to results in good agreement with experiment. One may hope, however, that these calculations depend less on the assumption of free electrons than it would appear; the results that are confirmed by experiments are mostly qualitative, and one may hope that they can be reproduced without making use of that assumption. However, that is a point at present unsettled, and even a reader who does not share Mr. Wilson's pessimism as to the future fate of the theory will find his account of the existing theory of low-temperature conductivity clear and correct.

The last chapter gives an account of superconductivity, a field in which there is little theory

to report upon, except for thermodynamical relations. These are derived, together with a brief description of the experimental facts. An appendix contains two derivations of the fundamental formulae of Fermi-Dirac statistics and a discussion of surface phenomena such as thermionic and cold emission and contact rectifiers.

The treatment throughout the book approaches more closely to rigour in the mathematical sense than most other physical monographs. It is likely to provide, therefore, a pleasant change for the more mathematically-minded reader, while in general it gives enough of the physical argument to be understandable to the physicist.

A list of symbols and a very complete subject index are very helpful for reference to special points.
R. P.

Gem-Stones

The Story of the Gems:

a Popular Handbook. By Herbert P. Whitlock. Pp. vi + 206 + 34 plates. (London and New York: Putnam and Co., Ltd., 1937.) 15s. net.

AS the title and sub-title sufficiently indicate, this new book on gem-stones has not been written for the student or specialist but primarily for the ordinary man and woman. The author has been for many years curator of minerals and gems in the American Museum of Natural History, and his experience in that position has helped him to realize the type of information about gems that is most desired by the intelligent layman. The book thus touches only very lightly on the scientific aspects of the subject, and there are none of the explanatory chapters on crystal form, hardness, refraction, etc., which are usually to be found in even elementary texts.

In the introduction, however, brief instructions are given for the measurement of specific gravity by the hydrostatic and pyknometer (here curiously misspelt 'plermometer') methods, and for the detection of double refraction in faceted stones with no apparatus beyond a white card or a pocket lens. Only American gemmologists seem to mention the sunlight-and-card test for double refraction—possibly because in the United States sunlight is a less fugitive commodity than in north-west Europe. Since, however, not only sunlight but any beam of parallel light can be made to serve, this simple and sensitive test merits wider recognition over here. It would have been well also to include the Mohs scale of hardness, since an acquaintance with this is assumed in the many references to hardness later in the book.

The main part of the book opens with a chapter on the antique use of gems, followed by an interesting and unusually full account of the cutting and fashioning of diamond and other stones, illustrated with line drawings and photographs. This is probably the most valuable part of the book.

The remainder of the volume is mainly occupied with descriptions of the various mineral species used as gems, starting, as usual, with diamond, and ending with chapters on opaque and ornamental stones and on 'unusual' gems. The treatment accorded to some of the more important gem-stones is decidedly meagre—ruby, spinel, and zircon, for example, receive an allotment of barely two pages apiece.

Simple means by which stones of similar appearance may be distinguished from one another are in most cases indicated in the appropriate context.

A list of books on gems (in which Eppeler's "Edelsteine und Schmucksteine" and Spencer's "A Key to Precious Stones" should certainly have been included), and descriptive tables giving the composition, chief localities and characteristics (except refractive index) for each species in alphabetical order conclude the book. An index is provided.

The work is copiously illustrated from photographs of gems and carved objects from the Morgan collection and there is a double frontispiece in colour of cut specimens to which frequent reference is made in the text. Though not entirely free from small errors and omissions, it provides a well-written and extremely readable account of the subject, and should help to spread a knowledge and love of gems among the general public.

B. W. A.

Temperatur, Salzgehalt und Dichte an der Oberfläche des atlantischen Ozeans

Lief. 1: Das Beobachtungsmaterial und seine Aufbereitung. Von Günther Bohncke. Pp. iii+186. 27 gold marks. Atlas. Pp. vii+74 plates. 37 gold marks. (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925-1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft, von A. Defant, Band 5.) (Berlin und Leipzig: Walter de Gruyter und Co., 1936.)

THE temperatures on which this work is founded were observed for the larger part by merchant ships. A very large proportion were collected and partly worked up by the Royal Netherlands Meteorological Institute; the Danish Meteorological Institute, the German Seewarte and the charts published by the Meteorological Office in London with the reports of various expeditions were the sources of other material. For the area from 50° N. to the Antarctic, about 1,400,000 observations were used. The observations of salinity available were so few that it was necessary to use the earlier ones made with the hydrometer; a table of sources gives the method by which they were reduced to modern standards. This table contains 176 entries, some of which cover many ships, and should be useful for reference. The chief table gives the mean temperature and salinity for each month and one-degree square.

The results are not discussed in any way, but are shown in an atlas of beautifully printed charts. There are four charts in black and white showing the distribution of the observations, then follow thirteen in colour giving the mean temperature for the year and each month. Other charts show anomalies and yearly range. Observations of salinity are too few to allow of charts of mean values being drawn for the whole ocean for periods less than three months, but monthly charts for the North Atlantic Ocean are included. There are also charts showing anomalies and times of maximum and minimum, with a complete set for surface density.

These two volumes make an extremely valuable work of reference, and there are few questions as to the surface temperature and salinity which could not be answered by their aid.

The Chemistry of Natural Products related to Phenanthrene

By Prof. L. F. Fieser. (American Chemical Society Monograph Series, No. 70.) Second edition, with Appendix. Pp. xiv+456. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 35s. net.

A REVIEW of the first edition of this important treatise appeared in *NATURE* last year, and already a second edition has become necessary. The opportunity has been taken to add a 90-page survey of relevant papers of 1936, each referred to its appropriate context. The appendix with the revised index may be obtained separately, so that the first edition is not devaluated. The wisdom of adding so large an appendix is doubtful, since abstracts of the three

hundred papers cited are available, but references to certain real advances of 1936 could not well have been omitted. Several simple carcinogenic compounds, notably *o*-aminoozotoluene, have been discovered, and the range of oestrogenic substances has been considerably extended. The animal organism has been found to synthesize polyterpenes; and the first chemical transformation of cholesterol to a natural bile-acid has been realized. Outstanding has been the isolation of natural vitamin D and its identification with the irradiation product of 7-dehydrocholesterol. Certain crystalline substances from the adrenal cortex have been found to possess close structural relationship to the sterols. Moreover, the year has witnessed steady increase in knowledge of the stereochemistry of the sterols and sex hormones, and of the structures of the cardiac glycosides.

(1) *Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance* By Arthur W. Judge. (Motor Manuals, Vol. 1.) Third and revised edition. Pp. 301. 5s. net.

(2) *Car Maintenance and Repair* By Arthur W. Judge. (Motor Manuals, Vol. 4.) Second edition. Pp. xii+283. 4s. net.

(3) *The Electrical Equipment and Automobiles: a Book on Principles for Motor Mechanics and Motorists.* By Prof. Stanley Parker Smith. Third edition, revised and enlarged. Pp. xii+250. 6s. net. (London: Chapman and Hall, Ltd., 1936-37.)

(1) MR. JUDGE presents the elementary principles of the petrol engine together with a comprehensive description of the various types used in automobiles. A chapter is devoted to the heavy oil engine, and considerable space is given to the lubrication, cooling and testing of petrol engines of all types. The text of the book is well written and adequately illustrated, and the subject-matter has been made interesting by a judicious and versatile selection of examples from modern British practice.

(2) The text of this book is clearly presented, with some 200 useful diagrams, and forms a good introduction to garage technique for the motor-car owner who desires to carry out much of his own maintenance work. The scope of the book is necessarily limited to one or two types of motor-car, and from some points of view it may be considered that the book is intended to be merely supplementary to the appropriate illustrated handbook usually supplied by the motor-car manufacturer with each model sold.

(3) This is the third edition of a book written primarily for students undergoing a course of instruction in the principles and practice of motor-car engineering. The book has been thoroughly revised and considerably enlarged in order to include the extended application which electricity now plays in the modern motor-car. It is comprehensive and thoroughly reliable, and it should prove valuable to the motorist who takes an intelligent interest in his car, as well as to the class of student for whom it was written.

In the Realm of Mind:

Nine Chapters on the Applications and Implications of Psychology. By Dr. Charles S. Myers. Pp. v+251. (Cambridge: At the University Press, 1937.) 7s. 6d. net.

THE appearance of a further volume of semi-popular papers on psychological subjects by Dr. C. S. Myers, just before the recent meeting of the British Association, was an inevitable reminder of the part he has played in securing the recognition of psychology as one of the sciences. As far back as 1913, it was so recognized by the British Association to the extent of its being made a sub-section under physiology. Not until 1920 was it accorded the rank of a section, and from 1922 to 1931 Dr. Myers was president of that Section.

It is fortunate for a subject which has been called—even by one of its distinguished representatives—no science but only the hope of a science, that so true a man of science as Dr. Myers has had a large share in guiding its destinies. His great work, not only as an experimental psychologist, but also as our national leader in the practical application of psychology to industrial and other problems, is too well known to call for special remark in this place. Readers of his former volume entitled "A Psychologist's Point of View" will not be likely to miss this new collection of papers. They cover a variety of topics—the choice of a career, the human factor in accidents, medical education, social psychology, internationalism, psychological conceptions in other sciences, and the nature of mind. But all this variety is consistent with a unity which comes of a common point of view. This is just the kind of book and just the kind of treatment calculated to convince any reasonable person that psychology is unquestionably a science.

(1) *Biochemistry Applied to Malting and Brewing*. By Prof. R. H. Hopkins and B. Krause. Pp. 342. (London: George Allen and Unwin, Ltd., 1937.) 12s. 6d. net.

(2) *Practical Management of Pure Yeast: the Application and Examination of Brewery, Distillery and Wine Yeasts*. By Alfred Jørgensen. Third edition, revised by Albert Hansen. Pp. xii+111. (London: Charles Griffin and Co., Ltd., 1936.) 6s.

MANY famous names in the past have established the tradition that chemical research is an essential part of brewing practice. It is desirable, therefore, that a proper training in biochemistry should form the basis of the education of the would-be brewer and that the text-books available for the students be of high standard.

(1) The book under notice is largely a translation from the Danish of a book by Krause to which Prof. Hopkins has given an English aspect. It falls into two sections—one chemical, the other largely practical. The former is on the whole unsatisfactory, though the difficulty of compressing the necessary chemistry into a few pages must be allowed for. Probably it is best to separate the two subjects and

teach the student his chemistry on orthodox lines. The more practical portion written by a man who knows his subject is excellent: the work should prove useful.

(2) In the yeast field the name of Jørgensen of Copenhagen stands high: no one has done more for the subject in practice and as a teacher. A third edition of his little practical handbook, revised by A. Hansen, is assured of a welcome.

Military Engineering

Vol. 6: *Water Supply*. (War Office.) Pp. 421+171 plates. (London: H.M. Stationery Office, 1937.) 10s. net.

THIS volume on water supply, issued as a manual by the War Office, is a comprehensive survey of the subject in which, naturally, predominance is assigned to those aspects of the matter which affect military operations. At the same time a very useful summary is given of general principles, and the essential facts relating to water supply, whether civil or military, are set out with commendable directness and precision. There are fifteen chapters, covering water supply requirements; reconnaissance of sources and measurements of yield; well-sinking and -boring; reciprocating and centrifugal pumps; water elevators and pumping by compressed air; selection, installation and operation of pumping plant; storage; water analysis; principles of water purification; water purification practice; distributing systems, water points and water transport; field supplies during mobile operations; field supplies during protracted operations; water supply calculations and examples of camp supplies. A number of tables, plates and figures, with seven appendixes and an index, help to make up a very serviceable manual for general use.

In the compilation within reasonable limits of such a variety of information, there is naturally scope for difference of opinion on certain points, such as the statement on p. 42 that "in searching for suitable sites for shallow wells and tube wells, the employment of dowzers, or water diviners, may save time and possibly fruitless labour in well sinking". B. C.

Health and a Day:

Addresses. By Lord Horder. Pp. viii+213. (London: J. M. Dent and Sons, Ltd., 1937.) 7s. 6d. net.

THIS volume consists of twelve addresses delivered during the last two years before medical and lay audiences in Great Britain and the United States. Six of the addresses were given before medical gatherings, but only two, entitled "The Clinician's Function in Medicine" and "Direct Action in Medicine", were specially intended for the medical profession. Other addresses deal with the strain of modern civilization, the doctor as humanist, the doctor's place in society, the Hunterian tradition, national health, old diseases and new, and euthanasia. Although several of the addresses have been published before, the pleasant conversational style, and the eminently sane opinions expressed by one of the most distinguished London physicians, should secure for the work a wide circle of readers.

Tendencies of World Power Development

By Dr. E. F. Armstrong, F.R.S.

IN the modern world the question of natural power supply becomes more and more important. There is the tendency, not by any means confined to power alone, to exploit national resources and to make these available even if they are uneconomic. Power resources are of two kinds: those which are limited, including coal, oil, natural gas, peat, oil-shale; and those which are perpetually renewed, such as water, wood, wind or even the tides. A recent analysis shows that for 1935 the world power supply consisted of 56.6 per cent coal, 3.7 per cent lignite, 16.5 per cent oil, 3.8 per cent natural gas, 12.8 per cent firewood, 6.6 per cent water.

The proportion derived from coal has been stationary over the last four years, but has gone back materially since 1913; that from oil and water has increased. The consumers of power take little heed that these resources are limited, and the less wasteful use of recent years has been in the main imposed by increasing cost. Modern technique does aim constantly at a reduction of the amount of power used per product or per working unit, a factor which must tend towards a decline in the total consumption of power unless the trend of general industrial development is upward. This growth will determine in the future whether the production and consumption of fuel will rise slowly or rapidly.

In Great Britain during the last twenty-five years the gas industry has increased its yield of gas per ton of coal by more than 27 per cent: it is unlikely, however, that this figure will improve further. In the electrical industry the increase has been more than 130 per cent per unit of weight: substantial technical economies and improvements are being effected. The chief cause of the decrease in home consumption of coal is shown by the statistics to be due to the diminished use in blast furnaces and steelworks owing to more efficient methods of production. The coke consumption per ton of pig iron actually stood still for forty years at 40 cwt. per ton—to-day it is down to 33 cwt. per ton of pig. For steel the corresponding figures are a fall from 37.8 cwt. in 1920 to about 21 cwt. to-day. There is still more to be done in this direction in almost every industry; moreover, the change will be accelerated by the largely increased price of coal.

There are thus strong reasons for a decline in consumption of coal even with accelerated industrial development.

Actually the protection of oil and coal resources will first be attained when these materials cease to be squandered and are used only in the form of 'residual products' after more or less extensive chemical changes.

Coal resources are variously estimated as lasting some hundreds or even thousands of years; the mineral is becoming increasingly costly to mine. Oil resources at the present rate of consumption are given only a very short life. Water resources are in a sense inexhaustible, but it must be remembered that in the more advanced countries the most accessible falls are already developed, and that in consequence every expansion of water-power meets with more unfavourable conditions and therefore involves high costs of development. About 35 per cent of the total electric current generated is hydro-electric.

It is difficult to say in assessing the competition between coal and water-power which of the two is the cheaper: this largely depends on the continuity of the load. It is stated, for example, that the kilowatt hours produced in steam plants or water plants cost the same on an average yearly performance of 3,000 hours, water-power being cheaper above and steam-power being cheaper below this factor. The most satisfactory modern development aims at establishing a combined use of water-power and steam-power: it is preferable to use them to supplement one another rather than in competition. There is still ample water-power available in the world, only 55 million h.p. being so far developed out of 470 million h.p. available. One of the factors with electricity produced by water-power in remote places is its economic transportation with a minimum of loss to the point where it is used. Should industry, however, be thrown back more largely on water-power, it would mean a transference of manufacturing plants to countries or localities where this is available. For this reason, there are many who regard Canada as having great potentialities as a manufacturing country.

Oil competes with coal for motoring and for the aeroplane, both new uses for which there is no alternative source of power, and for shipping—this last turnover constituting a serious loss to coal. Its use for transportation and general purposes is regionally limited. The development of the competition is influenced far more by the price of oil derivatives than by that of crude oil, and it appears likely that the advance in the use of

synthetic oils having special and valuable properties will in the long run involve their production from coal even at a higher cost. The purely economic point of view alone will not be sufficient to prevent this development as it does to-day—military, political and fiscal points of view are likely in the near future to make the advent of oil from coal nearer than is generally believed.

Whereas in the United States coal only makes up half of the power production, in Germany it is necessary for 90 per cent. Hence Germany is forced to make oil from coal, the more so as in times of peril she will have no easy access to world supplies without command of the sea.

The position in Great Britain is an intermediate one; with no natural oil we are staking everything on the command of the sea and the ability to continue supplies of oil on an enormous scale. To-day, as for many years past, our industrial supremacy is based on coal.

In any event, under present-day conditions, crude oil production can scarcely keep step with the rate of increase in demand. The share of the United States has declined, though the production of Venezuela, Rumania, Iran and Iraq has assumed greater importance.

There is always a change in the particular oil product required: thus the proportion of gasoline (petrol) to crude oil has risen from 7 per cent in 1913 to 35 per cent in 1931, since when it has slightly declined as the production of heavier gas

oil has increased. The position of oil supplies twenty years hence is obviously one of uncertainty.

In England, where the wood resources are so small, it comes perhaps somewhat as a surprise that 12.8 per cent of the world power supply is produced from wood, the equivalent figure in 1913 being 17.6 per cent. In heavily timbered countries, however, both on the continent of Europe and abroad, wood is still of prime importance. The forests which cover so much of northern Quebec represent to-day what the English Lake District must have looked like before the trees were felled—largely to smelt copper—in the time of Elizabeth: the oft-related destruction of the Sussex woods to smelt iron ore before the discovery of sea-coal is another parallel of what is happening abroad to-day. Scientific attempts are being made to utilize wood and its products in the best manner for a variety of purposes connected with power production and also as a raw material for the paper industry. Actually about half the total wood cut is used as firewood—a quantity estimated at 680 million cubic metres.

At the turn of the nineteenth century, coal seemed to dominate the field and to have pushed all other sources of power into the background. To-day coal, oil and water compete: the situation is determined in the various countries by conditions which have relation to factors not purely economic.

Modern Study of Plants in Relation to Education*

By Prof. E. J. Salisbury, F.R.S.

FROM the cultural point of view, plant life and all that it implies may be regarded as the foundation of a vast extent of human activity and the basis of a large and essential part of every human environment. Because neither we nor the animals could persist without plant life, it follows that much of the present distribution of these organisms over the face of the earth can only be understood in terms of the plant life either of the present or the past. Even man's industrial activities have been largely localized and in part determined by the geographical distribution of vegetation, whether it be that of the forests, of perhaps 280 million years ago, which gave origin to our coal deposits, or the vast extent of grasslands that have determined the location of pastoral communities.

A realization of the widespread demands made upon plant products would probably astonish

many of those who, like Mr. Babitt, find in the mechanistic devices of the age their chief delight. Yet it has been recently estimated that a thousand Ford motor-cars utilize in their manufacture the entire plant yield of more than six hundred acres, and this quite apart from the indirect demands for grazing necessary to furnish the materials of animal origin. Despite the vast areas of the earth's surface devoted to the growth of foodstuffs, of textile fibres, of timber, rubber, tea, tobacco and innumerable other plant products, the plant remains perhaps the least known and appreciated of all man's servants by those who lay claim to any cognizance of their environment.

Even the town dweller can scarcely fail to recognize the indirect contacts of his everyday existence with the activities of agriculture, forestry and horticulture, and, if education is to be interpreted as a means of enabling the individual to

*Continued from p. 671.

have an intelligent appreciation of and harmonious relations with his environment, then a knowledge of plant life is manifestly essential to that end. I should almost feel that an apology was necessary for expressing sentiments so trite were I not sure that whatever agreement there may be in theory, our educational curricula bear witness to the neglect of these principles in practice.

The increasing diversity of pursuits in a progressive science is only too liable to be accompanied by an increasing detachment of interests and divergence of expression. Specialization, which should be accompanied by greater co-ordination, is only too frequently the begetter of disintegration rather than synthesis, and the mutual interdependence of one branch on another is lost sight of. One of the main purposes which the British Association should serve is to promote the co-operation between workers in different fields. But we only come together for a short week in each year, and so it is to the universities that we must look mainly for the continuous fostering of a liberal outlook both on science as a whole and within the domains of each particular subject.

In its earlier phases, botany was naturally concerned largely with description, and in such branches as taxonomy, morphology, anatomy, cytology, mycology, palaeobotany and plant geography the descriptive aspect must necessarily play an important part, just as in ecology, physiology, bacteriology and genetics the experimental aspects should predominate. But in all, the cultural value can only be maintained if form and function are closely integrated. Each branch has its own contribution to make in this respect not only to the pure science but also to its applied aspects in agriculture, horticulture, pomology, silviculture and plant pathology. The mere enumeration of these branches, whether pure or applied, envisages the richness of the field we cultivate and the extensive contribution that botany can make towards both the enrichment of the human mind and the well-being of the race. But the accumulation of data in these varied directions of inquiry will only fulfil its full purpose if the many threads are continually woven into the warp and woof of a single fabric.

The retention of plant physiology within the domain of botany has saved us from the worst evils of the study of form unrelated to function. This has also been one of the chief factors which led to that synthetic approach to our subject which concerns the relation of the plant to its surroundings. The supreme value of ecology, however, lies not so much in the attention which it focuses upon the mutual relations of organisms or even upon their relation to the environment, but in the synthesis which ecology achieves, into a

single picture, of so many aspects of botany itself and so many branches of human knowledge. Its high educational and cultural potentiality is an outcome of the fact that it is the very antithesis of that common failing of the human mind to think of different subjects as isolated compartments of knowledge and not as different facets of one and the same jewel.

When we attempt to understand any plant community, the necessary study of the physical environment leads us at once into realms of soil structure, into the physical problems connected with water retention and water movement involving colloid properties and surface action. So, too, the chemist and the meteorologist make their contributions to our concept of the habitat, whilst the bacteriologist, the mycologist and the protozoologist all help us to envisage that teeming population of bacteria, fungi and protozoa in the soil which, by their proper balance, maintain a healthy circulation of chemical products and are a necessity for the maintenance of the supply of raw material for the higher plants and animals.

Since the environment of the present is in some considerable degree the consequence of that of the immediate and sometimes of the remote past, the study of external conditions brings us into contact with the contributions of glaciologists and historians, whilst even the student of 'place names' may materially assist in the reconstruction of those past conditions that in part have determined the present state.

When we turn from the study of the habitat to that of the vegetation which it supports, we are at once confronted with the question as to the extent to which one is in equilibrium with the other.

The morphologist and the anatomist furnish the data upon which we base our judgment as to the degree to which the external form and internal structure have contributed to render the organisms suited to the environments that they frequent. In so far as there is adaptation, whether passive or active, in this respect, to that extent the community is in equilibrium with its surroundings and represents a climax subject, it is true, to secular change but of a relatively stable character.

The contribution of the systematist is to distinguish between the more critical species and races which exhibit a localization that less meticulous examination might readily ignore and which often have an ecological importance far greater than the Linneons of which they are the segregates. The experimental conclusions of the physiologist in the laboratory must be applied by the ecologist to the elucidation of problems in the field, complicated and often profoundly modified

by the continual operation of the competitive factor.

Finally, knowledge of the life-histories of the constituent organisms, the reaction of the various phases of their development to the environment, their modes of reproduction, their establishment and extension, comprise a mass of knowledge to which many astute observers have contributed and amongst whom the amateur holds an honoured place in our esteem. The *clichés* of the politician with regard to policies could be applied with far more than their usual significance to the ecologist, who might with some reason be described as "exploring every avenue" and "leaving no stone unturned" in his attempt to reveal the causal relations underlying the social organization of plant life; but this all too brief résumé of the contents and contacts of a single branch of botany has, I hope, sufficed to emphasize that the wide range of knowledge invoked by the ecological approach, though constituting its chief difficulty, is the very basis of its cultural value, since it weaves together into a comprehensive whole so many threads of knowledge spun by the specialists upon the wheels of research.

The value of such approach is also obvious in relation to everyday affairs. In any well-considered plan of land utilization of catchment areas the ecological aspects are apt to be ignored. The land surface under its various guises may be likened to a sponge which absorbs the divers forms of precipitation and allows the water with more or less rapidity to find its way into the streams and rivers. But the effectiveness of the land surface for holding back the water varies according to whether it is under high forests, scrub, grassland or is arable. Each type of plant cover has its own absorptive factor and its own resistance to erosion. Furthermore, each vegetation type is not static but dynamic, and its role in this respect changes both with the seasons and with the passage of time. If therefore our land utilization is to be properly conceived, due regard must be had to the proportions in which the various communities, whether natural or artificial, are present. If we are to avoid floods and droughts, we must preserve rural England for practical, as well as æsthetic, reasons. To all this ecologists can contribute valuable help, the more so that with the passage of years the surface of our roads has become better and less absorbent, and our ditches are kept cleaner so that drainage to rivers has generally become more effective and rapid. Hence what sufficed to restrain extreme conditions a hundred years ago would not suffice to-day. Afforestation of the catchment area of the Thames and other rivers would, in the long run, be perhaps far more effective and less costly as a guarantee against

future floods or droughts than grand-scale engineering works, and whilst the former would produce ancillary assets of great value the latter would not.

Prof. F. W. Oliver pointed out, in reference to the reclamation of foreshores, that the plastic plant can and does meet the constantly changing impact of the forces of Nature in a way which the dead material of the engineer cannot hope to emulate, and at a far lower cost. But such biological control demands not only a comprehensive knowledge of the life-histories of the species utilized, but also an appreciation of the environmental factors, dynamic as well as static, that is summed up in the phrase ecological foresight.

Another matter is the much-discussed question of the preservation of natural areas. Owing to the widespread ignorance of biological knowledge, the dynamic character of vegetation is by no means widely realized. There are indeed many educated people to-day who think that to preserve an area all you need to do is to leave it alone. The fact that our open downland, presented to the National Trust, may, if left unhindered, ultimately cease to be downland and become woodland, with the loss perhaps of the very features for which the area was preserved, is for most a novel concept. But an enlightened policy of such control of national reserves and all that this implies will only be possible if the rising generation has been inculcated into a biological mode of thought.

It is probably true to say that no branch of botany could be cited that has not its important practical applications. Botany needs no defence in respect to the practical utility of its pursuit, although it is probably true to say that the majority of those who reap the benefits of its achievements are unmindful of their source. But it is, I feel, the contribution that botanical knowledge can make towards general culture and spiritual contentment that is its chief claim to rank high in our educational scheme.

A sympathetic understanding of botanical thought and progress is essential to a community which is to deal adequately with such national problems as agricultural policy, land utilization, afforestation, drainage and water supply, the preservation of rural areas or the provision of national parks. Only on the foundation of a knowledge of plant life and its requirements can an educated public opinion be built up that will receive and give effect to well-considered legislative action. Moreover, it is perhaps truer of these pressing questions than of most that a sympathetic and informed public opinion is essential to the continued effective operation of any policy however well conceived and enlightened.

Congrès du Palais de la Découverte

International Meeting in Paris

WHEN the President of the French Republic entered the main hall of the Sorbonne to take part in the opening of the 'Congrès du Palais de la Découverte', many were struck by the civic simplicity of his appearance, contrasting strangely with that usually associated with assemblies in which the political heads of States take part. Even the accompanying sounds of the *Marseillaise* seemed merely to give an objective commentary on the political situation: 'Contre nous de la tyrannie l'étendard sanglant est levé. . . .' The opening speeches of the Minister of Education, and of Jean Perrin, who acted as president of the Congress, echoed this anxiety. Both speakers affirmed their belief that the independent search for truth embodied in science is the best safeguard of civilization against threatening destruction. Jean Perrin went to the length of acclaiming science as the new supreme religion destined to reign over the happy future.

At the first moment these utterances appeared strange and exaggerated, yet as the meeting went on, bringing out one symptom after another of the world-wide struggle of international science with various local tyrannies, they gained a very simple significance.

The political situation of science unfolded itself as the various delegates rose to greet the Congress. When, after the English and the Americans, the Germans got up they were listened to with the consideration due to the hardy survivors from a great flood. Later in the evening, in conversation with one of the German delegates, he spoke to me about a better understanding between the German and French peoples; and three delegates used what seemed to me to be the same official phrase. The Italian delegates did not mention politics. The U.S.S.R. was not represented by a single member. Great applause went up when the delegate of 'the Spanish Government' was called. He said little, but the words 'in the name of the Academy of Madrid' made all the subdued terror of the situation flare up in a momentary blaze. The Portuguese who followed him, the Jew who spoke later for the University of Jerusalem, evoked in turn their particular fringe of political associations, and so did the fact that no Japanese delegate appeared. By the time the list had finished the political scene of the world was fully illuminated, and on it the new situation of science was well visible.

Science, and generally the independent search of truth, is destroyed when political liberty falls. The totalitarian States which claim to be supreme spiritual beings can admit no independent thought, be it religious, political or scientific. By its very nature such thought must claim superiority to temporal power and is therefore incompatible with totalitarianism. Thus it is quite logical that in such States the position assigned to science by the official philosophies of dialectic materialism and racialism respectively should be merely to serve the higher aims of the State.

In view of this common fate shared by independent science and political liberty, the opening speeches of the Congress appeared in a clearer light. Their appeal to science from the depth of political anxiety was guided by the recognition that the link between science and liberty is completely reciprocal: while the profession of truth needs for its protection the free institution of democracy, these institutions themselves must decay and fall if people abandon their belief in reason. The idea of liberty derives its strength from many roots but among these there is one most vital: the belief that men can reach a better understanding by free discussion, that in fact society can be continuously improved if public life is steadily guided by reasoned controversy. It was a controversy on the question of a single fact from which about half a century ago the present political system of France emerged. A handful of men had faced the violence of the Government and the fury of the populace to establish the innocence of Dreyfus. They won, and modern political France was built on their victory. To-day the rise of a new threat to liberty causes the French Government to appeal with anxious hope to the men whose profession embodies the right to reasoned controversy and whose political duty is to defend this right. M. POLANYI.

PHYSICS

THIS international congress of physicists, chemists and biologists was conceived and organized within ninety days, chiefly through the initiative of M. Frederic Joliot-Curie, who was the chairman of the executive committee. It was attended by eleven hundred men of science

and four hundred other members. Its aims included the intellectual celebration of the success of the Palais de la Découverte, the unique quality of which was described in *NATURE* of August 21, p. 328, and which was visited by two million persons between May 25 and October 7.

The chief motive of the congress, which gave it exceptional vitality, was the concern of many of the leading men of science in France to struggle for the preservation and extension of the conditions upon which culture, science and democracy are equally dependent. M. Jean Perrin, M. Paul Langevin, M. F. Joliot-Curie and their colleagues are determined to act in support of these principles, which they regard as sacred. M. F. Joliot-Curie told me that good scientific workers would not willingly spare time from the fascinations of research, but to-day it was their duty to appeal to the people.

The scientific meetings were arranged in thirty-seven sections. It was characteristic of the anti-nationalistic spirit that no opening paper was given by a Frenchman. All the first speakers were non-Frenchmen of international standing. Prof. P. Scherrer (Zurich) gave a review of the results published on the nuclear reaction $D + D = {}^3\text{He} + n$. Various experimenters find that the number of deuterons needed to produce one neutron varies by a factor of 1,000, according to the compound of deuterium bombarded. Scherrer has bombarded heavy orthophosphoric acid with a beam of deuterons of 80 microamperes and 130 kv. The number of neutrons and their energy were measured from recoil atoms of helium with an oscillograph in an ionization chamber. For a pure D target and 100 kv. it is calculated that 8.9×10^4 deuterons produce one neutron. The energy of the nuclear reaction is 2.92 ± 0.3 Mev., corresponding to a mass for the neutron of 1.0090.

Dr. J. D. Cockcroft described the new high-tension equipment at the Cavendish Laboratory. This is housed in a hall of dimensions 25 m. $\times$ 13 m. $\times$ 14 m. A 1.2 Mv. generator of the multiplied voltage type has been installed, and another of the same type giving a continuous 2 Mv. is being installed. A 12 Mv. cyclotron is also being constructed. He discussed the transmutation of boron with fast protons. The experiments show that it breaks into three alpha particles in two steps. The first involves the formation of a nucleus excited to the very high level of 3 Mv. He discussed the physical significance of the separate existence of such an excited nucleus.

Prof. Niels Bohr (Copenhagen) described the essential differences between the dynamics of the nucleus and that of whole atoms. In the latter the movements of the constituent particles can be treated to a high degree of accuracy as those

of free particles in isolation. This leads to a great simplification, and a complete explanation of the details of the periodic table of the elements. In the nucleus the conditions are different. Here the constituent particles are very closely packed, and therefore under the mutual influence of forces which act only at very small distances. They act, therefore, as a collective system, and the energy of the nucleus is to be conceived as shared among the constituent particles. Disintegration occurs when sufficient energy becomes concentrated through mutual interactions on one particle. The final result of the nuclear reaction is determined by a concurrence between the various possibilities of disintegration and of the radiation of the collective system. From this point of view, the capture and expulsion of swift particles has analogies with the phenomenon of evaporation of a molecule from a liquid surface. One arrives at a notion of the 'temperature' of the collective system, which determines the speed of the ejected particles. In the case where the ejected particles are charged, the influence of the electrostatic forces is predominant, but with neutrons these forces do not exist. The collisions of slow neutrons exhibit resonance phenomena analogous with optical dispersion. Considerable progress has been made with the help of the theory of the collective system towards the understanding of the new data revealed by nuclear transmutations. Bohr remarked that very surprising analogies between the structure of nuclei and of organic molecules might be discovered.

Prof. P. M. S. Blackett (London) gave a thorough analysis of present knowledge of cosmic ray particles. The absorption of the soft component of energy up to 250 Mv. obeys the quantum theory, and the theory of Bhabha and Heitler explains the formation of cascade showers in thick plates. The evidence that the soft rays are Dirac electrons is satisfactory. But what are the hard rays? They penetrate a mile of water and produce their own type of showers. Examination of 5,000 tracks shows that only 20 exhibited abnormal ionization. All the heavy particles appear to be protonic, and Anderson's suggestion of the existence of a heavy electron seems to be rather too simple to explain the experimental evidence. Blackett suggests that, if the hard cosmic rays consist of heavy electrons, then it follows that they must have a variable rest-mass which is a function of their energy, and must change into ordinary electrons below energies of 250 Mv. But other explanations are possible.

Dr. J. Clay (Amsterdam) discussed the penetration of matter by cosmic rays and gave evidence for the existence of artificial radioactivity produced by cosmic rays. He finds that if a chamber

is suddenly covered with lead, the intensity of the cosmic rays passing through the chamber does not fall to a new steady value suddenly. There is a period of gradual decline which suggests the presence of artificially radioactive atoms with half-lives of eight minutes. He has observed similar effects when the lead is removed.

Prof. G. Lemaître (Louvain) gave an account of his analysis of the deflection of cosmic rays by the earth's magnetic field according to Størmer's theory. The equations were developed in a form of Fourier series, and solved with the Bush machine at the Massachusetts Institute of Technology. The principal cone has been exactly determined up to latitude 30° , and the Johnson latitude effect has been satisfactorily explained.

Dr. W. Bothe (Heidelberg) discussed the different methods of the experimental determination of nuclear levels, depending on the spectra of gamma rays and ejected particles. He gave some new data concerning isomeric nuclei, and results of proton and neutron capture which may be interpreted by Bohr's new theory.

Dr. P. Debye (Berlin) gave a lucid exposition of the adiabatic demagnetization method of reaching very low temperatures. He remarked that the method is an excellent demonstration of Boltzmann's principle, because the application of a magnetic field has the effect of increasing the amount of atomic order, which is conserved during demagnetization, so the effect is equivalent to a cooling. Simon's recent experiments show that heat anomalies occur in two regions under the adiabatic process. In the second, at very low temperatures, ferromagnetic properties appear. He explained that the atomic theory of paramagnetism accounts for the experimental data, and also the considerable effect of relatively weak magnetic fields on caloric properties. He extended the notion into the domain of nuclear magnetism, and said that the calculations of Heitler and Teller on the time necessary to produce thermal equilibrium deserve very close attention.

Prof. E. Wierama (Delft) discussed the recent progress in low temperature research, and Prof. F. Simon (Oxford) reviewed the recent experimental work. He referred to the impossibility of reaching absolute zero, and described the progress in the technique of liquefying helium. He said that Talmud in Leningrad has successfully used the 'bellows' method of liquefying helium which he had proposed ten years ago. Prof. M. Polanyi (Manchester) summarized the Griffith, Taylor, and other theories on the deformation of solid bodies. J. D. Bernal contributed to the discussion with an account of Stepanov's thermal theory of deformation.

Sir C. V. Raman spoke on the optics of colloids, and on ultrasonics in liquids. He described the

importance of the optical study of colloids for the determination of the size, form and distribution of the particles, and the analogy between the Tyndall effect and the diffusion of light by molecules. His general lecture on ultra-sonics was illustrated by striking metaphors. He described the experiment of Debye and Sears, and Biquard and Lucas, in which fringes are produced by light passing through a liquid transmitting ultra-sonic waves, as making sound visible, and as introducing the accuracy of optical technique into experiments on sound.

Dr. B. Van der Pol (Eindhoven) gave a lecture with experimental demonstrations of non-linear vibrations, and explained their importance in mechanics, electrical engineering and biology.

Prof. W. L. Bragg (Teddington) spoke on the structure and classification of silicates; Dr. U. R. Evans (Cambridge) on the state of the surface of bodies during corrosion; and Dr. F. London (Paris) on supraconductivity in aromatic compounds.

J. G. CROWTHER.

BIOLOGY

THE Palais de la Découverte, which represents a great effort of popularization on the part of French science, is an attempt, and a very successful attempt, to parallel the South Kensington Science Museum and the Deutsches Museum. In the biological section, for example, there are exhibits of evolution phenomena, embryology, tissue-culture, etc., and continuous demonstrations of such experiments as the Berger rhythm. All the most modern devices such as neon lighting and automatic switching are used to give life to the exhibits and diagrams.

On Friday, October 1, there was no specifically biological meeting, but many biologists took advantage of an elegant description of the polyterpene compounds by Prof. Ruzicka (Basel), who did not fail to point out the biological importance of the sterols and lipochromes while tracing the chemical similarities between them, and their transformations. The following day was entirely devoted to embryology. Prof. Holtfreter (Munich) gave a lucid address in which he went over the fundamental discoveries on which our knowledge of the material interactions of the parts of the embryo during its development is based. He described recent results obtained by his method of explantation of parts of amphibian embryos; thus a piece of the dorsal surface is taken from the neurula and cultivated in isolation: if from the spinal region, a neural ball is formed, surrounded by ectoderm; if from the eye-region, an eye-cup covered with ectoderm is formed, to which a naked piece of brain is attached. Such experiments are

of great value in analysing the process of induction, a question which O. H. Waddington (Cambridge) dealt with in the succeeding paper. Waddington also described the progress made with synthetic substances in Cambridge; thus oestrin itself, styryl blue, the acenaphthene derivatives, and to a lesser extent, squalene, can act as efficient evocators, inducing the appearance of neural tubes from ventral ectoderm.

In the afternoon Dr. J. Needham (Cambridge) spoke on carbohydrate metabolism and the morphogenetic process. The association, he said, between carbohydrate metabolism and the earliest stages of development, in which determinative processes are going on, has been observed by many independent investigators for many animal groups. The glycolysis of embryonic tissues appears to differ from that of adults, in particular the machinery of the phosphorylation cycles is not fully laid down at early stages, and non-phosphorylated glycolysis takes place. Organizer phenomena and carbohydrate metabolism are probably connected, since there are strong reasons for thinking that the evocator exists in its masked form in combination with polysaccharide and protein.

Monday, October 4, opened with a paper by Prof. D. Keilin (Cambridge), who dealt with the enzymes peroxidase and catalase which have protohaematin compounds as their prosthetic groups. The reaction of these with their substrates changes the absorption spectrum and this allows the analysis of the mechanism of the reaction. Prof. B. Kuhn (Heidelberg), on the other hand, in dealing with vitamins, emphasized how in several cases they, or compounds very similar to them, may be united in combination with proteins, giving compounds of quite different properties. Thus the lipochrome retinene, almost identical with vitamin A, forms with protein the visual purple of the retina. Lactoflavin, vitamin B₂, forms with protein the dehydrogenating enzyme, flavoprotein, of Warburg; while vitamin B₁₂, a thiazol derivative, is one of the components of co-carboxylase. Phosphorylation may be as important as combination with protein.

In the afternoon Prof. J. H. Northrop (Princeton) described the present state of the work on the constitution of the crystalline enzymes, trypsin and pepsin. In none of these can any prosthetic group be detected, and practically any modification of the molecule leads to a loss of its enzyme properties. No fragments are active. Work on the bacteriophage was described and an analogy sustained between its power of increase and the autocatalytic action of trypsin on trypsinogen. He was followed by Prof. Warburg (Berlin), who in a brilliant address proposed a new classification

of active proteins (alloxazino-proteins, pyridino-proteins, ferro-proteins, etc.) according to the reactive groups.

On Wednesday, October 6, Dr. N. W. Pirie and J. D. Bernal (Cambridge) gave an account of their work on the plant virus of tobacco mosaic disease, from which this appears to be a nucleoprotein of special character, spontaneously forming liquid crystals of gigantic cell-size when isolated, but probably existing as spheres or short rodlike particles in the actual plant sap. This gave rise to a long discussion. Later Prof. Rideal (Cambridge) described the work of his collaborators and himself on monomolecular films of proteins and other substances of biological importance. Of particular interest was his demonstration that a sterol-protein complex, requiring long treatment with ether for separation, dissociates and reforms again under the pressures applied to it in monolayers.

Thursday, October 7, was devoted entirely to genetics. Prof. Muller (Moscow) gave a fine paper on the effects of radiations on the genotype, and this was remarkably extended by the lecture of Dr. Timofeev-Ressovsky (Berlin) in the same afternoon, who has succeeded in analysing the physico-chemical mechanism of X-ray-induced mutations much further than possible hitherto. Spontaneous mutations may now be regarded as mono-molecular reactions produced by thermal agitation when this oversteps the energy threshold of the chemical bonds. Mutations should therefore conform to the rules of chemical kinetics, and it has indeed long been known that, other things being equal, the mutation-rate is proportional to the external temperature. Prof. Haldane (London) gave an interesting discussion of the genetics of populations, introducing the term "cryptopolymorph" for populations such as man, many individuals in which carry recessive genes giving (sometimes deleterious) abnormalities. Finally, Dr. Wrinch (Oxford) developed her theory of protein structure, which she applied particularly to the structure of genes and chromosomes.

To one participant, at any rate, it seemed that the main idea which, in a quite unrehearsed way, ran through all the papers, was the great importance of compounds combined with proteins, either as loose complexes or as prosthetic groups. There were the lipochrome-protein compounds (Ruzicka, Kuhn), the sterol-protein compounds (Needham, Rideal), the vitamin-protein compounds (Kuhn, Warburg), the haematin-protein compounds (Keilin) and last but not least the nuclein-protein compounds (Pirie, Bernal and all the geneticists). It is the intention of the organizers of the congress to publish three volumes containing the contributions (Hermann et Cie., Paris), so that these will happily be available in permanent form. J. N.

BIOLOGICAL CHEMISTRY

THE rapid increase, during recent years, of our knowledge of the chemistry of the biological catalysts and of the chemical changes involved during intracellular respiration was the most striking feature of the Section of Biological Chemistry.

On the basis of this knowledge Prof. O. H. Warburg (Berlin-Dahlem) proposed a classification of these catalysts according to chemical structure. These ferments, or active proteins, he classifies into four groups.

Protein	Prosthetic Group	Active Group
1. Alloxazine protein	Alloxazine nucleotide	Alloxazine
2. Pyridine protein	Pyridine nucleotide	Pyridine
3. Cupro protein	Unknown	Copper
4. Ferro protein	Ferroporphyrin	Iron

As examples were quoted (1) the yellow enzyme, (2) the enzymes of alcoholic fermentation and hexose phosphate oxidation, (3) the catechol-oxidase of potato recently investigated by F. Kubowitz, (4) the well-known catalysts of the haemoglobin type. Such a classification will naturally meet with criticism in Group 2, where the conception of enzyme plus coenzyme forming as rigid a compound as, for example, haemoglobin will not be generally accepted. The action of these ferments was described in the case of hexose phosphate oxidation involving the stoichiometric transfer of hydrogen to atmospheric oxygen via the alloxazine and pyridine nuclei.

Prof. R. Kuhn (Heidelberg) dealt with ferments of the first two classes in a paper illustrating the close relationship between vitamins and ferments. Thus, aneurine (B₁) when phosphorylated is the prosthetic group of carboxylase, lactoflavine (B₂) plays a similar part in the yellow enzyme, while ascorbic acid (C) without phosphorylation is the active grouping of esterase. Prof. D. Keilin (Cambridge) confined his address to ferments of the fourth class. The three compounds methaemoglobin, peroxidase and catalase were taken as well-established examples, and the remarkable similarities in the chemical and spectroscopic properties were emphasized. In particular, an account was given of the spectroscopic study of the reaction with hydrogen peroxide, by which it was established that the iron of catalase, but not of the other two, is reduced in reacting with hydrogen peroxide. Manometric evidence for this reduction was also brought forward.

The discussion which followed these two papers centred mainly round the role of the yellow enzyme. It was generally accepted that oxidation *in vivo* of the reduced yellow enzyme, which cannot take place at the oxygen tension in the tissue, must be brought about through the intermediate action of the cytochrome system according to the scheme previously proposed by H. Theorell.

In dealing with the chemical nature of pepsin, trypsin and bacteriophage, Prof. J. H. Northrop (Princeton) stressed the difficulties of obtaining reliable evidence as to the purity of so-called pure crystalline preparations. Apparently the most reliable criterion is the solubility test based on phase rule considerations. Thus only with a pure substance will the concentration of dissolved solids remain constant as further solid is added to a saturated solution. This method has established that many preparations formerly believed pure are mixtures. An active crystalline nucleoprotein has also been obtained from bacteriophage. These substances contain no prosthetic group, and the properties must be ascribed to characteristic molecular structure. Their formation from inactive precursors involves but a very slight chemical change, which is autocatalytic.

A general discussion, entitled "Enzymes, Chromosomes, Virus," was opened by Dr. N. W. Pirie (Cambridge), but was mainly restricted to the subject of virus. The chief problem here is the exact relationship between the crystalline preparations and the virus as it exists in the plant. Ultrafiltration of tobacco mosaic virus shows that particle size increases during purification and gives rise to anisotropy of flow. J. D. Bernal, reviewing his work on the optical properties of purified preparations and on X-ray diffraction measurements, produced evidence of a linear aggregation of virus particles during purification, and was able to deduce the dimensions and spacial configurations of these aggregates. The identical 'unit cell' dimensions of three tobacco viruses find a parallel in the serological tests of Prof. Garcia, whereby the tobacco and potato viruses fall into two groups of closely related individuals.

An address by Prof. E. K. Rideal on chemical reactions in monolayers indicated a new line of approach to the study of changes within the cell, where surface reactions predominate. The change of chemical activity with molecular orientation in a monolayer is well illustrated by the action of permanganate on a film of oleic acid. By compression of the film the molecules assume a perpendicular position, the double bonds are removed from the interface and the oxidation practically ceases. Similarly, the photochemical decomposition of stearyl anilide can be stopped by compressing a film so that the benzene nuclei, revolving until parallel with the incident light, no longer absorb in the ultra-violet region. Similar technique makes possible the study of the orientation of protein molecules, with results in agreement with Astbury's X-ray diffraction method, and the degradation of proteins with loss of chromophoric groups (tyrosine residues) and formation of melanine.

E. F. HARTREE.

Obituary Notices

Mr. Richard Inwards

SOMETIME near the beginning of the present century a distinguished Continental meteorologist remarked that in England meteorologists were long-lived. It was perhaps the example of the Meteorological Council of that time that was in the mind of the speaker. If the remark had been printed in time it might have been included in the well-known book on "Weather Lore" by Richard Inwards, who died on September 30, at the age of ninety-seven, after seventy-six years of fellowship of the Royal Astronomical Society and seventy-five of the Royal Meteorological Society, including therein a considerable period of 'occlusion' at his residence in Croft-down Road, Highgate, accentuated by failing eyesight.

Mr. Inwards was born at Houghton Regis, not far from Dunstable, on April 22, 1840, the son of Mr. Jabez Inwards, and was educated at Soulbury, about ten miles away. In some way not apparent in the available records his education led to mining as a professional career. His interest in science is obvious from the first. He joined the Royal Astronomical Society at the age of twenty-one and the Royal Meteorological Society at twenty-two, when the latter Society was closely associated with the Institution of Civil Engineers and held its meetings in their room. According to "Who's Who", he managed mines in Bolivia and in Spain, and he reported upon mining enterprises in Norway, Austria, South America, Mexico, Spain, Portugal and England. His recreations were mechanical and microscopical.

When Mr. Inwards joined the Royal Meteorological Society, founded in 1850, it was engaged in organizing and collecting weather observations from volunteer observers in England, represented from 1881 onwards by an annual volume of the "Meteorological Record", while the Scottish Society, with Sir Arthur Mitchell, T. Stevenson (of the Screen) and A. Buchan, were discharging similar duty for Scotland. G. J. Symons was developing the British Rainfall Organization, Kew Observatory was held by the British Association, and the Meteorological Department of the Board of Trade under FitzRoy was organising, collecting and co-ordinating observations from the sea.

In 1900 the Society had ninety-three stations of the second or third order, and among the names of observers we find E. Mawley at Berkhamsted, Sir J. W. Moore at Dublin, E. Kitto at Falmouth, H. Mellish at Hodsock, Sir Lothian Bell at Rounton, J. Baxendall at Southport, R. Bentley at Slough, F. Campbell Bayard at Wallington. Inwards's name does not appear, though he had already "passed the chair" of the Society in 1894 and 1895, with addresses on "Weather Fallacies" and "Meteorological Observations". He had been on the Council since 1884 and was treasurer in 1900, when Theodore Williams had passed up to be president on the death of G. J. Symons. He was joint editor of the *Quarterly Journal*

for about twenty years and contributed three papers ("The Metric System in Meteorology", "On Some Phenomena of the Upper Air", and "Turner's Representations of Lightning"). He also wrote "On an Instrument for Drawing Parabolic Curves" (*Phil. Mag.*, 1892) and "The Temple of the Andes", 1884. In 1911 he edited the "Life and Work of W. F. Stanley", the instrument maker.

Inwards is specially remembered for his book on "Weather Lore" published first in 1869, with a third edition in 1898. So it would appear that while helping his colleagues to collect and arrange observations from British localities he was himself engaged in collecting notes about the weather and its ways from the literature of the ancients and the moderns, ranging from Hesiod and Theophrastus to *Notes and Queries*. It is a wonderful collection of the weather wisdom of more than two thousand years of common experience, 206 pages displaying perhaps three thousand spontaneous inferences.

In respect of its arrangement this book is perhaps typical of the meteorological practice of the time and has something to do with the final sentence of Mr. Inwards's introduction to "Weather Lore" that "meteorology itself especially as regards English weather is very far from having reached the phase of an exact science". In the "Meteorological Record," as elsewhere, we find separate columns for the several items observed, and the page is so brimful of observations that one is reminded of a supersaturated solution which will develop into beautiful crystals if only an efficient nucleus can be suggested. So in "Weather Lore" we find remarks about weather collected and arranged in groups related to times and seasons, sun, moon and stars, wind, clouds, mists, and so on, while those who were dealing with observations of instruments were formulating their theory round the idea of the cyclonic depression, as they do now on the idea of fronts. In "Weather Lore" the grouping under the chosen headings is rigorous, regardless of latitude or chronology (outside the limits of the solar year) and generally regardless of orographic features. The reader may be pardoned for wondering whether some day a meteorological Kepler may co-ordinate the facts which are disclosed and formulate the insight into Nature which they carry.

Prof. de Burgh Birch, C.B.

We regret to record the death, which occurred on September 18 at the age of eighty-five years, of Prof. de Burgh Birch, emeritus professor of physiology in the University of Leeds. Prof. Birch, who was born on May 18, 1852, received his medical training at Bristol and graduated at Edinburgh.

After three years as assistant to the professor of the Institutes of Medicine at Edinburgh, Birch went in 1883 to Leeds as the first full-time professor in

the School of Medicine, which had just been amalgamated with the Yorkshire College of Science in order to become a constituent of the Victoria University and had received a nucleus of an endowment of a chair in memory of Lord Frederick Cavendish. There was practically no equipment and as little money, so for ten years, while sharing in the work of a scheme for building a new school, he set about the task of equipping the department with the practical assistance of a young mechanical engineer—Kershaw—who later made a name in the invention and manufacture of instruments for the film industry. When the new school was opened in 1893 it was extremely well equipped for practical courses, especially experimental physiology.

The necessities of the time seem to have diverted Birch's mind from inquiry into physiological problems, for which he had shown excellent promise in his work with Rutherford in Edinburgh. His attention was given to perfecting apparatus: unless perfect an instrument was no use; when perfect it ceased to have interest. His bent for organization and making the fullest use of slender funds was well shown in his military hobby. He raised a medical staff corps with such success that little improvement was required to make it a full unit in the Haldane scheme. He retired with the distinction of C.B. after serving as A.D.M.S. of the unit of his own creation. In 1915, although more than sixty years of age, he was invited to resume the rank, and he accompanied the division to France.

The same bent was marked in the organization and discipline of Birch's department and in his conduct of the affairs of the Faculty in the dean's chair, which he occupied in the first seven years of the century and again from 1913 until his retirement in 1917. In these periods he laid certain lines along which the post-War development of the school were facilitated. In these days of grants of a liberality entirely unknown in the Victorian period, this generation can scarcely understand the amount of labour and ingenuity exercised by men like Birch in laying the foundations of a department in the condition of *magna inopia omnium rerum*. Though unquoted in text-books, he is one of the corner stones of the Leeds Medical School.

Dr. W. N. Bond

It is with much regret that we record the death of Dr. W. N. Bond, lecturer in physics in the University of Reading, which occurred on August 25, following an operation, while on holiday at Minehead.

Wilfrid Noël Bond was born on December 27, 1897, and educated first at St. Albans School and afterwards at East London College and the Royal College of Science, whence he graduated with first-class honours in the University of London. After nearly two years' experience in industrial research in the engineering works of Messrs. Kent in Luton, he returned to academic research work, first under Prof. A. W. Porter at University College, London, and later at the Cavendish Laboratory, under Sir J. J. Thomson, where he took his Cambridge B.A. by

research. He was appointed lecturer in physics in the University of Reading in January 1921, a position which he continued to occupy with distinction until his death.

A kind, patient and conscientious teacher, Bond was also keenly interested in research and published numerous original papers. Readers of NATURE may recall his recent investigations into the most probable values of the universal constants, made in connexion with the theories of Sir Arthur Eddington. Bond's experimental work was mainly (though by no means exclusively) concerned with the flow of fluids, and the allied subjects of viscosity and surface tension. An experimenter of exceptional skill and ingenuity, his methods were distinguished by their elegance and simplicity. His research work showed a steady development in power and maturity, and his most recent publications on "The Viscosity of Air" and on the "Measurement of Surface Tension by the Moving Sheet Method" (a continuation of which was passing through the press at the time of his death) reveal his work at its best. In addition to his original papers, Bond published three books, "Numerical Examples in Physics", "An Introduction to Fluid Motion", and "Probability and Random Errors", all of which received very favourable notices.

Modest, friendly and sincere, Bond will be greatly missed, not only by his students and colleagues to whom at all times he gave unsparingly and unselfishly of his best, but also by a much wider circle of acquaintances and friends. He is survived by his father, and leaves a widow and three children.

We regret to announce the following deaths:

Sir John Dewrance, G.B.E., president of the Institution of Mechanical Engineers in 1923, on October 7, aged seventy-nine years.

Dr. Paul Emerson, senior soil scientist of the Soil Conservation Service of the U.S. Department of Agriculture, an authority on soil bacteria, on September 20, aged fifty years.

Mr. W. B. Ferguson, K.C., known for his researches in photography, on October 7, aged eighty-five years.

Mr. W. S. Gosset, head of the scientific staff of Arthur Guinness, Son and Co., Dublin, known for his contributions to statistics and economics over the pseudonym "Student", on October 16, aged sixty-one years.

Prof. L. M. Hoskins, emeritus professor of applied mathematics in Stanford University, on September 8, aged seventy-seven years.

Sir Ashley Mackintosh, emeritus professor of medicine in the University of Aberdeen, an authority on nervous diseases, on October 14, aged sixty-nine years.

Sir John Moore, president of the Royal Academy of Medicine in Ireland in 1918-21 and president of the Royal College of Physicians of Ireland in 1898-1900, author of "Meteorology: Practical and Applied", on October 13, aged ninety-one years.

Prof. F. Morley, emeritus professor of mathematics, in Johns Hopkins University, on October 17, aged seventy-seven years.

News and Views

Lord Rutherford, O.M., F.R.S.

It is with profound regret that we record the death at Cambridge, on Tuesday, October 19, at sixty-six years of age, following a serious abdominal operation, of Lord Rutherford, whose experimental researches and scientific genius form the main part of the impressive structure of modern physics. By his friendly nature, as well as his alert and brilliant mind, he won the affection and esteem of all with whom he came in contact, whether as students, research workers, or members of the numerous scientific councils, committees and other bodies on which he served. The outstanding characteristics of his life, work, and influence were described by Maurice, Duc de Broglie, in *NATURE* of May 7, 1932, when Lord Rutherford was added to our series of Scientific Worthies; and there would be little to add to that article if it were now published as an obituary notice. We prefer, however, to arrange for personal tributes after a great scientific investigator like Lord Rutherford has passed into silence but leaving his friends a memory which will be cherished by them all throughout life, and a record in the history of science which will never be forgotten.

Dr. C. C. Paterson, O.B.E.

DR. C. C. PATERSON is delivering the Guthrie Lecture of the Physical Society for this year at the Imperial College of Science and Technology, South Kensington, at 5.15 p.m. on October 22. The title of the lecture is "The Appraisal of Lighting". Dr. Paterson is the director of the Research Laboratories of the General Electric Company, Ltd., Wembley. He was for sixteen years a member of the staff of the National Physical Laboratory, Teddington, where he established and administered the Electrotechnics and Photometry Divisions of the Laboratory until 1918. He then accepted the task under Lord Hirst of initiating the G.E.O. Laboratories at Wembley. These have now grown so much in size and influence that they have a personnel of 500 and cover a floor area of about 170,000 sq. ft. Dr. Paterson's activities have not been confined to the Wembley Laboratories. He was president of the Institution of Electrical Engineers in the year of the Faraday celebrations (1931). He has been president of the International Illumination Commission, the Illuminating Engineering Society, and this year of the Institute of Physics; he is also a vice-president of the Royal Institution and of the Royal Society of Arts. He has been Faraday Lecturer of the Institution of Electrical Engineers and Huxley Lecturer of the University of Birmingham. Whilst Dr. Paterson's activities in engineering and science have covered a wide range, his chief personal contributions and scientific papers have been in the fields of light and lighting. He has recently had the honorary degree of doctor of science conferred on

him by the University of Birmingham "in recognition of his many contributions and services to electrical science".

Prof. J. H. Gaddum

PROF. J. H. GADDUM, professor of pharmacology at University College, London, has been appointed to the University chair of pharmacology tenable at the College of the Pharmaceutical Society of Great Britain and has also been appointed director of the Society's Pharmacological Laboratories. Prof. Gaddum was educated at Rugby and at Trinity College, Cambridge, and afterwards he studied medicine at University College Hospital in 1922-24. From that time onwards he has been in the forefront as an investigator of problems of biological standardization. In 1924 he was appointed to the Wellcome Physiological Research Laboratories and in 1927 became assistant to Sir Henry Dale at the National Institute for Medical Research. From January 1934 he was professor of pharmacology in Cairo, and in the summer of 1935 was appointed to the professorship of pharmacology at University College which he has just relinquished. Prof. Gaddum was a member of the sub-committees on the biological standards for digitalis, strophanthus and ergot for the British Pharmacopoeia, 1932: he also served on the sub-committee dealing with the accuracy of biological assays for the 1936 Addendum to the Pharmacopoeia. His published work includes contributions on the estimation of strophanthus, thyroid preparations and on the determination of the toxicity of neocarsphenamine. His other work has been connected with the detection and isolation of substances occurring naturally in the body, such as the estimation of histamine in blood. He is secretary of the Physiological Society.

Moriz Kaposi (1837-1902)

PROF. MORIZ KAPOSI, one of the leading dermatologists of the nineteenth century, was born at Kaspovár, Hungary, on October 27, 1837. He studied medicine at Vienna, where he qualified in 1861, and then became assistant to the celebrated Prof. Hebra, whom he succeeded later in the chair of dermatology in the medical faculty of the University of Vienna. He was the first to describe several new skin diseases, such as multiple pigmented sarcoma of the skin (1872), xeroderma pigmentosum (1876), to which he has given his name, and lichen ruber moniliformis (1886). In addition to collaborating with Hebra in his work on diseases of the skin, which was translated into English in the New Sydenham's Society's publications (1866-80), he brought out an independent work on skin diseases which was translated into English and French, and a handbook on syphilis, as well as numerous articles in the *Archiv für Dermatologie und Syphilis* and the *Wiener medicinische*

Wochenschrift. His lectures, which attracted numerous specialists from both his own and foreign countries, were remarkable for their clearness and precision, and many of his pupils afterwards occupied chairs of dermatology in different countries. Throughout his life he upheld Hebra's teaching, including the erroneous doctrine of the identity of chicken-pox and small-pox, and of measles and German measles. He died on March 16, 1902, a few days after the celebration of the twenty-fifth anniversary of his appointment as professor.

Compton Manor Estate: Veterinary Field Station

THE recent announcement that the Agricultural Research Council has purchased from Mr. Alfred Barclay the Compton Manor Estate on the Berkshire Downs will be welcomed by farmers and others having an interest in the well-being of agriculture and particularly the livestock side of the industry. In addition to the purchase of the land, the Council has arranged to buy the well-known pedigree herds of Ayrshire, Friesian and Guernsey cattle and also the herd of Large White pigs. A field station is to be established at Compton Manor primarily for investigation of problems of animal health and disease. Farmers, veterinarians and all workers in any branch of animal husbandry or nutrition will agree that a development of this nature is long overdue. Material advance has been made in recent years in our knowledge of the breeding and feeding of farm livestock, and while admitting that important advances in the diagnosis, prevention and treatment of many diseases have been made, it is unfortunately only too true that there are still diseases, of wide incidence and causing enormous loss, of which very little is known in the way of treatment. Until these diseases can be controlled or cured, the potential gain which could be derived from the existing knowledge of nutrition and breeding is very seriously curtailed. The Council's announcement mentions two such diseases on which it is proposed work should commence immediately, namely, contagious abortion in cattle and fowl paralysis in poultry stocks. A bad attack of either may seriously interfere with progress which has been made over years of constructive breeding and successful feeding and management.

IN the investigation of diseases, the initial work must be carried out in research laboratories and then on small animals, but a stage comes when the results must be tried out on farm animals and under normal farm conditions. Facilities for this field work, while not non-existent, have been extremely limited in the past, and the creation of a field station for this specific purpose will help to bridge this gap. The field station will allow methods of treatment or control apparently successful in the laboratory to be tried out under practical conditions before being passed on to the farmer or practising veterinary surgeon. Another object in the establishment of the station is that it will be able to supply to other research institutes, for experimental purposes, farm animals of known history and free from disease. This service will bridge another gap; and in addition

to increasing the opportunities for work at existing research institutes, it will help to maintain the desirable collaboration between those institutions and the new station. The Council states it does not wish to set up a self-contained research institute, and hopes that, in addition to other methods of collaboration, existing institutes will second members of their staff to work at Compton on some problem when it would appear that the station is the most suitable place for joint work. All agriculturists, whether farmers or research workers, will watch with great interest the development of this new station, and wish it success in the important work which it is undertaking.

German and British Lantern Slides

A CORRESPONDENT writes: "Those who, during recent years, have attended lectures on scientific subjects in Germany will have been favourably impressed by the well-made, dignified lantern slides which are used there. In many cases, the slides are made with different colours to indicate the various curves or other significant portions of diagrams. Sometimes they have coloured arrows pointing to special details. The lantern slides are generally produced to a standardized system, so that time and mental energy are saved in knowing where to look for the title, date of preparation and other significant features. This year it was noticed that some of these lantern slides were made by the Technische-Wissenschaftliches Lehrmittelzentrale, Berlin N.W.7, Dorotheenstr.32. There would appear to be no organization in England corresponding to this technical science teaching equipment centre and it is probably true to say that lecturers in this country generally use lantern slides less satisfactory than those seen in Germany. It is suggested, therefore, that it would be to the benefit of technical education in England if encouragement could be given to the production of high-class lantern slides in this country, through the Board of Education, organizations of technical teachers and similar bodies. In this manner they would assist technical education both from the point of view of the lecturer and of the student."

Lectures and Demonstrations at the Zeiss Works

NINE hundred scientific workers, including no fewer than 160 non-Germans, attended the second Zeiss-Kurs in Jena last month. As apparently only three Englishmen were present, it would appear to be worth recording that many German firms sent several representatives to this three-day course of twelve lectures, at which more than two hundred instruments were set out, to be demonstrated by between fifty and sixty experts. On one evening during the course, a performance was given in the Zeiss Planetarium. The first day was devoted to microscopy and metallography, the lecturers being Prof. Hanemann (speed of alloy transformations); Prof. Pomp (causes of failure in the working of iron and steel); Dr. Scheil (theory of hardening steel) and Dr. Hansen (light metals and their uses). The second day's lectures dealt with spectro-analysis and photometry, the lecturers being Prof. Gerlach (progress in spectro-analytical methods); Dr. Ginsberg

(new photometrical methods in light metal analysis); Dr. Ramb (various spectro-analysis investigations for industrial laboratories) and Dr. Kaiser (contributions to the spectro-analysis of light metal alloys). The third day's work was on fine measuring, the lecturers being Prof. Kienzle (means of obtaining reliable dimensional data regarding machine components); Dipl.-Ing. Claassen (supervision of gear wheel manufacture); Dr. Berndt (testing of gear teeth) and Herr Nichterlein (modern developments in projection as a means of measuring).

Engineering and Transport

In his presidential address to the Institute of Transport on October 11, Sir Alexander Gibb suggested that we are on the threshold of another great advance in methods of transport. He did not speak of the experiments that the great physicists of the world are carrying out in their laboratories; he confined himself to consideration of the most that engineers can offer, to improve transport with the knowledge and means they have at present. In constructing bridges, the record for length (4,200 feet) is held by the Golden Gate Bridge at San Francisco. He said that American engineers are confidently looking forward to building, within the next ten years, spans up to 10,000 feet long. With present materials and the development of wire cable construction, it is quite possible to expend this length to 18,000 feet; but before this limit is reached, the ratio of dead load to live load would be too great to make spans of this length economically justifiable. In air transport the speeds at which aeroplanes will regularly operate will before many years equal or exceed the highest speed records at the present time, and the distances over which they will operate will be greatly extended. Sir Alexander doubts, therefore, whether floating headrome bases or mother seaplane ships will ever be necessary for great ocean crossings.

At the moment, road design is the most urgent of the problems of transport engineering. It is purely a matter of policy and economics whether Great Britain should endeavour to develop road systems like those in Germany. In Great Britain there are 41,000 miles of road subject to the 30 m.p.h. restriction; and more than half the Great North Road is only suitable for two-line traffic, although we have the greatest density of motor traffic on the roads of any country in the world. Germany recently in one year spent 25 million pounds on entirely new road construction, and in 1935 the United States spent about 120 million pounds. In Great Britain the building of a new road is a rare event. A complete programme of new trunk motor roads in Great Britain, connecting all the principal towns, might cost up to a thousand million pounds. A further attempt to solve the traffic problems of London in the way that New York is dealing with its difficulties, on the lines of the regional plan of 1929, with its forty years programme, involving about 1,700 miles of parkways, boulevards, etc., would cost more. It might even not be possible. Sir Alexander pointed out that

these are not exclusively engineering problems. They must be examined from the economic point of view before a decision can be reached.

The Hanseatic Scholarships

It is announced in *The Times* that a Hamburg merchant, who desires to remain anonymous, has created out of his private means a fund to provide in the first instance not fewer than four scholarships annually, each of the value of 3,000 Rm., for young British graduates who desire to study in Germany. These scholarships are to be known as the Hanseatic Scholarships. They will be tenable for one year, may be held in any subject, and will be open to all students of the universities of the British Empire, with a preference for students from Great Britain. The founder hopes that the Hanseatic Scholarships may help "to further closer relations and understanding between the German and British peoples and to promote a consciousness of European solidarity". The trust, of which the first patron is the German Ambassador at the Court of St. James's, will be assisted in the selection and guidance of the scholars by a German and a British committee. The British committee, as so far constituted, will consist of: Lord Lothian (chairman), Dr. W. G. S. Adams, Prof. E. D. Adrian, Dr. George Gordon, Sir Henry Tizard, and Prof. H. G. Fiedler (secretary), professor of German language and literature, University of Oxford, from whom further particulars may be obtained.

Association of British Chemical Manufacturers

TWENTY-ONE years of activity were reviewed by the chairman, Mr. Eben Wallace, at the annual general meeting, held on October 14, of the Association of British Chemical Manufacturers, which was formally incorporated on December 28, 1916. The initial membership was 110 firms, representing a capital of £30,000,000, whereas now, although the actual membership has not shown any great increase, the capital represented is more than £200,000,000. The Association's directory, "British Chemicals and their Manufacturers", was first published in 1919, and a new edition has since been issued every second year. 1920 saw the formation of the British Chemical Plant Manufacturers' Association, whilst in 1927 the Association's Works Technical Committee commenced its work on safety in the chemical industries. Other activities have been concerned with fiscal matters, with the setting up of standards, with the organisation of exhibitions, with the incidence of legislation, and, generally, with the promotion of co-operation within and around the industry. The annual report refers to the Association's activities, during the year ended May 31 last, in relation to the new Factories Act and other legislation, to the work of the Import Duties Advisory Committee, to commercial treaties, to safety measures, to the fund which the chemical industry has established in support of chemical publications and library facilities, to transport, and to various other relevant matters. Dr. F. H. Carr was elected president of the Association, and Mr. E. V. Evans and Mr. R. Duncalfe respectively chairman and vice-chairman of the council.

Plant Hormone Investigations

A study meeting on the subject of "Phytohormones" was held at the International Institute of Intellectual Co-operation on October 1 and 2. This meeting, which was organized by the International Institute of Intellectual Co-operation and the International Union of Biological Sciences, was the first of a series that will be held in the course of the coming months and which will discuss a variety of questions such as "The New Vitamins", "Nomenclature of Genetics", "The Double Electric Layer", etc., included in the plan of work of the International Council of Scientific Unions, which acts as a committee of scientific advisers to the Intellectual Co-operation Organization. The meeting was held under the chairmanship of Prof. P. Boysen Jensen and reports were discussed on various aspects of the study of phytohormones, prepared by the following: Prof. F. Kögl, Utrecht; Prof. Nils Nielsen; Prof. N. J. Koningsberger, Utrecht; Prof. G. S. Avery, Connecticut; Prof. R. Bouillenne, Liège; Prof. C. Zollikofer, Zurich; Prof. K. Dostal, Brno; and nomenclature of phytohormones, by Dr. Janot, Paris. The question of the nomenclature of phytohormones gave rise to an exhaustive discussion and positive results have been reached. The reports and the discussions to which they gave rise will be published under the auspices of the International Institute of Intellectual Co-operation and the International Union of Biological Sciences. This publication will be revised by Prof. Boysen Jensen before being issued. The second meeting of this character will be held at Copenhagen at the end of September 1939. Profs. Boysen Jensen, Leibach and Koningsberger have been invited to organize this meeting from the technical point of view, in collaboration with the International Union of Biological Sciences.

Archæological Investigations in Ireland

ARCHÆOLOGICAL excavations continue to be carried on with vigour in Ireland through the scheme for the relief of unemployment under the direction of the Office of Public Works and the National Museum. Among the more important of recent discoveries are the antiquities brought to light in the excavation of the large ring fort at Garranes, near Templetown, Co. Cork, which throw a valuable light on the industries and culture of the little-known period of the sixth century of our era. The excavations are being conducted by Prof. Sean P. O'Riordain, professor of archæology in University College, Cork. The site is identified with Rath Raithleann. The fort has triple ramparts, with an external diameter of about three hundred feet. The entrance proved on excavation, according to a report in *The Times* of October 18, to be of a complex character, with several gates, of which the fourth and last in the approach to the interior was formed by rows of posts, small tree trunks of six inches in diameter, set in two palisade trenches terminating the middle bank at each side of the opening.

In the inner bank of the fort under masses of stone, which had been used to strengthen it, was a deposit showing that here had been the workshop of the metal-workers, who had been under the patronage of the ruler. Clay crucibles were found here in greater number than had previously been found in the whole of Ireland. Some still contained the bronze they had been used to melt, while others, of a type previously known from Scotland, but not hitherto found in Ireland, had been used to melt enamel. A discovery of extreme interest consisted of pieces of *millefiori* glass, made by fusing different coloured pieces of glass together, which leave no room for doubt that the *millefiori* glass of Irish ornament was a native product. Another important discovery was a quantity of pottery fragments, of which some are Roman, while others are copies. Such pottery has hitherto been lacking from Irish fifth and sixth century sites.

The Battersea Power Station

THE annual report of the Electricity Commissioners (London: H.M. Stationery Office) giving the returns of fuel consumption and electric units generated in Great Britain shows that the total quantity of electricity generated during 1936 was 14 per cent more than during the preceding year. The annual fuel consumption was 1.57 lb. per electric unit distributed. The steam station with the highest thermal efficiency, 27.63 per cent, is Battersea (London Power Company) and the station with the highest load, 208,000 kilowatts, is Barking A (County of London). The London Power Co. is extending its station at a cost of £1,500,000. The work constitutes the beginning of the second half of the station and includes the extension of the building to double its present size and the installation of 100,000 kw. of generating plant. This is the first instalment of the plant to be provided in the new building. It is expected that this, together with the 243,000 kw. plant already working, will meet the probable demands for electricity up to the winter 1939-40. Eventually the generating capacity is to be raised to 500,000 kw. The new plant comprises a high-pressure set, a low-pressure set and a house set. The high-pressure set generates 16,000 kw., the low-pressure set 78,000 kw. and the house set 6,000 kw. The new plant also includes one boiler of 550,000 lb. evaporative capacity. Londoners will watch the development of this huge power station with interest. Practice has justified the policy of fostering the efficient stations in Great Britain. The returns show that whilst there were 458 generating stations in 1935, there were only 442 in 1936.

Loris: a Journal of Ceylon Wild Life

IN many respects the fauna of Ceylon is of unusual interest, and like many another island fauna it runs the risk of gradual encroachments at the hands of 'civilized' man. In order to further the preservation of the native animals and to stimulate a greater interest in them and their habits, the Ceylon Game and Fauna Protection Society has undertaken the

publication of a new natural history magazine, *Loris*, to be issued twice a year (Colombo and London: *Times of Ceylon Co., Ltd.* 2s. 6d.). That there is need for such propaganda is shown by the history of faunal protection in Ceylon, which A. B. Lushington contributes to the first number. The slaughter of sambhur and deer for the sake of the export of their hides and horns had reached gigantic proportions and entailed great cruelty, before the Government in 1891 passed ordinances to check the trade and to "prevent the wanton destruction of elephants, buffaloes and other game". Even so the trade continued, and several subsequent enactments have been required to bring about the protection which was desired. The first number of *Loris* is by no means confined to direct propaganda, for the editors are aware that the stimulation of interest in animal life is a better means to their end than mere denunciation. Accordingly they include sporting articles of a naturalist flavour, accounts of trips in the jungle, and an instructive article on natural history photography and the apparatus it demands, illustrated by excellent photographs of birds and nests.

Fisheries of Wales

A TEMPORARY exhibition illustrating the activities of the Welsh fishing industry has been on view during the past five months at the National Museum of Wales. A small hand-book supplements the information given on the labels of the exhibits ("The Fisheries of Wales". By Colin Matheeson. National Museum of Wales and the Press Board of the University of Wales. 2d.). The fishes landed in the largest quantities in Wales are demonstrated by models and spirit specimens, and the handbook sets forth the habitats and means of capture of the different species, with some comments on their biology. The hake, on which the deep-sea fisheries of South Wales are based, is given due prominence. A separate section is given to the deep-water trawler and its methods of work, with exhibits of echo-sounding devices and wireless direction-finders. The beam trawl and various appliances of the inshore fisherman are explained; and there are notes upon the primitive Welsh coracle and the salmon nets and spears used in fresh water. The general ignorance about the modern fishing industry is so great that a welcome must be extended to such an exhibition as this, for it will show that each species of fish must be sought by methods adapted to its habitat and habits; and that every fishing boat more than 20 feet long is not necessarily a trawler. Mr. Matheeson is to be congratulated upon the arrangement of such a demonstration.

British Association Seismological Committee

THE recent report of the Committee of Seismological Investigations records much useful work done by its members. During the preceding year, three slight earthquakes occurred in the British Isles: in East Kent on December 20, 1936, in North Staffordshire in April 7, 1937, and near Inverness on June 26, 1937. Brief references are made to the study of the recent earthquakes in Montserrat, to Mr. Brennan's work

on the greater frequency of earthquakes in Jamaica during the dry months of the year, to the deep-focus earthquakes of 1932, and to the new globe, 18 in. in diameter, recently installed at Oxford, which has already proved most useful in the determination of epicentres. Notes are also contributed by Dr. H. Jeffreys on seismic transmission times, and by Dr. R. Stoneley on his study of the records of the Mongolian earthquake of August 10, 1931.

Parliamentary Science Committee

THE Right Hon. J. Ramsay MacDonald has recently accepted an invitation to join the executive of the Parliamentary Science Committee. It has always been the aim of the Committee to preserve an even balance between men of science and Parliamentarians on the executive, and on the Parliamentary side to secure representatives from all political parties. Mr. MacDonald's advent brings the Parliamentarians up to eleven—three peers, and eight members of the House of Commons. The three peers are the Earl of Dudley (president), Lord Melchett and Lord Rothschild. The members of the lower house are Sir Arnold Wilson (chairman), Mr. Alan Chorlton (deputy-chairman), Mr. Ramsay MacDonald, Prof. J. Graham Kerr, Sir Philip Dawson, Sir Murdoch MacDonald, Mr. Andrew MacLaren, and Mr. S. F. Markham.

Komodo 'Dragons' at Edinburgh Zoological Park

By permission of the Netherlands Government, two Komodo monitors (*Varanus komodoensis*) have been added to the collections at the Scottish National Zoological Park in Edinburgh. This gigantic lizard, which may reach a length of 10 feet, was first shown in Great Britain at the London Zoo in 1927, a year after the habits of the creature had been studied by an American expedition in its native island of Komodo to the south-east of Java. It is swift and active out of keeping with its heavy build, and is said to be fierce as well as voracious, the larger individuals feeding when opportunity offers upon deer and wild pigs.

The Joint Committee on Materials and Their Testing

THE Joint Committee, which consists of representatives of twenty-four co-operating technical institutions and societies under the chairmanship of Dr. H. J. Gough, has arranged its first technical discussion to take place in the College of Technology, Manchester, on October 29, commencing at 2.30 p.m., when a series of three important papers on different aspects of "Notched Bar Impact Testing" will be presented. Application forms for papers and reprints, and for tickets to attend, should be made to the Secretary, the Manchester Association of Engineers, St. John Street Chambers, Deansgate, Manchester, 3. Particulars regarding the objects, aims and work of the Joint Committee may be obtained from the Secretary, Joint Committee on Materials and their Testing, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1.

Aeronautical Research in Australia

MR. H. E. WIMPERIS, who retired last March from the position of director of scientific research to the Air Ministry, is at present visiting Australia at the invitation of the Commonwealth Government. The determination to establish an aircraft industry in Melbourne has focused attention on the need for greatly improved facilities for scientific investigation, and Mr. Wimperis will advise the Government early next year on the steps which he considers necessary for the initiation and steady development of aeronautical research. A careful survey is being made of existing laboratories, particularly in the universities, to determine to what extent they may serve specific purposes in association with a central establishment.

Institution of Civil Engineers: Awards for Papers

THE following awards have recently been made for papers read and discussed at ordinary meetings of the Institution of Civil Engineers: Telford Gold Medal to D. M. Watson. James Watt Gold Medal to Sir Noel Ashbridge. Coopers Hill War Memorial Prize to J. Guthrie Brown. Telford Premiums to A. H. Naylor; Dr. S. F. Dorey; F. W. A. Handman; O. L. Howard Humphreys; G. E. Howorth; B. W. Huntsman; Dr. L. R. Wentholt; Prof. S. M. Dixon, Gerald FitzGibbon and Dr. M. A. Hogan; Prof. A. J. Sutton Pippard, Eric Tranter and Letitia Chitty; and A. J. Dean. Indian Premium to Dr. H. J. Nichols. Trevithick Premium to D. A. Stewart. For papers published in the *Journal* with written discussion the following awards have been made: Webb Prize to Dr. P. L. Henderson. Manby Premium to Prof. H. W. Swift. Crampton Prize to B. D. Richards. Telford Premiums to Dr. W. H. Glanville and F. G. Thomas; J. O. Richards; and Robert Ferguson. Trevithick Premiums to E. N. Webb and Prof. B. L. Goodlet. For students' papers read in London or at meetings of local associations the following awards have been made: James Forrest Medal and a Miller Prize to D. F. Orchard. Miller Prizes to S. K. Jordan; N. C. C. de Jong; D. M. Hamilton; R. O. Whitehead; Henry Grace; and F. C. Squire. The Baker Gold Medal for the triennial period 1934-37 has been awarded to B. M. Hallstrom and the Howard Quinquennial Prize for the quinquennial period 1932-37 has been awarded to Prof. J. F. Baker.

Announcements

SIR ROBERT ROBERTSON, treasurer of the Royal Institution, and lately Government chemist, has been appointed director of the Salters' Institute of Industrial Chemistry in succession to Prof. Arthur Smithells, who has resigned through ill-health.

THE Baly Medal of the Royal College of Physicians of London was presented on October 18 to Prof. E. L. Kennaway, professor of experimental pathology in the University of London and director of the Research Institute of the Royal Cancer Hospital, for his biochemical investigations which have led to the identification of a group of substances provoking malignant growth of tissues.

THE Planck Medal of the German Physical Society has been awarded to Dr. Erwin Schrödinger, professor of theoretical physics at Graz.

THE following awards have been made by the Institution of Naval Architects: Parsons scholarship in marine engineering (1937) to S. F. Rice of Messrs. G. and J. Weir, Cathcart, Glasgow; the scholarship is of the value of £150 per annum, and will be held at the Royal Technical College, Glasgow, for four years; Denny scholarships in naval architecture and marine engineering (1937): the naval architecture scholarship to A. Silberblatt, of Kilburn Grammar School, and the marine engineering scholarship to P. Martin, of Eltham College; both scholarships are of the value of £75 per annum and will be held at the University of Glasgow for four years.

THE Hillel pharmaceutical concern in Haifa, Palestine, has recently announced the foundation of a Hillel prize of 2,500 dollars for medical work in Palestine. Prof. Gottlieb of Vienna, the founder of the concern, has stated that funds had been provided by the company for raising the standards of hygiene in Jewish agricultural settlements in Palestine.

UNDER the auspices of the Food Education Society, Dr. M. Bircher-Brenner of Zurich will give three addresses on "The Principles of Therapy according to the Laws of Life" at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, on October 25, 27 and 29 at 8 p.m. Admission is free.

THE ninth International Ornithological Congress will be held at Rouen on May 9-13, 1938, under the presidency of Prof. A. Ghigi. Visits will be paid to Paris on May 14-15, and on May 18-19 there will be a long excursion to the Camargue. Further information can be obtained from the Secretary, M. Jean Delacour, Chateau de Clères, Clères, Seine Inférieure, France.

WE have received a copy of an attractive publication entitled "The World from a Window Garden" compiled by Grace E. Pulling (Society for the Propagation of the Gospel in Foreign Parts, 15 Tufton Street, London, S.W.1. Pp. 88. 1s. 6d.). It takes the form of a diary for gardening or engagements and contains notes on some plants suitable for cultivation in window-boxes, hanging baskets, etc. Apart from general descriptive notes and hints for culture, not the least interesting are brief references to the history and geographical distribution of each plant. The work is illustrated by forty photographs twenty neat black-and-white drawings by Frank J. Stanley, and eight beautifully executed water-colour drawings by various artists.

ERRATUM. In the second part of the table included in the letter "Solubility of Silica Dusts" by Dr. E. J. King in *NATURE* of August 21, p. 320, for "acetic fluid" read "ascitic fluid".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 730.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Recent Improvements in Diffraction Gratings and Replicas

THE advent of the aluminized glass mirror has done away with many of the difficulties of making diffraction gratings of large size and unique properties. Some years ago, after some preliminary experiments in diamond grinding and adjusting, we ruled a six-inch three-metre concave grating with 15,000 lines to the inch which threw about 80 per cent of the light into one first-order spectrum. This estimate was made with a photo-electric cell and the light of a high-intensity mercury arc passed through a green filter.

Feeling that we had the problem solved, we sent this grating to Prof. Herzberg of the University of Darmstadt, but we have not been able to duplicate its properties, until we abandoned speculum for aluminium. The first large grating ruled on this metal was a plane one with a ruled area measuring about 4 in. $\times$ 5.5 in., 15,000 lines to the inch, throwing perhaps 75 per cent into the first order for red light, and giving a very strong spectrum in the second order for the ultra-violet. This grating has been in continuous use on the spectrograph of the 100-inch telescope of the Mt. Wilson Observatory, and was responsible for the discovery of ionized titanium vapour in interstellar space. More recently, we have sent a still better grating to the Observatory ruled on an 8-inch disk of aluminized Pyrex glass which Dr. Adams reports as 30 per cent brighter than the first one. In a letter he tells me that, with the first grating which we sent, he believes that they have made the finest stellar spectrograms ever produced and that in his opinion the day of the glass prism for star spectrographs is over.

This high concentration of light in a single order cannot, however, be accomplished with a ruling of 30,000 lines to the inch, since the diffracting elements are now too narrow to act as oblique mirrors giving preferential direction to the diffracted energy. It is also difficult to produce such rulings on concave surfaces, especially those of short focus, owing to what I have called the target pattern, which shows up as concentric circular zones of different colours, especially at fairly large angles of incidence. These are due to the change of form of the groove, as the diamond drops down into the bowl, for as the diamond descends, the ruling edge turns through a small angle, coming up more on to its point. My assistant, Mr. Wilbur Perry, has developed a very ingenious method of compensating for this difficulty, and we have

already obtained promising results with it on some small gratings of 50 cm. radius.

Fig. 1 is from an enlargement of the green mercury line in the third order of the last 30,000 line grating ruled. This was a 6 in., 21-ft. grating ruled on aluminium, and the photograph was made with the slit and plate close together. The print shows clearly the several components of the line and the freedom from ghosts; there is also a lack of appreciable background, indicating that nearly all the reflexion is specular and not scattered. The exposure was only ten minutes.

I have been making a lot of replicas from the $4\frac{1}{2}$ in. $\times$ $6\frac{1}{2}$ in. aluminium plane grating, which I estimate contain 80 per cent (concentration) for λ 4300 and 50 per cent for the extreme red. Combined with a flint prism of 25° it gives direct vision (normal) for the blue-green boundary, and the dispersions are added. I have just mounted one on the 6 in. 25° objective prism of the Lick Observatory. To obtain the same dispersion with prisms, several would be necessary, and the spectrum would be very far from normal.

By employing aluminium deposits of several times the thickness of those in common use, it is now possible to construct very superior echelette gratings for the infra-red. Gone are the old difficulties of producing optical flats of copper, free from embedded grains of abrasive which wore away the razor edge of the ground diamond. Replicas made from such echelettes by flowing them with a nitro-cellulose solution, stripping the film and mounting in optical contact with selected plate glass, or better still plane parallel glass, may give by transmission as much as 90 per cent of the light in the first-order spectrum, as I showed some years ago with replicas taken from a 15,000 ruling on commercial half-tone copper plate. Such replicas can be made with a ruled area measuring $4\frac{1}{2}$ in. $\times$ $6\frac{1}{2}$ in. and with a 5-inch telescope show the D lines with a separation fully equal to eight times the width of the lines. One of these has been in use at the Harvard Observatory every clear night by Dr. Whipple during the past year as an objective grating for obtaining the distribution of the different gases in nebulae.

The introduction of the modern plastics, such as Lucite, makes it seem probable that fair gratings of small size, both plane and concave, may be made by a moulding process. The casting of a concave grating from a ruling made on a convex spherical surface has been in the minds of all interested in the cheap duplication of gratings for many years, but the few experiments which I made some years ago with Bakelite did not look promising as the casts warped. More recently I have obtained better results with Lucite, the castings being made with polymerized material, softened by a moderate temperature and

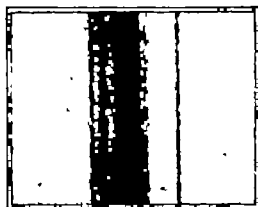


Fig. 1.

under high pressure. Whether the technique can be developed to such a point that a large casting can be separated from the metal surface without losing its figure remains to be seen. If this can be accomplished and the ruled surface is found to keep its structure intact during the ordeal of the bombardment by aluminium vapour, excellent concave gratings should be within the means of the smallest institution. This can doubtless be accomplished, as a nitro-cellulose replica from an echellette grating has been successfully coated with aluminium.

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July 15.

Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936

At the total solar eclipse of June 19, 1936, a joint party composed of observers of the Tokyo Astronomical Observatory and the Central Meteorological Observatory of Japan, headed by me, was engaged in various sorts of observations of astrophysical as well as geophysical interest at Nisnin ($\lambda = 9^h 37.1^m$, $\phi = 43^\circ 51'$) in Hokkaido.

An exposure of 50 seconds made by myself and Mr. Koiwai with a slit spectrograph with two 55° prisms of very heavy flint and a Tessar type camera lens of 55 mm. aperture having the focal ratio $F/4.5$ gave fourteen bright lines that cannot be attributed to chromospheric emission. Their wave-length calculated by referring to a number of well-situated Fraunhofer lines of the photospheric spectrum taken a few minutes before second contact are tabulated below. The accuracy for the lines near the red end and for those near the blue end is not satisfactory, for the instrument was focused for the green part and the curvature of the focal surface was not negligibly small.

No.	Wave-length	Intensity	No.	Wave-length	Intensity
1	4812	1*	8	5738.0	1
2	4725.3	1	9	5930.3	2
3	4815.9	1	10	6266.9	1
4	5116.4	2*	11	6373.9	6*
5	5593.8	>4*	12	6634	2
6	5624.4	1	13	6708	2*
7	5718	1	14	6777	1*

The lines marked with an asterisk are of recognized coronal origin. Beside the above lines there appeared chromospheric lines such as $H\alpha$, $H\beta$, $H\gamma$, D_{δ} , 4472 He, etc. But out of another 20 chromospheric lines within our region of intensity exceeding 20 (Mitchell's values¹), we could detect with confidence only five on our plate, and none out of 140 chromospheric lines of intensity between 8 and 20. This fact must be borne in mind in considering the significance of the lines in the above table. There are no chromospheric lines near them the intensity of which exceeds 7 on Mitchell's scale.

Some of the outstanding features of the spectrogram are mentioned below:

(1) Predominance of the green line $\lambda 5303$.

(2) So far as the region near the eastern limb is concerned, the coronal emission in lower latitudes, especially over the spot zones, appeared to be more intense and to have extended to a higher level than in the polar region.

(3) The fact observed by me that the line $\lambda 6374$, though inferior in intensity, extended farther outward

than $\lambda 5303$ seems to give support to the view of Prof. Mitchell² that they can be classed in separate groups.

(4) The fact that the line $\lambda 725.3$, which has been rejected by Prof. Stratton³ and others from the list of coronal lines, appeared on our plate, points to the necessity of reconsidering the possibility of its being a genuine member of the coronal emission spectrum. In this connexion, it may be cited here that Prof. Tanaka of the Tokyo Imperial University has also pointed out its reality on his spectrogram taken at the same eclipse by means of a three-prism apparatus, giving the wave-length $\lambda 725.4$ by comparison with the iron arc lines⁴. Special attention must be paid to the fair coincidence of the wave-length of this line with that of the nebular line $\lambda 725.7^5$. The lines $\lambda 815.9$ and $\lambda 738.0$ also respectively come close to the nebular lines $\lambda 814.78$ and $\lambda 737$ observed in the spectrum of η Carinae by Moore and Sanford and also by Lunt⁶.

On each of three plates taken by means of another spectrograph with four prisms (60° , 60° , 45° and Rutherford's compound system), which was used without slit, a few monochromatic rings of coronal emission could be detected. We can easily perceive on one of these the difference in the general mode of intensity distribution of the lines $\lambda 5303$, $\lambda 6374$ and $\lambda 704$; thus those lines seem to originate from different kinds of atoms or at least from atoms in different states of excitation. On the same plate there is a short emission arc detected near $H\alpha$. It is rather weak but distinct. Its reality cannot be doubted as judged by its general appearance and by the fact that the curvature is quite consistent with that of $H\alpha$. Moreover, it shows a rather sharp boundary on the concave side, namely, towards $H\alpha$, fading gradually toward the convex side, even manifesting some sort of structure. This arc is limited to the range of position angle a little less than 30° in middle latitude along the north-eastern quadrant of the sun's limb. It may be remarked that this is the region which corresponded to the most active zone of the solar surface at that time, as shown by independent photographs and spectroheliograms. Such a peculiar distribution of emission intensity is quite contrary to that of the other three emission lines, which were observed to extend over other quadrants with remarkable intensity, and lends support to the view that this line belongs to a separate group of atoms.

It is a remarkable fact that the wave-length of the above line calculated by referring to $H\alpha$, $\lambda 6703.5$, $\lambda 6374.2$ and assuming the effective lower boundary of each coronal emission layer to be located at the upper limit of the $H\alpha$ chromosphere, came out to be $\lambda 6583.8$, which nearly coincides with $\lambda 6583.6$, the well-known nebular line⁷ as given by Wright. Moreover, there was detected another faint arc, barely visible near $H\alpha$ on its violet side and over nearly the same range of position angle as $\lambda 6583.6$. The wave-length computed in the same manner as $\lambda 6584$ is $\lambda 6548.7$. This result is also noteworthy since it comes very near the nebular line $\lambda 6548.1$, though the real existence of this arc cannot be regarded as so conclusive as $\lambda 6584$. This, with the former line, was observed⁸ in the spectrum of the Wolf-Rayet star $D.M. + 30^\circ 3630$.

Finally, it is to be remarked that our detection of such weak lines by a prismatic camera owes its success to their chancing to be placed in a part of the spectrum where the photographic density due to

the continuous spectrum was extremely feeble, so as to bring out sufficient contrast of the line against the background; and also to the excellent focusing of the apparatus, which had been attained by using a long and slender neon discharge tube of circular shape with a considerable diameter set at a distance of about 200 metres for focus adjustment and also for rehearsing.

A full account of the work will be given in a paper which is now in preparation to be published shortly.

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Aug. 23.

¹ *Astrophys. J.*, 71, 1 (1930).

² *Astrophys. J.*, 75, 1 (1931).

³ *Mem. Roy. Ast. Soc.*, 64, 106 (1937).

⁴ *Proc. Phys. Math. Soc. Jap.*, (III) 12, 603 (1937).

⁵ Wright, W. H., *Lick Obs. Publ.*, 18, Part vi (1918).

⁶ Baxandall, F. H., *Mon. Not. Roy. Ast. Soc.*, 70, 619 (1910); *Lick, J.*, *Mon. Not. Roy. Ast. Soc.*, 70, 628 (1919).

⁷ Wright, W. H., *Lick Obs. Publ.*, 18, Part vi (1918).

⁸ Wright, W. H., *Lick Obs. Publ.*, 18, Part v (1918); Merrill, W., *Lick Obs. Bull.*, 7, 129 (1918).

THE unusual brightness of the corona at the 1936 total eclipse—it was easily seen several seconds before totality began—has given Prof. Sekiguti and his colleagues the chance of obtaining some new lines in the emission spectrum of the corona. Confirming Prof. Tanaka, he restores the line at 4725 Å., previously rejected as being insufficiently supported, to the list, and points out that this line and several other lines are close to, if not identical with, certain lines in the spectra of nebulae and novae. His new spectral lines strengthen the link between the coronal and nova spectra based previously solely on the presence of the stronger coronal lines in the spectrum of RS Ophiuchi a few weeks after its outburst in 1933.

If Prof. Sekiguti's identification of the two weak arcs in the objective prism spectrograms is accepted, then we have evidence for the first time of a known element in the corona, namely, nitrogen, for the lines 6548, 6584, which Prof. Sekiguti classes together, are forbidden lines in the spectrum of N II. New emission lines in the spectrum of the corona have been reported as secured by Dr. Dunham at the eclipse of last June. Their wave-lengths will be awaited with interest. Before long the last important celestial spectrum of unknown origin may have been identified.

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Phosphorus Exchange in Yeast

THE individual phosphorus atoms present in the leaves of plants have been found¹ for the most part to exchange with great ease within a short time. We extended our experiments to the behaviour of phosphorus atoms present in yeast.

Yeast was grown in a culture solution which, after the lapse of some days, was replaced by a similar solution containing 8.7 mgm. of labelled phosphorus per 100 c.c., besides the usual amount of salts and in some cases ten per cent sugar, in others none. The radioactivity of the labelled sodium phosphate was such that 1 mgm. P corresponded to 1000 activity units. After the yeast had grown for twenty-four hours in the solution containing labelled phosphorus, it was removed, washed carefully and digested by treatment with sulphuric acid and nitric acid. The phosphorus content of the solution of the

yeast was determined both by radioactive measurements and by the usual chemical (colorimetric) analysis.

The results of both determinations for the last set of a long series of experiments are given in the accompanying table. As seen from the later the same figure for the uptake of phosphorus was obtained by the chemical and by the radioactive analysis. We can conclude from this coincidence that no exchange of phosphorus atoms takes place between the yeast and the culture solution. Had such an exchange taken place we would have higher values by the radioactive than by the chemical analysis.

The lack of exchangeability of the phosphorus atoms present in yeast could be interpreted on the assumption that yeast contains little or no readily exchangeable phosphate ions but only phosphorus compounds like hexosephosphates, adenylyphosphoric acid and so on in which the phosphorus atoms are not or are only slowly exchangeable with the inorganic phosphate ions.

An alternative explanation would be that yeast cells are impermeable to phosphate ions except when growing.

Yeast grown	Dry weight of yeast (mgm.)	Total P found by chemical analysis (mgm.)	Total P per mgm. dry weight of yeast	Mgm. P taken up	
				chem. analysis	radio-active analysis
Initial weight and P content of yeast samples used	108.6 108.0 108.4	1.375 1.384 1.361	0.0127 0.0126 0.0126		
In labelled P with sugar at 25°	249.8 250.2 252.3	3.414 3.407 3.390	0.0137 0.0131 0.0134	2.046 2.034 2.017	1.966 1.987 2.005
In labelled P with sugar at 0°	101.4 103.1 101.5	1.395 1.399 1.320	0.0128 0.0127 0.0130		0.004 0.012 0.012
In labelled P without sugar at 20°	89.2 88.1	1.360 1.345	0.0153 0.0153		0.044 0.054

The radium-beryllium mixture was most kindly put to our disposal by Prof. Niels Bohr; we should also like to express our thanks to Mr. V. Hartelius, Mr. H. Lenz and Miss Hilde Levi for their assistance in this work.

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¹ *NATURE*, 137, 66 (1936); 139, 140 (1937).

Glycerophosphoric Dehydrogenase

THE question whether the dehydrogenation of α -glycerophosphoric acid by animal tissues depends upon the catalytic action of coenzyme I (diphosphopyridine-nucleotide) has recently been the subject of controversy¹⁻⁴. The extraction of a very powerful α -glycerophosphoric dehydrogenase preparation from horse brain by a modification of Green's method¹ has offered an opportunity of contributing a few observations.

The enzyme is prepared in the following way: minced horse brain is incubated with two volumes of *M*/20 bicarbonate at 37.5° for 20 minutes. The extract is centrifuged off, care being taken that only the red supernatant layer is decanted, and the

residue washed twice with two volumes of water. The combined extract and washings are brought to pH 4.6 by addition of dilute acetic acid, centrifuged, the precipitate washed twice with distilled water and resuspended in two volumes of *M*/15 veronal buffer, pH 8.2.

Pyocyanine was found to be more active as 'carrier' with this enzyme than either methylene blue or brilliant cresyl blue (Table 1).

TABLE 1.

2 ml. enzyme, 0.3 ml. *M*/3 dl-*N*a- α -glycerophosphate. Values corrected for blanks.

	0.5 ml. <i>M</i> /50 methylene blue	0.5 ml. <i>M</i> /50 brilliant cresyl blue	0.5 ml. <i>M</i> /50 pyocyanine
Oxygen uptake in 10 min. (ml.)	183	184	216

Although the enzyme preparation contained no coenzyme I, its addition did not influence the oxygen uptake at all. This result corroborates the observations of Green¹ and of Dewan and Green². To explain the divergent results of the Stockholm workers who

of the initial velocity of the reaction by coenzyme I would be produced. This hypothesis, however, could not be verified. Only half a molecule of oxygen is taken up per molecule of α -glycerophosphoric acid with and without coenzyme I (Fig. 1).

Supplementary to Green's work, the interesting observation may be added that with our enzyme preparation the final value of the oxygen uptake was almost doubled in presence of cyanide. This is no doubt due to an inhibition of catalase and formation of hydrogen peroxide, which can be demonstrated by the titanium sulphate reaction. The three carriers give the same result. A slow and steady evolution of gas is observed after the reaction is completed owing to the slow decomposition of this peroxide (Fig. 1). This explains the 'stimulating' effect of cyanide on the rate of reaction observed by Green.

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¹ Green, D. H., *Biochem. J.*, **30**, 639 (1936).

² v. Euler, H., Adler, H., Günther, G., and Hellström, H., *Hoppe-Seyl Z.*, **243**, 217 (1937).

³ Dewan, J. G., and Green, D. H., *Biochem. J.*, **31**, 1074 (1937).

⁴ v. Euler, H., Adler, H., and Günther, G., *Hoppe-Seyl Z.*, **240**, 1 (1937).

⁵ v. Euler, H., Adler, H., and Hellström, H., *Hoppe-Seyl Z.*, **241**, 259 (1936).

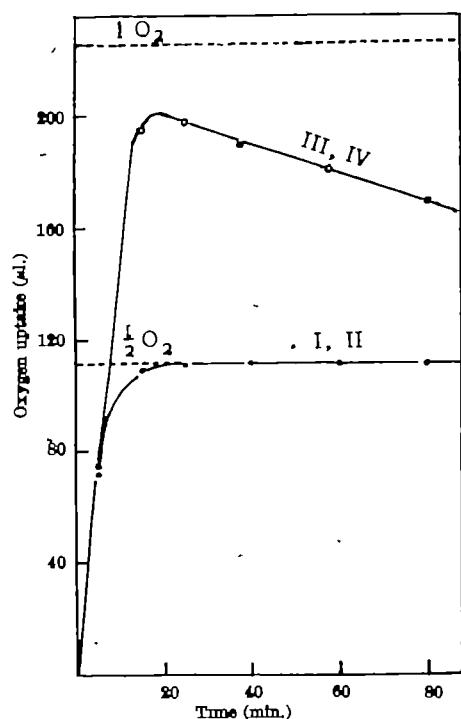


Fig. 1.

(I). 2 ml. enzyme, 0.5 ml. *M*/50 PYOCYANINE, 0.2 ml. *M*/10 dl-SODIUM- α -GLYCEROPHOSPHATE.

(II). 2 ml. enzyme, 0.5 ml. *M*/50 PYOCYANINE, 0.5 ml. 0.8 PER CENT COENZYME I, 0.2 ml. *M*/10 dl-SODIUM- α -GLYCEROPHOSPHATE.

(III). SAME AS I + 0.2 ml. *M*/2 CYANIDE.

(IV). SAME AS II + 0.2 ml. *M*/2 CYANIDE.

reported an acceleration of the reaction by coenzyme I⁴, the assumption was made that the preparations of α -glycerophosphoric dehydrogenase contained another enzyme oxidizing the triosephosphate further to phosphoglyceric acid and depending on coenzyme I. Such an enzyme has been found in yeast⁵. In that case half a molecule of oxygen per molecule of α -glycerophosphoric acid should be taken up in absence of coenzyme I and one molecule in its presence. It is possible that in such a case, with an excess of α -glycerophosphoric acid, no acceleration

The Effect of Enol-Esters of Testosterone

ENOL-ESTERS from the series of male sex hormones were first prepared by L. Ruzicka and W. H. Fischer¹. Experiments carried out in our laboratories showed that testosterone diacetate was less active on the caapon's comb than the testosterone monoacetate, but that in single injection (2 mgm.) it was more active than testosterone monoacetate on rats². Deaneely and Parkes³ recently compared the effect of testosterone monoacetate and testosterone diacetate, and the results of their experiments indicated that these two substances are similar as regards activity. In the meantime, our experiments were extended to the previously described dipropionate and also to two newly prepared enol-esters of testosterone. The technique corresponds to that earlier described by Miescher, Wettstein and Tschopp⁴.

TABLE 1.

Testosterone Esters	Int. Unit measured on the caapon's comb	Max. effect is attained on the
Testosterone-5, 17-diacetate ..	35 γ	10th day
" -3-acetate-17-propionate, ..	40 γ	12th "
" 140-141° F. ..	45 γ	14th "
" -3, 17-dipropionate ..	45 γ	14th "
" -3-acetate-17-n-butylate, ..	200 γ	15th "
" 97-98° F. ..	20 γ	7th "
" -17-acetate ..	20 γ	9th "
" -17-propionate ..	20 γ	14th "
" -butylate ..	60 γ	15th "

Caapon's comb. As will be seen from Table 1, the effect of testosterone diesters on the caapon's comb is in general less intense but rather more prolonged than that of the mono-esters.

Rats. Fig. 1 shows that also in the 10-day test (10 daily injections; examination on the 11th day) the effect of the enol-esters on the seminal vesicles of castrated rats is less than that of, for example

estosterone propionate (Perandren). The longer the chain of the acid groups the less the effect. This also applies to the prostate.

A different picture is obtained if merely a single injection (2 mgm.) is given and the total temporal course of the effect is considered. The activity of testosterone diacetate in the seminal vesicles (Fig. 2) is between that of the monoacetate and that of the propionate. The remaining enol-esters, however, exercise a much more intensive influence. With these the maximum effect is considerably higher and is reached considerably later. Of all known compounds of the male sex hormone series, testosterone-3-acetate-17-butyrate exhibits the most prolonged effect. Forty days after a single injection, the weights of the seminal vesicles and prostate amounted to 140 mgm. and 190 mgm. respectively, and attained on the 50th day 90 mgm. and 160 mgm. respectively (controls: 14 mgm. and 45 mgm. respectively). In comparison the duration of the effect of a similar dose of testosterone is seven days and that of a similar dose of testosterone propionate about twenty days.

The utilization of testosterone by the organism varies apparently according to the degree of esterifica-

tion. An efficiency coefficient is calculated by comparison of the surfaces bounded by the respective

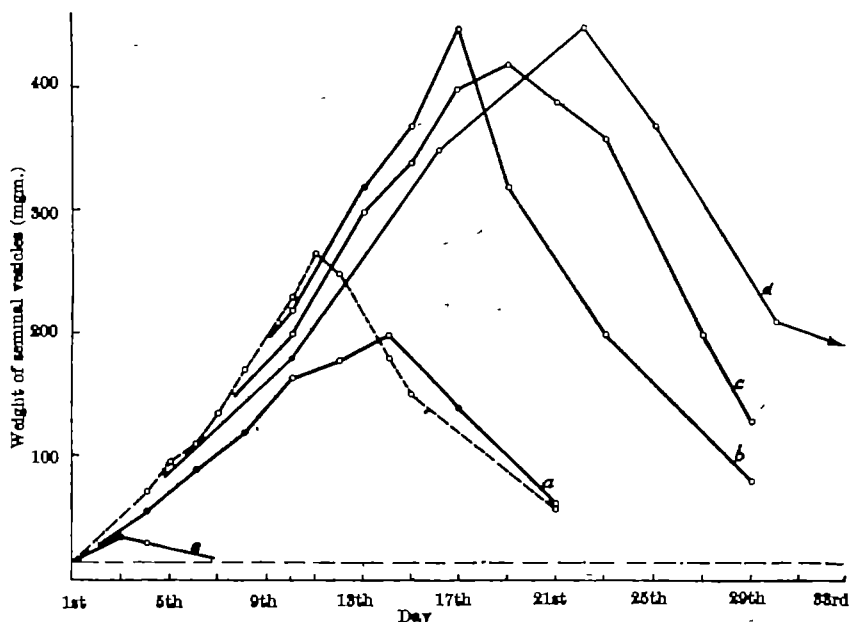


Fig. 2.

EFFECT OF TESTOSTERONE ENOL-ESTERS ON THE WEIGHT OF SEMINAL VESICLES (METHOD OF SINGLE INJECTION).

a: T-3,17-diacetate; b: T-3-acetate-17-propionate; c: T-3,17-dipropionate; d: T-3-acetate-17-n-butyrate. T = testosterone. Broken curve: T-17-propionate.

than when measured on the prostate. Based on equimolecular quantities the efficiency coefficient of the esters would be still more favourable.

TABLE 2
EFFICIENCY COEFFICIENT OF THE ESTERS*, BASED ON TESTOSTERONE AS THE UNIT, USING SINGLE INJECTIONS OF 2 MGm.

Testosterone Esters	Seminal Vesicles	Prostate
Testosterone-3, 17-diacetate	28	25
" -3-acetate-17-propionate	77	51
" -3, 17-dipropionate	90	62
" -3-acetate-17-n-butyrate	137	81
" -17-propionate	33	23

* Determined by estimating the completion of the curves.

The hypothesis put forward earlier¹, that enol-esters of testosterone belong to the most active hormones, has been confirmed on rats (but not on castrons). In the ten-day test, the enol-esters appear to have a lesser activity, but this is due to a somewhat delayed onset of effect; their maximum effect being attained much later than on the eleventh day. Similar investigations to those dealt with in this report should be carried out on other animals, as apparently the efficiency coefficient varies according to the different species of animals.

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Sept. 1.

¹ Ruzicka, L., and Fischer, W. H., *Helv. chim. Acta*, 19, 806 (1936).

² Ruzicka, L., and Fischer, W. H., *Helv. chim. Acta*, 19, 1371 (1936).

³ Deansly, B., and Parkes, A. S., *Biochem. J.*, 31, 1161 (1937).

⁴ Miescher, K., Wettstein, A., and Tschopp, H., *Biochem. J.*, 30, 1970, 1977 (1936).

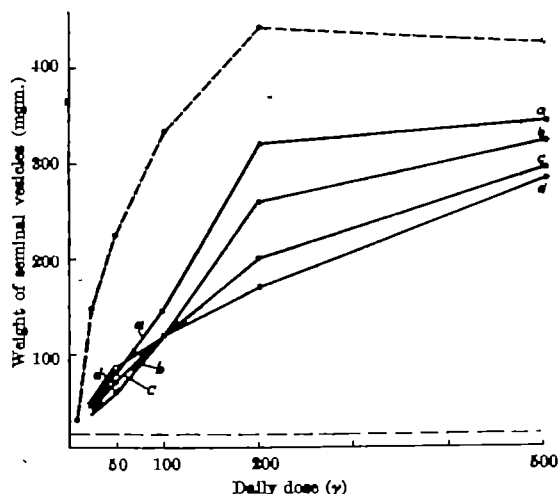


Fig. 1.

EFFECT OF TESTOSTERONE ENOL-ESTERS ON THE WEIGHT OF SEMINAL VESICLES (METHOD OF TEN INJECTIONS).

a: T-3,17-diacetate; b: T-3-acetate-17-propionate; c: T-3,17-dipropionate; d: T-3-acetate-17-n-butyrate. T = testosterone. Broken curve: T-17-propionate.

tion. An efficiency coefficient is calculated by comparison of the surfaces bounded by the respective

Changes in Chloroplast Pigments in Leaves during Senescence

Loss of chlorophyll in senescent leaves is a general phenomenon, and various views have been put forward to explain how chlorophyll disappears as the leaf yellows. The possibilities recognized are: (1) the decomposition of chlorophyll into its basic components and the transference of the latter to places of storage; and (2) the transformation of chlorophyll into certain substances likely to function during senescence.

Meyer¹ suggested that chlorophyll decomposes and is then borne away, while the yellow pigments remain as they were in the leaf. His conclusion having been reached without any quantitative estimations, it can only be regarded as tentative. Swart² concludes that chlorophyll is decomposed and nitrogen translocated. Stoklasa, Senft and Sebor³ believe that the autumnal changes of colour depend on the hydrolytic fission of chlorophyll and the formation of phyophytin and phosphatids.

In the course of our studies on the seasonal variations in the chloroplast pigments of tropical plants, the data obtained pointed to the possibility of a conversion of chlorophyll to carotenoids during the yellowing of the leaves.

Leaves of *Bassia latifolia* examined passed through the following stages during senescence; after dark green, bright green 10 days, green 15 days, yellow green-yellow 6 days (at this stage yellow spots appeared along the marginal veins), almost yellow 2 days and then bright yellow. The results of the pigment analysis at these successive stages are set forth in the accompanying table.

Stage of senescence	Chlorophyll*	Carotin*	Xanthophyll*
Dark green	23.68	9.84	7.21
Bright green (5 days after the dark green stage)	17.96	10.41	7.91
Green (15 days after the dark green stage)	11.34	11.06	8.84
Yellow green-yellow (30 days after the dark green stage)	6.25	16.06	11.72
Almost yellow (36 days after the dark green stage)	1.16	17.25	14.21
Shedding (42 days after the dark green stage)	0.00	3.45	2.10

* Expressed as mgm. per 10 gm. of dry weight.

The chlorophylls ($a + b$) were determined by the procedure recently developed by us⁴: the measurement of light absorption of an alcoholic extract (80 per cent methyl alcohol) of plant pigments within a narrowly defined region of the spectrum, for which the chlorophylls ($a + b$) possess a marked absorption, while the absorption of the other pigments is infinitesimal. Carotin and xanthophyll were determined by a new spectrophotometric method, a description of which will appear shortly.

The data indicate that during the different stages of the yellowing of the leaf, as chlorophyll decreases, there is a corresponding rise in the carotenoids, the increase in carotin being more than that in xanthophyll. Further, at the shedding stage of the leaf, the carotenoids disappear almost completely.

On a consideration of the results presented here, in conjunction with the experimental results of Ewart⁵ that carotin is present in greater amounts

when chlorophyll is absent and carotin apparently decreases as chlorophyll increases, it appears that the increase in carotenoids during the yellowing of the leaves is a consequence of the disappearance and transformation of chlorophyll.

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Sept. 18.

¹ Meyer, A., *Flora*, 85 (1918).

² Swart, N., *Jena* (1914).

³ Stoklasa, J., Senft, H., and Sebor, J., *J. Chem. Soc.*, 106 (1914).

⁴ Singh, B. N., and Anantha Rao, N. K., *Chem. Sci.*, 8, 416 (1937).

⁵ Ewart, A. J., *Proc. Roy. Soc. Victoria*, 80, 187 (1918).

River Flow around Bends

In two paragraphs in the News and Views column of NATURE of September 18, a lecture on "Rivers", delivered in connexion with the recent meeting of the British Association by Mr. R. Kay Greenwell, was summarized. A statement made in this report requires comment on the ground that, while undoubtedly representing a view held by a considerable number of competent geographers, geologists, and others, it is at variance with the facts as established experimentally many years ago by the late Prof. James Thomson.

The statement was as follows: "In turning a corner, the speed on the outside of the curve is always greater than that on the inside. This results in the water on the outside being able to take an additional load and so erode the bank." The erosion of the bank is incontrovertible; it is universally in evidence, but Prof. Thomson's investigations showed that the erosion is not due, as alleged, to greater velocity on the outside of the curve. On the contrary, the velocity there is less than on the inner side of the bend.

Prof. Thomson's explanation of the matter is contained in papers contributed to the Royal Society (*Proc.*, 28, 356) and the Institution of Mechanical Engineers (*Proc.*, p. 456; 1879). I have not the original papers at hand, but I venture to quote as follows from the authoritative article on "Hydro-mechanics" by the late Prof. W. Cawthorne Unwin, in the "Encyclopedia Britannica" (ninth edition, 1881, vol. xii):

"When water moves round a circular curve under the action of gravity only, it takes a motion like that in a free vortex. Its velocity is greater parallel to the axis of the stream at the inner than at the outer side of the bend. Hence the scouring at the outer side and the deposit at the inner side of the bend are not due to mere difference of velocity of flow in the general direction of the stream; but, in virtue of the centrifugal force, the water passing round the bend presses outwards, and the free surface in a radial

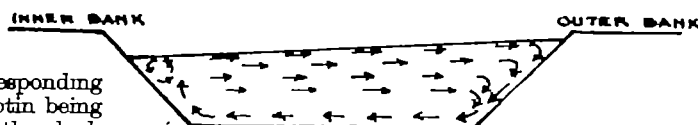


Fig. 1.

cross section has a slope from the inner side upwards to the outer side (Fig. 1). For the greater part of the water flowing in curved paths, this difference of

pressure produces no tendency to transverse motion. But the water immediately in contact with the rough bottom and sides of the channel is retarded, and its centrifugal force is insufficient to balance the pressure due to the greater depth at the outside of the bend. It, therefore, flows inwards towards the inner side of the bend, carrying with it detritus which is deposited at the inner bank."

This explanation of Prof. Thomson's, which he completely verified by experiment, has long been known to, and accepted by, river engineers, and it is unfortunate that, through unawareness of it, an incorrect, though admittedly plausible, view of the action of rivers at bends should still be entertained and disseminated.

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Gravitational Statics in Three Dimensions

THE commonly accepted case for three-dimensional gravitational statics is far from complete. On the Faraday tube hypothesis, a diagram shows that gravitational tubes of force attract laterally and exhibit a thrust longitudinally. Each pressure is $g^2/8\pi G$ dyne.-cm.⁻², where g is the field intensity and G Newton's constant. The field has energy $-g^2/8\pi G$ erg.-cm.⁻³, the negative sign holding because if work is done against, that is, added to the field, for example, by expanding a sphere, the numerical value of the field's energy-volume integral is diminished, positive and negative energy being annihilated in the process, which naturally is reversible.

By the mass-energy relation, which, of course, need not be taken as proceeding from four-dimensional theory, we are forced to ascribe to the field a mass-density, $-g^2/8\pi G c^2$ gm.-cm.⁻³, and we have

$$\text{div } g = -4\pi G \rho + \frac{g^2}{2c^2}, \quad \dots (1)$$

where ρ is the positive mass-density at the point. Corresponding to electricity, the conceptions of negative mass and energy are gravitational only; inertially, they are absurd.

Applying (1) to a sphere of mass M , uniform density ρ , and radius R , the internal field is given by

$$g = k c \tanh \frac{kr}{2c} \quad \dots (2)$$

where $0 < r < R$ and $k = (8\pi G \rho/3)^{1/2}$. Now, keeping $r < R$ let both tend to infinity. g tends to the constant value g , equal to kc , so that $-g^2/8\pi G c^2 = -\rho/3$. If these arguments are sound, they dispose of Einstein's objection¹ to an infinite Newton-Faraday universe. Again, if $g = g_0$ when $r = R$, we get

$$4\pi R^3 g_0 = 4\pi G M \sqrt{\frac{2}{\gamma}} \tanh \sqrt{\frac{\gamma}{2}} \quad \dots (3)$$

where $\gamma = GM/c^2 R$. That is, the number of unit tubes threading the surface varies even with M constant.

The external field is given by

$$g = \frac{G \Delta}{\left(1 + \frac{1}{2} \frac{G \Delta}{c^2 R}\right) r^2 - \frac{1}{2} \frac{G \Delta}{c^2} r} \quad \dots (4)$$

where $R < r < \infty$, and Δ is defined by $g_0 R^2 = G \Delta$,

being related to M by (3). If $\gamma \ll 1$ and $r \gg R$, then in (4) we may replace Δ by M and reject the second term in the denominator on the right hand side. Differentiating, we get

$$\frac{\partial g}{\partial M} = \frac{G}{r^2} \left(1 - \frac{5}{8} \gamma\right),$$

which is simply the relativistic claim that a particle apparently loses mass when lowered slowly into a gravitational field.

Finally, since the field is not a true inverse square, it is not in equilibrium, the resultant force being clearly directed towards expansion. To approximate the conditions in our own universe, treated as a huge sphere the constituent particles of which are free to move, if we exclude all sources of energy-supply for this force but the field itself, spontaneous expansion will begin only if the total field energy can become more negative in the process so as to allow the further creation of positive energy. Actually, our universe cannot be infinite for its observed expansion would then be meaningless. This is impossible if $\gamma \ll 1$, but when γ compares with unity, it has a range of values satisfying this condition. Thus the recession of the spiral nebulae is due, not to real repulsion, but to the field's intrinsic instability, and, *ceteris paribus*, such an expansion, once started, would become oscillatory. These high values of γ for a sphere make the total field energy comparable with the total positive energy, and exact evaluation (which for one of the two necessary integrals does not appear to be simple) would probably reveal that the algebraic sum of the quantities of all forms of energy is zero under these conditions. Applied to our universe, such a result is manifestly philosophically necessary and conclusive.

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415, The Strand,
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Sept. 20.

¹ Einstein, A., "Relativity. The Special and the General Theory", pp. 106-108.

Snow Crystal or Snowflake

IN the introduction to his useful summary in NATURE of August 28, p. 345, of Prof. U. Nakaya's physical investigation on falling snow, Mr. G. Seligman writes: "he [Prof. Nakaya] proposes to continue to call a particle of falling snow a 'snow crystal' in preference to my 'snowflake'. As all snow, whether falling or having lain on the ground for months, is crystalline, the word 'snow crystal' is likely to lead to ambiguity. I admit that 'snowflake' ('simple' for a single crystal; 'compound' for an assemblage) is not perfect, but until a better word is devised it must, I fear, remain."

I regret to have to disagree with Mr. Seligman, who is doing so much to revive the study of snow and glaciology in Great Britain, but I cannot accept his use of the word snowflake to describe the single ice crystals of which snow is composed. In the choice of scientific words great care must be taken not to extend the meaning of words in common use beyond their ordinary significance. Now the compound word 'snowflake' has a very definite meaning in the English language and is applied only to that variety of atmospheric precipitation which occurs in the form of loosely cohering masses of ice crystals. To quote

the "Concise Oxford Dictionary": "Flake—light fleecy tuft or piece, esp. of snow." It is the 'fleecy' quality which is essential to a snowflake, and this fleecy quality is given by the cohering together of a number of ice crystals. It is, therefore, an inadmissible extension of the word snowflake to apply it to the individual ice crystals composing the flake, which have nothing fleecy about them and would not be described as snowflakes if exhibited individually to anyone familiar with the English language but unacquainted with the nature of snow.

I may mention that Prof. Nakaya's use of the terms snowflake and snow crystal is in full agreement with the practice of the Meteorological Office as set out in the "Meteorological Glossary" published by the Office.

G. C. SIMPSON.

Meteorological Office,
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Sept. 7.

I AGREE with Sir George Simpson that the word 'snowflakes' is not a perfect description of a single ice crystal falling as snow (indeed I said so in the passage which he quotes), but can a better be found?

'Snow crystal' is not good, for after having fallen the snow particles remain snow crystals or crystallites right through the *firn* stage until they become the ice crystals of pure glacier ice. Therefore in a description of snow phenomena it is continually being found that some separate designation is required to differentiate between snow crystals in the falling and the fallen states, the more so because their characteristics in the two states are quite different.

My 'flake' is not quite so bad as Sir George suggests, for I choose it after consulting "Webster's Dictionary", which gives: "A loose, filmy or scale-like mass; a film; a flock; lamina; . . . and on turning to 'lamina' I find: "A thin plate or scale."

I may say that Prof. Nakaya has now accepted my nomenclature; nevertheless, I am still not completely satisfied with it and will gladly accept a better name for the particle of fallen snow, though not, I fear, the appellation 'snow crystal' which, as I have tried to show, applies equally to the falling and the fallen condition, and is therefore ambiguous.

GERALD SELIGMAN.

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Surrey.

(Chairman of the British
Group of the International
Commission of Snow.)

Points from Foregoing Letters

A PHOTOGRAPH showing an enlargement of the green mercury line in the third-order spectrum obtained by means of an aluminized diffraction grating with 30,000 lines to the inch is submitted by Prof. R. W. Wood. Gratings with 15,000 lines to the inch give high concentration of light in the first-order spectrum and have been used with very good results at Mt. Wilson Observatory. Replicas of such gratings made by flowing on them a nitro-cellulose solution have been successfully used by the Lick and Harvard Observatories for studying the extreme red and infra-red spectra of the stars, and for obtaining the distribution of the different gases in nebulae. Prof. Wood hopes to prepare both plane and concave gratings by the use of plastics and a moulding process.

A table showing the wave-lengths of a number of new lines in the spectrum of the corona observed during the solar eclipse of June 19, 1936, is given by Prof. R. Sekiguti, who discusses some of the features of the spectrogram. The new observations confirm the existence of the line 4725 Å. This and other lines are close to certain lines in the spectra of nebulae and novae. Prof. F. J. M. Stratton remarks that if Prof. Sekiguti's identification is accepted, then in the lines 6548 and 6684 we have evidence, for the first time, of a known element in the corona, since these lines are ('forbidden') lines in the spectrum of nitrogen (N II).

Experiments by Prof. G. Hevesy, Dr. K. Linderström-Lang and N. Nielsen indicate that, unlike plants, yeast cells immersed in a solution containing 'labelled' (radioactive) phosphorus atoms (as phosphates) do not take up or exchange such atoms. This may mean either that all the phosphorus in the yeast is in bound organic form (as hexosephosphates or adenyolphosphoric acid) or that yeast cells are impermeable to phosphate ions except when growing.

Dr. H. Weil-Malherbe finds that the addition of

coenzyme I to α -glycerophosphoric dehydrogenase does not affect its ability to take up oxygen and to dehydrogenate α -glycerophosphoric acid. A powerful dehydrogenating enzyme was obtained from horse brain by using pyocyanine as carrier.

Dr. K. Miescher, W. H. Fischer and E. Tschopp report on the effect of enol-esters of testosterone on the capon's comb and on the sexual organs of the rat. They state that the enol compounds produce on the rat, but not on the capon's comb, the strongest and longest duration of all hitherto known male hormones.

Prof. B. N. Singh and N. K. Anantha Rao find that in the tropical plant *Bassia latifolia*, as the leaves grow old and the amount of green colour (chlorophyll) decreases, there is an increase in the carotin and xanthophyll, colouring matter, but these also disappear almost completely at the shedding stage of the leaf.

Dr. B. Cunningham points out that the widely held view that, at a river bend, the speed of the water on the outside of the bend is greater than on the inside, does not agree with the observations of the late Prof. J. Thomson. He found a vortex type of motion which led to the velocity being greater on the inner side of the bend. The erosion of the outer side is due, in these circumstances, to a transverse current of water which flows along the bottom towards the inner side, carrying with it detritus.

S. D. Emalie develops the Faraday tube hypothesis for the treatment of gravitation and, by introducing the mass-energy equation, arrives at a relation for the field intensity which, he claims, disposes of Einstein's objection to an infinite Newton-Faraday universe. Further considerations lead him to the view that the recession of the spiral nebulae is due, not to a real repulsion, but to the field's intrinsic instability, so that an expansion once started would become oscillatory.

Research Items

Paleolithic Man in Norfolk

SOME time ago, Mr. J. E. Sainty made known the discovery of a paleolithic hand-axe at South Acre, Norfolk (*Proc. Preh. Soc. E. Anglia*, 7, Part 3). More recently he has found others lying upon the stone heaps in the pit, and there is little doubt that these specimens are referable to some phase of the Clacton II industry. During September, Mr. Reid Moir and Mr. J. B. Calkin visited South Acre and found, at a depth of about 15 ft. in the deposit, exposed there upwards of forty Clacton flakes and rough-outs. This deposit is of a remarkable character, being composed of great numbers of large flints and other stones embedded in a hard sandy matrix very rich in manganese. The gravel—if such it can be called—exhibits no signs of stratification, but is contorted and twisted by glacial action or solifluxion to a marked degree. Though this is the case, and while it is claimed by some that the process of solifluxion inevitably gives rise to extensive flaking upon flints, transforming them into rostro-carinate and other early forms, it is significant that the Clactonian specimens from South Acre show no signs of such flaking. They are patinated white, and in nearly every case show little or no abrasion. The deposit in which they are found is clearly to be correlated in time with the uppermost Cannonshot gravel of Norfolk, which in its turn equates with the Upper Chalky Boulder Clay of Suffolk. The South Acre implements were made, therefore, at the close of the well-known Hoxne interglacial period, which intervened between the deposition of the Kimmeridgian and Upper Chalky Boulder Clays. Moreover, at Slindon in Sussex, Mr. Calkin discovered a paleolithic floor resting upon a raised beach and covered by Coombe Rock. The specimens from this floor are precisely similar to those from South Acre both in their forms, technique and condition; and the deposits at both sites rest at 124–130 O.D., while each also is rich in manganese, which has attached itself freely to the flint implements. Thus, it is now possible to link up the Coombe Rock of Slindon with the South Acre deposit, and this with the Upper Chalky Boulder Clay. It is evident that the glaciation responsible for the laying down of these various deposits was of the same order. The South Acre gravel is more than 50 ft. in thickness, while as far south as Slindon a considerable deposit of Coombe Rock was accumulated.

Research at Cullercoats

THE report of the Dove Marine Laboratory, Cullercoats, Northumberland, for the year ending July 31, 1936, published by the Marine Laboratory Committee of Armstrong College (1937) and drawn up by the director, Prof. A. D. Hobson, shows a very satisfactory progress in all directions. Herring investigations by Mr. Storrow and Mrs. Cowan, chiefly on behalf of the Ministry of Agriculture and Fisheries, continue as before, and observations are also made on the Tyne salmon, a full account of which has already been published in the annual report of the Tyne Salmon Conservancy Board for 1935. The mussels in the Eas Estuary were examined on behalf of the North-Eastern Sea Fisheries Com-

mittee in view of increasing bait supply. Transplantation of several tons of mussels has given good results, and it is recommended that further supplies be transplanted. Dr. Bull continues his studies on conditioned responses in fishes. He has now begun to investigate the ability of fishes to perceive alterations in the rate of current flow. Special attention is given to those environmental factors which might be expected to affect purposive movements of fishes or condition their migration, most of this work being of a pioneer nature. Papers on herring investigations and on mussel transplanting are included in the report, and in addition there are two very interesting contributions, "The Development of *Capitelloides giardi* Meunil" by J. A. Day, which was breeding in the aquarium and offered a good opportunity for study of the life-history, and "Notes on the British Species of the Genus *Galathea* Fab.", by H. O. Bull. The latter effectively solves the much-debated problem concerning the validity of the species *Galathea neza*, which is shown both in structure and in the nature of the larva to be a distinct species.

Plant Ecology of Limestone Pavements

IN a paper read before Section K (Botany) of the British Association meeting at Nottingham, Miss A. Bennett discussed the ecology of the limestone pavements at Hutton Roof and Farleton, Yorkshire. Vegetation of limestone areas depends on three types of ground configuration, namely, pavements, escarpments and screes. Exposure to weather and angle of slope control the accumulation of soil and hydrogen ion concentration, and these of course affect the type of vegetation. One important biotic factor is that of grazing, which keeps the vegetation at the sublimax stage. A certain mixture of plants occurs owing to invasion of vegetation from nearby siliceous soils. The detailed distribution of certain species has been studied. For example, the hane-berry (*Arctostaphylos uva-ursi*), has been recorded as following a fault, but being unable to traverse a ten-mile glacial drift. As a dynamic ecological hypothesis, formulated from her records of the static ecology, the author suggests that in this area certain virgin country is being colonized and in others denudation has occurred and the vegetation is retreating.

Metamorphic Rocks of Unst, Shetland Island

PROF. H. H. READ has dealt with the polymetamorphic rocks of the Valla Field Block, one of the tectonic units of Unst. (*Trans. Roy. Soc. Edinburgh*, 59, Part 1 (6), 195–221; 1937). The metamorphic history of this block has been divided into three stages, each characterized by the type of pressure-temperature factors then operative. The First metamorphism was controlled by fairly high temperature and considerable stress; the Second by lower temperature and much greater stress; and the Third by low temperature and very localized strong stress. In true pelitic rocks, three distinctive mineral assemblages characterize the three metamorphic episodes. In calcareous rocks, diopside-bearing rocks of the First metamorphism are replaced by tremolite-bearing rocks in the Second, and the tremolite is

mechanically deformed during the Third. The change from diopside to tremolite takes place under about the same conditions as the change from biotite to chlorite in pelitic rocks. In rocks of other types—siliceous, hornblendi, pegmatites and injection-rocks—the mineral assemblages of the First metamorphism are stable throughout the Second and Third, though these minerals are deformed and often completely shredded-out during the later episodes. The general conclusion is advanced that in retrogressive metamorphism the stability of an assemblage depends on the bulk-composition of the rock, and that no mineral can be considered adequately apart from the rock in which it occurs.

Distribution of Electricity in Thunderclouds

Sir George Simpson and F. J. Scrase (*Proc. Roy. Soc., A*, 161, 309) have investigated the distribution of electricity in thunderclouds by a very direct method. A sounding balloon carries a trailing wire about 20 m. long terminated by a point at the lower end and a system of points at the upper end. When the balloon goes through a region of high potential gradient a point-discharge current flows in the wire. In a break in the circuit a paper disk soaked in a chemical solution is included, and the passage of a current leaves a characteristic discoloration at the positive electrode. The disk is rotated by a clock, and the direction of the point discharge current can be obtained from the traces. An idea of the magnitude of the potential gradient could be obtained from the width of the trace, and when the currents were very large the paper was charred by sparking. The height of the balloon was recorded continuously. Simultaneous records of electric field near the ground were taken. The results show that the most typical thundercloud has a positive charge at the top, a negative charge over most of the remainder, and a concentrated region of positive charge somewhere near the base. The authors consider that the breaking-drop theory of Simpson explains the concentrations of positive charge in the base of the cloud. The explanation of the positive electrification at the top of the cloud is sought in the presence of ice crystals or snow in these regions, which become electrified by friction or in some other way. The explanation given by C. T. R. Wilson, involving the electrical polarization of the falling drops, is held to be invalidated by the low temperatures of the relevant regions in the cloud, which are supposed to contain ice crystals rather than water drops. The paper contains considerable discussion of the configurations of thunderclouds. The results are not inconsistent with the idea that the circulation of electricity in the atmosphere is maintained by thunderstorms and shower clouds.

Absorption Edges in the Soft X-ray Region

H. W. B. Skinner and J. E. Johnston (*Proc. Roy. Soc., A*, 161, 420) have investigated the structure of the absorption edges of some metals in the wave-length region 100–300 Å. These edges correspond to transitions from an inner electron shell to the conduction-electron levels of the metal, and their fine structure therefore provides a method of investigating the distribution of the conduction levels. The spectrographic apparatus is a concave grating used at a small grazing angle, and Ilford Q plates are used. The absorbing metals were used as thin foils obtained by evaporation on to a celluloid film supported

on naphthalene which was then sublimed away. No light source giving a continuous spectrum was available, and a condenser spark in vacuum, usually with copper or silver electrodes, was used. A special technique of photographic photometry was developed to deal with the difficult conditions of a fluctuating source of line spectrum. Absorption curves were obtained for the K edge of Li in the metal and in LiOH, the L edges of Mg, and the M edges of Cu and Ni. A paper connecting these edges with the electron theory of metals is promised.

Ionosphere Disturbances

DR. J. H. DELLINGER has summarized the results obtained by the world-wide co-operative study of the fading out of high-frequency radio transmission for short periods during daylight, and the simultaneous perturbations of terrestrial magnetism (*J. Research, U.S. Bur. Stand.*, August 1937). Half the 118 disturbances investigated were accompanied by solar eruptions seen as sudden increases of brightness of large patches of the sun's surface. A detailed discussion of the observations leads Dr. Dellinger to the conclusion that the whole of the effects may be explained as due to an increase of ionization of the D layer of the atmosphere below the already known E, F₁, and F₂ layers at heights 120 km., 220 km. and 320 km. respectively, at which radio waves are as a rule reflected. This ionization, he considers, is due to an electromagnetic radiation of a penetrating type and of a frequency far greater than that of light emitted in all directions from eruptions on the surface of the sun. During the eighteen months of observation there is some indication of a 55-day period in the disturbances. Further observations are likely to add materially to our knowledge of the sun.

Pierre Gassendi (1592-1655)

A SHORT memoir, entitled "L'Œuvre Astronomique de Gassendi" by Prof. P. Humbert of the University of Montpellier recalls the work of one of the most notable observers in the first years of telescopic astronomy (*Actualités scientifiques et industrielles* 378. Pp. 32. Paris: Hermann et Cie., 1936. 8 francs). Pierre Gassendi was a philosopher, theologian, mathematician and, pre-eminently, an astronomical observer whose precise records of observations might well serve as precepts to be followed by astronomers of the present day. He was a diligent observer of sunspots (especially from 1620 until 1626), a joint compiler with Peirece of one of the first maps of the moon, an observer of a number of solar and lunar eclipses between 1621 and 1654, of occultations of planetary phenomena, the comets of 1618 and 1652, the great aurora of 1621, and of perihelia. But perhaps the observation which gave him the greatest pleasure was that of the transit of Mercury on November 7, 1631, which Kepler had predicted in 1629. This first observation at Paris ever made of a transit of Mercury had its counterpart in England in 1639, when Horrocks and Crabtree observed the rarer phenomenon of a transit of Venus across the sun's disk—the sole prediction of which Horrocks had derived just before the event when working on his corrections of Kepler's Rudolphine Tables of 1627. Eight years earlier, Gassendi had, indeed, watched the sun's disk on four consecutive days for the transit of Venus of 1631, as predicted by Kepler but the transit took place on December 6 when inaccessible to observation from Europe.

Invertebrates of the Faroes*

PUBLISHED at the expense of the Carlsberg Fund and accordingly sold at a very reasonable price, this monograph will appeal to a wide circle of workers interested in taxonomy and geographical distribution.

Most of the sections on marine Crustacea are by C. Stevensen and, of the Decapoda, twenty-nine species are now known from these islands. The majority of them seem to be rare, having only been taken a few times, or even a single time, and only six species are really abundant. Although the Faroes are only about 160 miles from the Shetlands, their Decapod fauna is comparatively poor, since the last-named islands contain forty-eight or forty-nine species. It seems that the deeps south-east of the Faroes are impassable to numerous littoral and sub-littoral species. Of the Amphipoda only twelve species were previously known, while the present work brings up their number to no fewer than sixty-one species. (The greater number of these belong to the epi-fauna living among algae or Hydroids, etc.) and the majority are common north-west European or arctic-boreal species. Previous records of the Isopoda and Tanaidacea are contained in works of H. J. Hansen (1913 and 1916). The present work contains only two species not listed by this author. Of the Mysidacea, Cumacea and Nebaliacea, only seven species are at present recorded, which is a very small number as compared with ninety-eight species for surrounding waters (Iceland, Shetlands (or Sootland) and Norway).

Of the Cirripedes it is noteworthy that six species were known from the Faroes so long ago as the year 1800 and, since then, only five have been added to that number. The marine Ostracoda have hitherto remained almost totally unknown and, in the present work, fifteen species are dealt with, but some of them could not be named with certainty. The majority are widely distributed and common. The fresh-water Crustacea are discussed by E. M. Poulsen, and

forty-one species are enumerated: while they show features recalling the more arctic regions, those of temperate zones predominate.

Of other Arthropoda, P. Hammer and K. L. Henriksen discuss the Myriapoda, of which seven species are identified: all these occur also in Britain excepting the Chilopod *Pachymerium ferrugineum*. Among the Insecta, K. L. Henriksen describes the members of several of the smaller orders. The only Thysanuran recorded is *Petrobius balticus*, a species often confused with *P. maritimus*. Of the thirteen species of Collembola the main part consists of Palearctic forms, widely distributed on the Continent as well as in Great Britain. The only Orthoptera are *Forficula auricularia* and *Blatta orientalis*. The Mallophaga comprise thirty-one species, but this total is obviously incomplete since no parasites off the puffin are recorded. While dragonflies, mayflies and stoneflies are unrepresented, and there is only a single Neuropteran (*Borimysia betulina*), seventeen species of Trichoptera are recorded. In the account of the Lepidoptera by N. L. Wolff thirty-two species are enumerated. The only butterflies are *Pyrausta atalanta* and the cosmopolitan *P. cardui*. None of the moths is endemic.

The concluding part of the volume is A. West's account of the Coleoptera, wherein some 156 species are enumerated. The Carabidae, with twenty-six species, and the Staphylinidae, with sixty-five species, are the only two large families at all well represented. A predominating feature is the close resemblance of the Coleopterous fauna of the Faroes with that of Scotland and Norway. Only five Faroese species have not been found in Sootland and only three have not been discovered in Norway, while sixty-three species do not, apparently, occur in the Shetlands. The last-named islands, however, have not been so thoroughly investigated as the Faroes. The orders Hemiptera, Diptera and Hymenoptera are not included in the present issue.

When complete the work will be published in three volumes, each in two parts. The whole is expected to be completed in 1938.

A. D. INNES.

* The Zoology of the Faroes. Edited by Ad. S. Jensen, W. Lundbeck, Th. Mortensen and B. Spilrock. (Published at the expense of the Carlsberg-Fund.) Vol. 2, Part 1: Crustacea, Myriapoda, Insecta I. p. 111+346. (Copenhagen: Andr. Fred. Hest and Son, 1937.) 16s.

West Middlesex Main Drainage

THAT part of the county of Middlesex lying to the west of the Finchley and Barnet Ridge has an area of about 160 square miles and is drained by four main streams, the Colne, the Aah, the Crane and the Brent and their tributaries, all of which flow to the Thames above London. In the post-war years the population and industries of this district increased and developed so rapidly that the twenty or more local authorities acting individually were unable to keep pace with the requirements, particularly in respect of sewerage and sewage disposal. Mr. David Mowat Watson has given the history of the scheme which was adopted to deal with this problem, and a description of the works and their design and construction (*J. Inst. Civ. Eng.*, April), for which he has just been awarded the Telford Gold Medal of the Institution of Civil Engineers.

In 1921 the average density of population per acre was 4.8 and in 1931 this figure had risen to 7.5, the greatest density in this latter year being 25.5. For the purposes of design an ultimate average of 23 was assumed, and the maximum rate of flow provided for was 240 gallons per head per day. The Act of Parliament which authorized the scheme empowered the County Council to construct trunk sewers for a wet weather flow of this amount, to make the necessary connexions with local sewers, to provide for gauging the sewage flow from each of the constituent authorities, to build purification works at Mogden with outfalls to the Thames at Isleworth Ait, and sludge disposal works at Perry Oaks.

Owing to the abnormally rapid development of the area, the Ordnance maps were out of date, the district had to be re-surveyed and about seventy

miles of existing sewers located. Over the greater part of the district the clay is overlaid with about twenty feet of water-bearing ballast and, to avoid trouble, the sewers were located in the clay, in which tunnelling is comparatively easy. In this connexion, the author notes that the contractors showed a growing preference for tunnelling, as it eliminated the heavy road charges and the costs and delays of diverting gas, water and other mains which open trench work involves.

A circular section was adopted for all sizes of sewers, as the higher velocity at low flows which might be expected from the egg-shaped section was deemed to be outweighed by the advantages of lower cost, increased resistance to external pressure and less loss of head. The lining of the larger sewers was best engineering brickwork, while pipes of aluminous cement were principally used in those less than 4 ft. in diameter. Although these tubes have a smoother surface initially, it was held that, over a long period, the average surface of brickwork is better; the roughness coefficients used in the Flynn-Kutter formula were 0.013 for brick, cast-iron and glazed stoneware, and 0.015 for cement pipes. The paper gives many valuable notes on the design of sewers, and describes the methods of effecting the junction of the local sewerage systems with the main trunk sewers. As the latter are at many points at a depth of 60 feet below ground, the design of backdrops and cascades forms an important feature, and several of

these and the methods of effecting flood relief of the rivers are illustrated.

For the purpose of ensuring that each district gets its fair share of the use of the sewers and of providing as much research information as possible of local storms and flows, a complete system of gauging has been installed. For various reasons, standing wave flumes were considered most suitable, and from tests made it is anticipated that a degree of accuracy of two per cent at full flow to six per cent at one thirtieth flow can be obtained.

At the Mogden works the purification of the liquid sewage is effected by the sludge activation process, and to ensure freedom from smell and also to utilize the available gas for power and heat, the sludge is subjected to complete anaerobic digestion. Large storm-water tanks have been constructed and these are in continuous use for partial treatment. In a partially digested state, the sludge is pumped seven miles to Perry Oaks, where the secondary digestion, drying and final disposal by tipping are carried out. The complete isolation of the drying beds from adjacent lands has been ensured by sinking a puddle wall through pervious clay and keying it into the London Clay. This method is regarded as unique, and was a necessary and wise precaution to prevent soakage finding its way into potable water. By means of this scheme, which was completed in May 1936, twenty-seven small sewerage works have been replaced by one large system.

Museums and the People

AT the present time museums, taking them all in all, are undergoing an interesting and critical stage of development. Some began and remain as collections of curios and some have degenerated to that condition, but the majority are striving in one way or another to test the reactions of the community, in efforts to discover the lines which hold out most hope of stimulating interest. The success or failure of these efforts is a matter of moment to the people as well as to the museums themselves, for upon it depends the place which museums are to take in the life of the community as centres of education and of intellectual and æsthetic pleasure. For many of our local museums, perhaps for most, this place is still undecided, and accordingly advice upon the most promising lines of progress by a museum official of experience and standing ought to fall upon open ears.

At the Newcastle conference of the Museums Association held in July, Dr. W. E. Swinton of the British Museum (Natural History), in a paper which has appeared in the *Museums Journal* (September), gave sound advice upon the improvement of collections. He justly pointed to the hesitancy of many municipalities to give proper financial backing to the museums under their care, a hesitancy to be observed particularly in the appointment of suitably paid curators with knowledge and training for posts which have their own peculiar difficulties and make their own special demands. Thanks to an awakening conscience and to the efforts of the Carnegie United Kingdom Trust, that position is improving, and "many municipal authorities to-day

feel, though vaguely it may be, that a natural history museum is somehow an asset to the community".

Granted a suitable curator, what of the collections themselves? In the first place the local natural history museum should concern itself with the objects of its own neighbourhood, and secondly, it should present these in such a way that the visitor should be induced to take a fresh or increased interest in the local fauna, flora and geology. That implies ruthless elimination of surplus specimens, so that room may be gained for a few well-selected groups in natural habitats, well lit and clearly, instructively and yet simply labelled.

Dr. Swinton properly suggests that no zoological series is complete without the inclusion of fossil forms in their systematic position, presumably to illustrate the course of evolution. But why not take the bull by the horns and arrange selected series specially to illustrate evolution and other general truths, for that would be education at its best; and the ordinary visitor who could visualize evolution from the systematic exhibits of most museums would be a miracle himself. The time will come when systematic collections, except for the merest skeleton of classification and other defined purposes, will be relegated to cabinets where identifications and detailed comparisons can best be made, and galleries will largely be given over to exhibits which stimulate observation of the habits and adaptations of living things, and which lead visitors gently to appreciation of the great truths which lie behind structure and development and evolutionary progress. J. R.

The Palao Biological Station

THE Tropical Biological Station, founded by the Japan Society for the Promotion of Scientific Research, was opened officially in April 1936 with a staff consisting of a director and three researchers drawn from Japanese universities. Its laboratory is situated to the south of Kororu Island in lat. $7^{\circ} 21' N.$, about the middle of the main Palao series. The whole group lies 500 miles east of the Philippines and consists of three or four small atolls to the north, a single elevated limestone island to the south and in the centre a great bank about 80 miles long by 15 miles broad with six main islands and more than two hundred islets. Most of the land is situated to the east with fringing reefs, while a great barrier to the west encloses a long narrow lagoon, which reaches a depth of more than thirty fathoms. Andesite and crystalline limestone form the land, the latter in terraces mainly in the southern half. Historically, the group is interesting for Karl Semper ("Animal Life", 1881), on the evidence collected there, was one of the first of that long series of field workers to dissociate himself from Darwin's theory of universal oceanic subsidence to explain the formation of atolls and barrier reefs.

The laboratory is a frame building with sheds and small boats, and provides accommodation for four research workers, who have to devote their attention to biological studies of coral reefs; their expenses are paid by the Society, and each stays at least four months. It is situated on a bay, or secondary lagoon (Twayama), almost entirely enclosed by high land, which here forms the meeting place of limestone and andesite. The bay is studded with many elevated limestone islets and has depths up to fifteen fathoms; it lies next to that area where Mikimoto cultures his pearls. Well protected from the trade winds and with small currents, corals grow in great variety, so far 116 species representing 43 genera having been collected. Most are "very delicate and brittle" and "show poor growth" so that the hoped-for comparisons with the vigorous growth of open lagoons and of sea reefs will be difficult. On the other hand, possessing protected environments where corals can be easily planted, the bay should be excellent for the study of the biology and variation of species.

Among the separate reports which follow, Fujio Hiro describes twenty-five cirripedes, leaving their interesting coral commensals to a future paper. He also studied crabs forming galls on corals, these due to the growth of coral around the young crab which has settled upon it. There is little new here beyond what Potts told us, except to show that the cavities produced vary greatly. A hydrographical study by Matsuya discloses in the bay higher temperature and silica and lower chlorinity, oxygen, pH and phosphates than in the ocean waters. Noboru Abe undertook the development of *Fungia* from the planula to the commencement of skeletogenous formation. Fertilization occurs in the gonad at full moon, and the planula there formed is liberated at new moon from September until April. It attaches itself on the third day and the first septa commence to form on the seventh; the growth curve shows a marked and suggestive slowing as soon as the septa commence to form. The development is said to be much delayed by an absence of light; but a deeper study is necessary before many interesting features can be understood.

J. S. G.

University Events

BIRMINGHAM.—On October 14 H.R.H. the Duke of Kent, as patron of the Hospitals Contributory Schemes Association, visited Birmingham to attend the annual meeting of the Association. His activities included a visit to the new Hospitals Centre and Medical School, after which at a special degree congregation the Chancellor of the University (Viscount Cecil of Chelwood) conferred on His Royal Highness the degree of LL.D.

With the object of securing closer contact between the University and the two Birmingham municipal hospitals at Dudley Road and Selly Oak, five of the professors of the Medical Faculty of the University have been appointed as part-time consultants to the hospital staffs. The professors are Sir Beckwith Whitehouse, Mr. W. H. Wynn, Mr. Philip Cloake, Mr. William Gemmill and Mr. Seymour Barling. The appointments have been made by the Birmingham Health Committee.

CAMBRIDGE.—G. Metcalfe, of Clare College, has been appointed to the Frank Smart University studentship in botany.

G. S. Gough, of Pembroke College, University lecturer in engineering, has been elected into a fellowship at Trinity College on appointment as lecturer in mechanical sciences. C. H. Bamford has been elected into a fellowship at Trinity College for research in natural sciences. He obtained a 1st Class in Part I, Natural Sciences Tripos (1933) and in Part II (1934), (Chemistry). D. M. A. Leggett has been elected into a fellowship at Trinity College for research in applied mathematics. He obtained a 1st Class in Part I, Mathematical Tripos (1932), and in Part II (1934), Wrangler (b) distinguished; Rayleigh Prize, 1936.

The Council of the Senate has reported that the University will eventually benefit under the will of the late Mr. William Charles Wilson, of St. John's College, to the extent of about £15,000. No conditions are attached. The Council is of the opinion that, in view of Mr. Wilson's interest in the alleviation of human suffering, it would be appropriate to use his bequest for the furtherance of some allied branch of research. It is recommended that the bequest be applied to the provision of an extension of the Psychological Laboratory. Should this recommendation of the Council be approved, the Rockefeller Foundation has promised to give £11,360, spread over a period of five years from January 1, 1938, towards the cost of developing the Department of Experimental Psychology.

SHEFFIELD.—A contribution of £5,000, being the second instalment of the contribution of £10,000 promised by the City Council, has been made to the University Extension Fund.

E. T. Goodwin and T. D. H. Baber have been appointed assistant lecturers in mathematics, and Dr. Helen Mullanby part-time demonstrator for medical and dental students in the Department of Zoology.

The following resignations have been received: Mr. J. W. Frame, of his post of lecturer in mathematics; Mr. J. Jenkins, of his post of lecturer in civil engineering; Dr. E. S. Duthie, of his post of demonstrator in pathology.

Science News a Century Ago

The Aurora Borealis

The Times of October 25, 1837, quoted from the *Leamington Chronicle* the following description of an aurora borealis. "Nearly the whole population of Leamington appeared, with ourselves, wonder-struck, last evening, by the appearance which is seldom witnessed in this locality—viz., the aurora borealis. This gorgeous and most sublime spectacle was visible from 6 until half-past 7 o'clock. The clouds in the north-east appeared as if suffused with the reflection of a vast mass of crimson flame. The stars seen through this brilliant medium had an extraordinary appearance, for the brilliancy seemed to be heightened by the surrounding glory. A gentleman who stood near us on the bridge, and who has resided in countries where the aurora borealis is a frequent visitor, directed our attention to a singular novelty in the effect of this striking atmospherical spectacle as it appeared about half-past 6 o'clock. At that period dense lines and dark clouds in parallel perspective lines spread from the far south-east, narrowing by regular gradations, and converging towards that flood of splendid light which 'pavilioned with its thousand glorious dyes' the whole northern horizon."

Arthur Woolf, 1766-1837

ON October 26, 1837, the famous Cornish engineer, Arthur Woolf, died at The Strand, Guernsey, to which he had retired four years previously. A mechanical engineer of the first rank, whose engines were noted for their fine finish, he was one of the last of the contemporaries of Watt, who made the Boulton and Watt steam pumping engine the admiration of the world. The Hornblowers, Bull, Trevithick, Harvey and others all had a share in the improvement of the Cornish pumping engine, which by about the time of Woolf's death had a 'duty' of more than 100 million ft. lb. per cwt. of fuel as compared with the 30 millions for engines at the beginning of the century. Some of the engines constructed by Woolf himself had cylinders of 90 in. diameter with a 10 ft. stroke, and at one time he had more mining engines under his charge than any other engineer in Cornwall.

Born at Camborne in 1766, Woolf served an apprenticeship as a carpenter, and then moved to London where he was fortunate enough to find employment in the shop of the famous mechanician Joseph Bramah, in Pimlico, having for one of his fellow workmen Henry Maudslay. When nearly thirty years of age he left Bramah to erect some engines for Hornblower, in Durham, and on his return to London secured the post of engineer to Meux's Brewery, having charge of the machinery and apparatus. Here he installed plant for heating water by waste steam, invented a cast-iron tubular boiler and made his first engine in which the steam was expanded successively in a high-pressure and a low-pressure cylinder; an important type of engine to which long afterwards the name of a 'compound' engine was given. At first he placed his cylinders side by side at the end of the overhead beam, but later on placed the high-pressure cylinder nearer the centre of the beam, an arrangement adopted later on by McNaught.

After spending the years 1797-1806 at the Brewery, Woolf joined Humphrey Edwards in partnership as an engine maker in Lambeth. The partnership lasted only five years, when Woolf returned to

Cornwall, where he erected at least six compound pumping engines. By 1824 the single-cylinder, however, had been greatly improved, and it was shown that with the steam pressures then in use—20-30 lb. per sq. in.—there was no advantage in compounding and it was therefore with the development of the single-cylinder engine that Woolf's last work was done. He was engineer to the important groups of mines known as the Consolidated Mines and United Mines, and was also associated with the Hayl engine works of Harvey. Working, in the dark, as they were, as to the theory of heat engines, Woolf and his fellows yet made a great contribution to steam engineering.

John Mackintosh (?-1837)

DR. JOHN MACKINTOSH, an eminent Edinburgh physician, the date of whose birth is not recorded was born at sea on return of his mother from America whither she had accompanied his father, Captain Mackintosh, on service. He studied medicine at Edinburgh, where he qualified in 1808, and was then appointed medical officer in the Royal Artillery. After serving in the West Indies, South Africa and France with the army of occupation after the battle of Waterloo, he settled in practice in Edinburgh where he became physician to the General Brown Square Dispensary and later professor of obstetric and practical medicine in the School of Medicine and Surgery. In 1822 he published a work entitled "A Treatise on the Disease Termed Puerperal Fever Illustrated by numerous Cases and Dissections", the disease at that time being very prevalent in Edinburgh and Leith. In the following year he began a course of lectures on midwifery and diseases of women and children, and proved a very successful lecturer. In 1825, in compliance with a request from the Edinburgh students, he delivered a course of lecture on the "Principles of Pathology and Practice of Physio". His chief work, which had the same title was first published in 1828 and was extremely popular among students and general practitioners both in England and America, so that it went through four editions. He devoted a good deal of his time to the investigation of cholera and made some important additions to the knowledge of its morbid anatomy. His death, which was due to typhoid fever, took place on October 28, 1837.

Subterranean Forest

THE *Gentleman's Magazine* of October 1837 contains an account of the following interesting discovery: "The labourers who are excavating the common sewer in High St., St. Giles, Westminster lately discovered just opposite the church two elm trees, in a high state of preservation at a depth of about 15 feet under the surface of the ground, lying completely across the part undergoing excavation and being parallel to each other, though at a distance of several yards. They were obliged to be sawn through, and the pieces which were removed to the surface were each about nine feet long and five in circumference. These trees were supposed to have belonged to a forest which once covered this and the surrounding district. On examination the exhumed timber was found to be as sound as if it had been felled only a few months. The superincumbent strata were composed of common rubble, clay and sand the whole of which was remarkably dry to the above depth."

Societies and Academies

Paris

Academy of Sciences, August 9 (*C.R.*, 205, 345-380).

RAYMOND HAMET: Demonstration of the direct vaso-constrictive action of a nicotinic substance, cytisine.

MILIEU. DIGNA VAN STOLK and ROLAND LEBROY DE LENOHER: Folliculin and dihydrofolliculin in the urine of pregnant mares.

August 23 (*C.R.*, 205, 397-428).

GEORGES CLAUDE: The search for aeroplanes lost at sea. Results of a practical application of the method (use of fluorescein) proposed by the author.

DIMITRI RIABOUCHINSKY: The vortex shaft method of hypersupport.

B. CARRERA: The moments of some cations of the rare earths and Weiss magnetism.

LUCIEN DANIEL: New experiments on acquired heredity in the leek.

ABYME DVORETSEKY: The arguments of the singularities of analytical functions.

LEOPOLD ESCANDE: Flow through a valve.

PIERRE VERNOTTE: The convection currents in experiments on thermal conduction.

GEORGES FOURNETIER: The precipitation of tricalcium phosphate and of hydroxyapatite.

C. F. GOODWIN and F. D. RICHARDSON: The existence of chlorous anhydride. A repetition of the experiment described by Kantzer (*C.R.*, 155, 158) for the preparation of Cl_2O_3 fails to confirm his conclusions: spectroscopic examination showed that only chlorine dioxide is formed.

LEON CALMICHET: Contribution to the geological study of the culminating massif of Ouarsenis (Algeria).

HUBERT GARRIGUE: The measurement of the radioactivity of the air enclosed in the snow layer, near the soil, in the mountains.

MAURICE LANGERON: New statistical and mycological observations on human favus in Morocco.

MME. VERA DANTCHAKOFF: The action of the female sex hormone on reptiles.

August 30 (*C.R.*, 205, 429-452).

PIERRE LEJAY: Measurements of gravity in Normandy and Brittany. Tabulated results for measurements of g at 21 stations in Normandy and Brittany.

ANDRÉ HAARBLUMCHER: Curves which are their own isogonal inverse with respect to a triangle.

W. K. TURKIN and P. E. DUBUQUE: Theorems on infinite groups.

PAUL PÉTRY: The determination of pressures and velocities in breaking waves. Measurements made on waves breaking on a jetty.

MAURICE D'OCAGNE: Remarks on the preceding note, pointing out that this is the first time such measurements have been attempted.

HORIA HULUBI: Contribution to the study of the K emission spectrum of gallium (31) and of germanium (32).

RENÉ GIBERT: The p,p' -dimagnesium compounds of diphenyl. The favourable role of magnesium iodide.

WILLIAM HENRI SCHOPFER: The action of the constituents of aneurin on yeasts (*Rhodotorula rubra* and *R. flava*).

MARCEL AVEL: The experimental study of the morphogenesis of the central nervous system in the regeneration of the head of worms.

Y. RAOUL: The evolution of hordenine in barley and the ultimate relations of this alkaloid with the tyrosine.

Geneva

Society of Physics and Natural History, July 1.

CH. BAEHNI: The male inflorescence of *Scyphostegia borneensis*. Following the discovery of a male specimen of this plant it would appear that the classification of the latter in the family of the Moraceae or in any other family of the nettles is erroneous. The exact systematic position of this plant is at present doubtful.

ALB. PÉRIER: Some critical observations on the torus mandibularis and on its ultimate phylogenetic signification. A detailed analysis shows that two varieties of mandibular hyperostoses must be considered: (a) the torus mandibularis alveolaris and (b) the torus mandibularis arcuatus. The examination of two series of mandibles, Genevan and Bushman, on which these toriform arrangements are encountered, shows that the torus mandibularis is not specifically Asiatic, as has been supposed hitherto.

P. WENGER, CH. CIMERMAN and A. CORBAZ: The micro-estimation of cobalt by means of anthranilic acid. The authors have established a gravimetric micromethod for the determination of cobalt by means of anthranilic acid.

CH. CIMERMAN and P. WENGER: (1) The micro-separation of zinc by means of *o*-oxyquinoline in acetic solution. (2) The volumetric micro-estimation of zinc in alkaline solution. The authors have established the conditions for the micro-separation of zinc with the cations NH_4 , K, Na, Li, Mg, as well as a micro-estimation of zinc in alkaline solution.

E. BRINER and E. PÉROTTE: Complementary results on the catalytic action of ozone in the oxidation of aldehydes. The influence of the peroxide present. This catalytic action is shown by an increase in the absorption velocity of the oxygen; the presence of peroxides increases this velocity as measured by the bubbling method.

D. MONNIER, B. SUSZ and E. BRINER: The Raman spectra of acrylic acid and of methyl methacrylate, both monomer and polymerized. The disappearance of the frequencies of the vinyl group in the polymer shows that the latter is a substance no longer containing the double bonds of the monomer.

L. MISCH and VAN DER WYK: The structure of crystallized azulene. Interference analysis with X-rays of azulene has furnished a whole series of crystallographic constants, which from this point of view suggests that this substance is allied to naphthalene.

EUG. PITTARD and HAYRI AZIZ SEYLAN: Prognathism, cranial capacity and area of the occipital perforation in the anthropoids. The authors have studied various skulls of gorillas, orang utans, chimpanzees, and gibbons. It follows from this work that the construction of the cranio-facial edifice is somewhat different in the anthropoids, according to the genus under examination.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, October 25

UNIVERSITY OF LEEDS, at 5.15.—Dr. F. Simon. "The Temperature Region below 1° Absolute".*

BEDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. G. I. Finch: "Electron Diffraction and Surface Structure" (Bedson Lecture).

Wednesday, October 27

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. Raymond Pearl: "The Natural History of Population" (succeeding lectures on October 28, November 1, 3 and 4).*

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at King's College, Strand, W.C.2), at 8.—Dr. A. F. Titley: "Paracelsus: A Résumé of Some Controversies".*

Thursday, October 28

CHEMICAL SOCIETY, at 5.30.—Prof. C. H. Desch, F.R.S.: Le Chatelier Memorial Lecture.

Friday, October 29

GEOGRAPHICAL DISCUSSION (at the Royal Astronomical Society), at 4.30.—"Variation of Latitude" (Opener: Dr. Spencer Jones, F.R.S.).

ROYAL SOCIETY OF MEDICINE, at 9.15.—Philip Guedalla: "The Method of Biography" (Lloyd Roberts Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN MATERIA MEDICA AND PHARMACOLOGY in the Welsh National School of Medicine, The Parade, Cardiff—Secretary (October 25).

HEAD OF THE CHEMISTRY DEPARTMENT of the Northampton Polytechnic, St. John Street, London, N.C.1—Principal (October 31).

HEAD OF THE CHEMISTRY DEPARTMENT of the Burnley Municipal College—Director of Education, Education Office, Burnley (November 8).

PRINCIPAL of the St. Helens Municipal Technical School—Director of Education, Education Office, St. Helens (November 6).

ASSISTANT IN THE DEPARTMENT OF NATURAL HISTORY in University College, Dundee—The Secretary.

Official Publications Received

Great Britain and Ireland

Miscellaneous Publications of the International Tin Research and Development Council. No. 6: The Role of Technical Information in Industrial Research and Development. By Dr. C. E. Homer and Dr. H. S. Hodges. Pp. 9. (London: International Tin Research and Development Council.) Free [710]

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1937. Pp. 24+4 plates. (Kirkhill: Hannah Dairy Research Institute.) [810]

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig Keeping. Pp. 62. (London: Bacon Development Board.) 2s. [910]

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1699: Report on Puss Moth Accidents, complete with Appendices. Pp. 388+19 plates. (London: H.M. Stationery Office.) 30s. net. [910]

The English Golf Union Year Book, 1937. Pp. xii+196+48. (Northwood: Hawthornes Library.) 2s. 6d. [910]

Management Library. Progress Report for the Five Years ended 30.6.37. Pp. 4. (London: Management Library.) [910]

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 26th October 1937. Pp. 44. (Newcastle-upon-Tyne: Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne.) [1110]

Transactions of the Royal Society of Edinburgh. Vol. 50, Part 1, No. 7: The Middle Devonian Fish Fauna of Achanarras. By C. Foster-Cooper. Pp. 232-240+8 plates. 5s. Vol. 50, Part 1, No. 8: On a New Longheaded Dipnoan Fish from the Upper Devonian of Seamount Bay, P.Q., Canada. By W. Graham-Smith and Dr. T. S. Westall. Pp. 241-256+2 plates. 4s. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1110]

Proceedings of the Royal Society of Edinburgh, Session 1936-1937. Vol. 57, Part 3, No. 21: On the Immature Stages of some Psyllid and other Psyllids. By Dr. K. B. Lal. Pp. 305-331. 2s. 6d. Vol. 57, Part 3, No. 22: Some Distributions associated with a Randomly Arranged Set of Numbers. By Dr. W. O. Kermack and Lieut.-Col. A. G. McKendrick. Pp. 332-376. 4s. Vol. 57, Part 3, No. 23: On Rotating Mirrors at High Speed. By Sir Charles V. Boys. Pp. 377-378. 6d. Vol. 57, Part 3, No. 24: Geometrical Density, Dikin, a Land Nemertean in Wales. By A. R. Waterston and H. E. Quick. Pp. 379-384. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1110]

Society for the Promotion of Nature Reserves. Handbook, 1937. Pp. 44. (London: Society for the Promotion of Nature Reserves.) [1110]

Other Countries

Government of India. Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Ahabag, in the Year 1935, under the direction of Dr. S. C. Roy. Reduced and tabulated under the direction of Dr. S. C. Roy and Dr. K. R. Ramanathan. Pp. xiv+A74+B41+C3+D15. (Delhi: Manager of Publications.) 9.14 rupees, 10s. 6d. [410]

Report of the Forest Department, British Honduras, for the Year 1936. Pp. 19. (Belize: Forest Department.) [510]

University of Illinois: Engineering Experiment Station. Circular No. 23: An Investigation of Student Study Lighting. By Prof. John O. Krehenbuehl. Pp. 36. 40 cents. Circular No. 29: Problems in Building Illumination. By Prof. John O. Krehenbuehl. Pp. 23. 35 cents. Circular No. 30: Papers presented at the Twenty-fourth Annual Conference on Highway Engineering held at the University of Illinois, March 3-5, 1937. Pp. 134. 50 cents. Reprint No. 11: Third Progress Report on the Joint Investigation of Failures in Railroad Rails. Pp. 30. 15 cents. (Urbana, Ill.: University of Illinois.) [610]

U.S. Department of Agriculture. Circular No. 390: Flour-Mill Insects and their Control. By G. A. Dean, R. T. Ootton and G. B. Wagner. Revised edition. Pp. 40. 5 cents. Miscellaneous Publication No. 271: A Revision of the Leafhoppers of the *Macrostelus* Group (*Oxycneta* of Authors) in America North of Mexico. By H. H. Dorn. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.) [510]

Smithsonian Miscellaneous Collections. Vol. 96, No. 5. The Male Genitalia of Orthopteroid Insects. By R. B. Snodgrass. (Publication 2442.) Pp. 107. (Washington, D.C.: Smithsonian Institution.) [710]

League of Nations: Health Organisation. Report of the International Conference of Far-Eastern Countries on Rural Hygiene, held at Bandung (Java), August 3rd to 13th, 1937. (Official No.: A.19.1937.III.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. 6d. [710]

Brooklyn Botanic Garden Record. Vol. 26, No. 4: Prospectus of Courses, Lectures and other Educational Advantages offered to Members and to the General Public, 1937-1938. Pp. iv+355-376. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [810]

Kenya Colony and Protectorate: Department of Agriculture. Annual Report, 1936. Part 2. Pp. ii+102. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 2s. 6d. [910]

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 19: The Orbit of the Solipsing Binary Ar Aurigae. By W. H. Harper. Pp. 311-316. (Victoria: Dominion Astrophysical Observatory.) [1110]

In Memoriam, Joh. Hv. Purkyně, 1787-1937. Pp. iv+102. (Prague: Purkyněova Společnost.) [1110]

Proceedings of the Conference on Maternity and Child Welfare, 12th to 18th December 1936, Madras. Pp. vii+166+xxii. (Madras: Health Propaganda Board.) 8 annas. [1110]

Department of Agriculture: New South Wales. Science Bulletin No. 56: Plant Breeding in New South Wales; Tenth Year of Progress, 1935-36. Pp. 56. (Sydney: Government Printer.) [1110]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 108: The Basaltic Soils of Northern Tasmania. By C. G. Stephens. Pp. 40. Bulletin No. 109: The Variability of Plant Density in Fields of Wheat and its Effect on Yield. By H. Fairfield Smith. Pp. 28. (Melbourne: Government Printer.) [1110]

Oil Production from Coal viewed from an Australian Standpoint. Report by Sir David Rivett. Pp. 22. 1s. Oil from Coal: Second Report of the Committee appointed to inquire into the Question of establishing a Plant in Australia for the Production of Oil from Coal by the Hydrogenation Process. Pp. 6. 6d. (Canberra: Commonwealth Government Printer.) [1110]

Summary Proceedings of the Thirty-fourth Meeting of the Indian Central Cotton Committee, Bombay, held on the 2nd and 3rd March 1937. Pp. 94. (Bombay: Indian Central Cotton Committee.) 1 rupee. [1110]

University of Michigan. School of Forestry and Conservation. Circular No. 2: The Spruce Gull Aphid (*Adelges abietis* Linnaeus) in Southern Michigan. By Bill Howard Wilford. Pp. 36. 20 cents. Circular No. 3: The Walking Stick as a Forest Defoliator. By Samuel A. Graham. Pp. 28. 20 cents. (Ann Arbor, Mich.: University of Michigan Press.) [1110]

Season Reports of the Tokyo Bunrika Daigaku, Section C. No. 6: The Nappe Theory with reference to the North-Eastern Part of the Kwantō-Mountainland. By Haruyasu Huximoto. Pp. 215-244+plates 30-34. 60 sen. No. 7: Past Glaciers and the Present Topography of the Japanese Alps. By Gakuro Jimamura. Pp. 63+19 plates 60 sen. (Tokyo: Maruzen Co., Ltd.) [1110]

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SATURDAY, OCTOBER 30, 1937

Vol. 140

A Scientific Approach to the Colonial Problem

THE Prime Minister has consented to receive a deputation on Monday next in support of a petition urging that the Government should take the initiative in promoting an inquiry into the fundamental causes of rivalry and unrest among the nations, by inviting all other fully self-governing States or Dominions to combine in setting up expert commissions to ascertain and report upon the basic facts in regard to such questions as access to raw materials and world markets, colonial development and the problem of surplus populations, etc. This proposal for fact-finding commissions is, of course, no novel idea ; but the influential support which the petition has received indicates how rapidly the idea is gaining ground.

Already an inquiry into raw materials has been initiated by the League of Nations with the support of Great Britain, and the League Committee on Raw Materials has now completed its report. This inquiry is a direct outcome of an offer made by the British Government in 1935 and formally renewed in 1936. Even earlier, however, valuable work of this kind had been carried out in respect of problems concerned with the Pacific by the Institute of Pacific Relations, and the scientific study of similar problems affecting European relations was considered by a Conference for the Scientific Study of International Relations held at Copenhagen in June 1931.

While, however, the idea of impartial inquiry into the basic facts as a preliminary to concerted action designed to eliminate causes of friction is steadily gaining ground in public opinion, a good deal of valuable investigation is being quietly carried out by different organizations, the results of which have been published. Reference has

been made above to the work of the Institute of Pacific Relations ; and the situation in the Far East is the more regrettable because of the admirable work of the Kyoto and later Conferences.

In Great Britain the Royal Institute of International Affairs has already issued a number of valuable studies and reports such as "Raw Materials and Colonies" and "The Colonial Problem", which are only the latest and most detailed of them. In addition, other organizations are doing invaluable educational work, such as the New Commonwealth Institute, by means of its Information Bulletins, on questions of peaceful change and collective security, which not only prepare a wider circle of the public to accept the idea of the impartial investigation of such matters generally, but also assist materially in the formation of intelligent public opinion upon particular questions.

The League Committee for the Study of the Problem of Raw Materials has held three sessions, and the two sub-committees appointed to study the supply of raw materials and difficulties of purchase and payment have completed reports which are embodied in the final report. On the question of supply, the report indicates that while prohibition and restriction of raw materials might be justified as defensive measures, there are serious objections to their use for exercising pressure on other countries, for the preservation of uneconomic industries or for the maintenance of artificial price levels. It recommends accordingly that these obstacles should be removed as soon as possible and that nations should enter into agreements not to employ them. Similarly the Committee takes the view that

countries controlling important quantities of raw materials should not place unreasonable obstacles in the way of those wishing to exploit these resources, and that their legislation should take account of the interdependence of nations as the basis of general welfare.

In common discussions this question of access to raw materials has been closely linked with the colonial question, and the League Committee's report indicates that some modification of the privileged situation which nationals of the mother country in fact enjoy in most colonial territories is desirable. Actual monopolies are rare, but the report clearly indicates the need for further investigation and study. Similarly the sub-committee dealing with obstacles to payment makes various suggestions for reducing existing restrictions on imports and exports by bilateral or multilateral action.

The League Committee's report includes, accordingly, a suggestion to re-examine the International Convention of 1927 for the Abolition of Import and Export Restrictions and Prohibitions, which should implement the resolution recently passed by the International Chamber of Commerce asserting that all countries should, so far as possible, have access to essential foodstuffs and raw materials. Much room is, however, still left for further investigation and discussion before an adequate and generally acceptable solution of the whole problem can be achieved. The appearance in the meantime of the latest report of the Institute of International Affairs* on the colonial problem is therefore particularly welcome. If its presentation is not all that could be desired—much of the third part, "Investment, Trade and Settlement", could with advantage have been dealt with earlier or incorporated in the appendixes, and the first part, "The International Aspect", should properly have followed the second, "The Colonial Aspect"—it contains much information to clarify thought upon many of the proposals at present being debated, such as the extensions of the 'open-door' policy in colonial territories or the transfer of colonies into Mandated Territories or territories under international administration. The most valuable and significant part of the book is, in fact, the second part, in which the colonial aspect of the problem is considered, and especially the chapters in which the theory and practice of the present status of colonies are reviewed and the

importance of common principles of administration is stressed. The vast amount of exact information which it contains is, of course, the chief value of the book, but the task of sifting and selecting cannot be pursued without judgment on the main issues. Particularly in this section of the report, the directions in which further inquiry is still called for are clearly indicated.

The dominant impression left on the mind by the survey presented in this part of the book is the immense field for co-operation and investigation which the colonial problem presents. It is seen not merely as a matter of immediate controversy, but rather as a constant problem the cur of which lies in the relations between economic and political aspects. The searching analysis which the study group gives of the way in which the democratic countries themselves are living up to the standards they profess shows no tendency to insist on the merits of British administration as opposed to those of other colonial Powers. In such questions as populations, the relative merits of plantations and native farming, labour policy, health services, education and nutrition, the report indicates the real problems to be faced and the need for research in British territories as elsewhere.

No scientific worker can read these chapters without realizing how large a contribution science itself has to make in providing a solution to these problems and assisting in the foundation of a wise policy. The possibilities for human happiness thus indicated make the present international clamour seem as stupid as it is threatening. Common principles of administration are essential because each of the colonial Powers is subjected to the same sort of criticism, whether from within or from without. Each suffers from the other's mistakes. The universal adoption of certain basic principles of justice towards non-colonial Powers and towards subject races is dictated by common prudence as well as by the more generous ideals of progressive civilization.

The colonial Powers must, in fact, prove to other Powers that their policy is not to exercise monopoly rights for themselves but rather to administer colonial resources in the general interest; and they must also prove to peoples in the Colonies that the protection and the administration they offer is a fair return for the taxation and the other obligations they impose, and is directed to ensure local prosperity. The report, indeed, suggests that in its international aspect the colonial problem is more than a grievance of particular "dissatisfied"

* The Colonial Problem. A Report by a Study Group of Members of the Royal Institute of International Affairs. Pp. xii+448. (London, New York and Toronto: Oxford University Press, 1937). 11s. net.

nations against particular "satiated" nations: it is a grievance of the whole community of nations against the misuse, wherever it occurs, of colonial sovereignty. All departures from the principle of the 'open door' are an injustice to the international community.

The adoption of common principles of administration would facilitate transfer, but the division of Europe into democratic and authoritarian States complicates the issue greatly. Transference of mandates or colonial sovereignty to States repudiating the League Covenant, and with it the international machinery set up to promote international co-operation and to ensure common standards in the administration of subject peoples, would be an even greater injustice to the international community. There is, in fact, little in the report to hold out hope of meeting the needs of non-colonial Powers in terms of prestige and world power.

Though the difficulties in the way of transfer are clearly displayed, a number of concrete suggestions for meeting the needs of the non-colonial Powers by methods that do not involve transfer are indicated for securing equality of economic opportunity. Moreover, the facts in regard to access to raw materials are set forth in a way which scarcely upholds many of the contentions of the non-colonial Powers. If, for the moment, it is assumed that the correct view of the problem is how to make available the raw materials of industry, the report very effectively disposes of some of these illusions. Of the basic raw materials as defined by Dr. Goebbels himself, France, the United States and Russia produce between them 66 per cent of the world's iron ore; the United States and the United Kingdom 54 per cent of the world's coal; the United States, Russia and Venezuela 81 per cent of the world's oil; the United States, India and China 75 per cent of the world's cotton; Chile, the United States and Canada 49 per cent of the world's copper; and Malaya and the Dutch East Indies produce 83 per cent of the world's rubber.

Accordingly, the basic raw materials, with the exception of rubber, are produced mainly within the boundaries of sovereign States. Rubber alone is mainly a colonial product, but this raw material is open to purchase by all comers on equal terms, and there is no reason why foreign capital should not acquire rubber estates. Equal access is indeed given in enormous colonial areas, although considerable restrictions do exist upon free trade in

colonial areas not covered by special treaties. An international agreement to guarantee equal commercial access over a much wider area, in accordance with a former principle of British colonial administration, should therefore do something to remove the feeling of non-colonial Powers that they may be cut off at any moment from access to all colonial supplies.

The problem of access to raw materials, therefore, is not the core of the colonial problem. The present study makes it clear that there is no simple solution and that the matter is one calling for the closest and most careful study. No hasty decisions are likely to be an easy way out of a dynamic but constant problem. The position of the colonial Powers is difficult. Mere transfer of colonial territories to the threatening States would not purchase safety and would be treachery to the colonial peoples and to the world community. The exposition of the facts given by the study group of the Royal Institute of International Affairs reinforces the need for some effective international organization and authority, such as the League of Nations, to which all colonial territories could ultimately be surrendered for administration under trust for the world community. Until that organization and authority are effectively established, the colonial Powers must perforce live dangerously, and their danger is best mitigated if their sovereignty is exercised in trust, first on behalf of the peoples inhabiting these areas and secondly for the wealth of all nations. In their own interests alone they must extirpate all taint of monopoly and exploitation.

Such a policy is not one of mere negation to the demands and aspirations of the dissatisfied or non-colonial Powers. It is essentially one of peaceful change, which offers the maximum inducement to participation in a system of international co-operation and collective security. Only as the facts are impartially assembled, and lucidly presented and clearly understood, can we hope to win acceptance of such ideas or policy, and the greatest merit of this volume is the weighty contribution it offers to the education of public opinion, in Great Britain no less than in other countries. Nor should it be forgotten there will still remain the task of organizing public opinion effectively everywhere to compel action in accordance with the facts, and to resist those nations who wantonly disregard them to the detriment of the community of nations.

World Structure

Relativity Theory of Protons and Electrons
By Sir Arthur Eddington. Pp. viii + 336. (Cambridge: At the University Press, 1936.) 21s. net.

DURING the past ten years or a little more, physicists have found themselves more and more peremptorily confronted with a question of theoretical conscience—a question which has gradually and almost inadvertently become of overwhelming weight. It is that of how to reconcile Relativity Theory and Quantum Theory. Increasing uneasiness grew from the fact that in the course of their development, both theories approached what many regarded as final states of perfection, but without reaching true *Anschluss* to one another, or even reconciling their mutual discrepancies. Having, both of them, acquired the rank of inalienable knowledge, they seemed incapable of undergoing serious modifications, yet in urgent need of such, in view of the mutual inconsistency of their respective fundamentals. The book under review, which is an enlarged exposition of the author's investigations from 1928 until 1936, in a way is a continuation of his well-known book on relativity. The least that must be said in praise of the present work is that Sir Arthur puts forward sufficient evidence of *blunder* (in the sense of misapprehension, of course) in current quantum- or wave-mechanics to reassure us that, in this theory, there is room and indeed need, for radical readjustment.

The General Theory of Relativity deals with macroscopic space, time and matter, which it treats as continua, admittedly ignoring the particle-structure. Space and time were formerly regarded as the mere frame, scene or stage on which or in which physical events take place. The content of the frame or the actor on the stage was called *matter*. Relativity Theory established such an intimate connexion or rather amalgamation between matter and space-time, that the conceptual separation into a pre-existing continuum and what is contained in it is no longer applicable. Space is extended or unfolded by the very matter it contains, and the rolling on of time is essentially determined by its presence. Though *actio in distans* is definitely excluded, yet the most primitive circumstances of an observation made now and here turn out to be the complicated product of all that has been going on hitherto in the rest of the world.

Quantum Theory, in its turn, has emerged from the careful consideration of observations on the detailed behaviour of the matter surrounding us

on our globe and in our epoch—which from the cosmical outlook means in the immediate neighbourhood of a *point* in space-time. By challenging a new meaning for the older ideas of atoms, electrons, radiation, etc., this theory has succeeded in accounting for bewilderingly numerous and complicated facts from comparatively simple (though strange) first principles. It is not very astonishing that in following up these tasks, quantum-physicists deemed it permissible for their purpose to accept as a given thing, which on that occasion called for no further scrutiny, the most primitive condition of the events they investigated, namely, that they happen in space and time; the more so since a rough estimate by Einstein's theory shows that not only the mutual gravitation between the particles composing an atom or a crystal, but also even the modifying influence of a particle on space and time in the *immediate* neighbourhood of the particle is altogether negligible. We were content to pay to Relativity the tribute of conformation to its small-scale geometrical principle, that is, to make everything invariant to the Lorentz transformation (unduly stretching the principle in some cases, as Eddington appropriately points out). But what was neglected was the following. The plane and apparently simple condition of *unmodified* space and time, under which every single particle is observed, is created by the previous and present existence of all the other particles in the world. This fact constitutes an interrelatedness between all of them which makes it imperative to treat previously, in broad outline at least, the problem of the universe, in order to obtain the right outlook for dealing with what is usually, but not very appropriately, called one or a few *isolated* particles.

Having reached this conclusion, we can make two gratifying and promising remarks. First, that quantum theory of its own right is entitled and even compelled to raise the imperative demand of dealing previously with the universe. Secondly, that relativity theory, by its very tendency to ignore the detailed structure of matter and to roam farther and farther to the outskirts of the universe, has quite unexpectedly provided the only sound means for explaining *atomicity*.

To elucidate the first statement: quantum mechanics has to abandon the idea of individuality in different particles of the same kind, two electrons for example. When, let us say, a carbon atom is excited, one of its six electrons is removed to a greater distance from the nucleus; but it is not

quite correct to think of an individual electron occupying the special position, the other five forming the inner core. At any rate, if one indulges in that way of viewing the subject, one has to put up with inadvertent *exchanges* between the electron under consideration and one of the others. Now there is nothing, in principle, to preclude the exchange of a particular electron we are contemplating with *any* other electron existing in the world. Hence if we have excluded some of them, or even most of them, from our investigation, we are quite likely to find ourselves all at once contemplating—nothing. This makes it fairly clear that one has to start by investigating the universe as a whole and to derive the methods, if any, for dealing with small isolated systems from the former investigation.

As regards the second remark: it is by discovering the *finiteness of space* that Relativity Theory has inadvertently found the clue to atomicity. The argument runs as follows. Atomicity is merely the oldest, best-known and still most important expression of the inherent *discontinuities* in Nature. Generally speaking, the latter are accounted for in wave- or quantum-mechanics by means of a close analogy with the discontinuous sets of proper modes of vibrating systems. But artificial devices have to be introduced for that purpose, because only a finite system possesses discontinuous proper modes. So the theorist has to segregate a finite portion of matter, keeping it together by strong forces or enclosing it in a 'box', in order to show atomicity appearing in the segregated region. If the universe were infinite it would be hard to explain along these lines why it is constituted of discrete particles, because its proper vibrations would form a continuous sequence. But Einstein's finite universe is in itself the natural and wall-less box, which engenders atomicity by the necessary discreteness of its proper modes of vibration.

All these different considerations converge to state Sir Arthur's main problem, as I see it, in broad lines thus: treat Einstein's closed universe along the lines of wave-mechanics, as you would treat a gas contained in a vessel, and try to make clear at the same time (1) the observed macroscopic features of the universe, (2) its being composed of particles, and (3) why current quantum-mechanics, dealing with isolated systems in the way it does, is able to account for such a vast multitude of facts (in other words, to regularize the customary procedure of quantum-theorists).

For the benefit of physicist readers, let me give a few details. The actual world is tentatively considered to be sufficiently near *that* state for which the name of Einstein universe, properly speaking, is usually reserved, which really is the only

static (though unstable!) state that is at all thinkable. It is therefore suggestive to identify it, from the point of view of quantum-mechanics, with the *ground state* of the system (the 'normal' or 'unexcited' state, in the case of an atom). Moreover, as in the case of the atom, the Pauli exclusion principle is admitted for the universe, stating that every energy-level (= proper mode) cannot be occupied by more than *one* particle. This really is the most important step. By it the ground state consists in the N lowest successive energy-levels being occupied each by one particle, whereas all the higher levels are vacant (a so-called completely degenerate Fermi distribution). Rigorously fulfilled, that would correspond to the absolute zero of temperature and make the system completely inert. The *actual* state is assumed to be one of slight excitation, very near to the ground state, with just a slight stirring up of the particles at the limit or threshold between the close-packed Fermi distribution below and the ordinarily vacant levels above. (From the point of view of wave-mechanics the levels are the proper vibrations of entire space. They are pictured as three-dimensional spherical harmonics, which by their nodal surfaces subdivide space into compartments of decreasing size. With the lowest mode entire space forms one compartment only. At the limit the compartments turn out to be about the size of a pint.)

It is, of course, the stirred-up threshold region between ordinarily occupied and ordinarily vacant levels which gives rise to the observable events (as in the atom the radiation is produced by the stirred-up light-electron). The particles *we handle* have emerged from this region and must, therefore, possess a certain minimum of energy—that of the threshold level—which is obviously their *proper energy*, m_0c^2 , embodied in their rest-mass m_0 . (My account cannot avoid being *very* rough—as though there were only *one* sort of particles in the world!) On the other hand, the totality of occupied levels (= vibrating modes) constitutes the mass of the universe and determines its radius R —by a well-known formula of General Relativity.

This enables one to *calculate* the radius R of space and the total amount of matter (or number N of particles) it contains from such physical constants only as can be determined within the walls of a room without windows. The results are in excellent agreement with astronomical evidence from, mainly, the recession of extragalactic nebulae—thereby corroborating the opinion that the conditions prevailing in our laboratory experiments are *essentially* determined by the state of the universe as a whole.

The particles well below the threshold have, each of them, an energy *smaller* than the observed

rest-energy m_0c^2 . The *energy-defect* (as it were) corresponds, in the author's opinion, to what in Newton's theory appeared as the *negative potential energy* of gravitating matter. Again, the entire lot of sub-threshold particles or levels supersede the cumbersome lot which in Dirac's famous 'hole'-theory of the positron appeared as an infinite continuous sequence of ordinarily occupied levels of negative energy; and there is the great advantage over the latter that (1) the sub-threshold levels form a *discontinuous* lot, as particles ought to, (2) they are numerous (of the order of 10^{10}) but not infinite in number, (3) they constitute the bulk of the material of the world, whereas Dirac's

lot were mere dummies, place-keepers, doomed otherwise to inactivity.

I have to refrain from following up many other ideas, however interesting they may be. I should be astonished if they proved all tenable in the form given, and so would Sir Arthur be, I believe. We have here before us a sketch of unusual grandeur, of which not the details alone need further development and, maybe, much modification. I am convinced that, for a long time to come, the most important research in physical theory will follow closely the lines of thought inaugurated by Sir Arthur Eddington

E. SCHRÖDINGER.

The European Snake Venoms

Die europäischen und mediterranen Ottern und ihre Gifte:

Grundlagen zur Darstellung eines wirksamen Schlangenserums. Von Prof. Dr. Richard Bieling, Dr. Albert Demnitz, Dr. Otto Schaumann, Prof. Dr. Hans Schlossberger, Dr. Waldemar v. Schuckmann, Dr. Ernst Schwarz. (Behringwerk-Mitteilungen, begründet von E. v. Behring, Heft 7.) Pp. x + 362 (35 plates.) (Marburg-Lahn: Selbstverlag der Behringwerke, 1936) n.p.

THE idea for this work originated with Dr. Richard Bieling, head of the Serological Department of the German Dye Trust at the Behring Works, Marburg, and it is due to this organization and its financial assistance that it has been possible to carry it through. The work was commenced in 1931 in an endeavour to find a better and more reliable antivenine for the European vipers in general.

The volume is divided into five parts, and each one is provided with a complete bibliography of its own.

Part 1, by Dr. Schlossberger, is an excellent and careful review of the history of snake venoms in general, and of the methods adopted through the ages for combating it. Part 2 discusses the pharmacology and chemistry of snake venoms and snake sera, and reviews the different groups, neurotoxic, hæmolytic, etc., into which the snake venoms can be divided. Part 3, by Dr. von Schuckmann, deals with the ecology of the European vipers, the methods of keeping and transporting them, a brief account of the venom apparatus, the moulting processes, hibernation, the treatment of disease, and finally the technique of extracting and preparing the venom for use in the making of antivenine. Part 4, by Drs. Schlossberger, Bieling and Demnitz, discusses the

question of antivenine in general and the manufacture of an antivenine for the European vipers in particular. This is the most important part of the book, and it contains much information that is both new and interesting.

The venoms of all the common species of European vipers were examined and their actions observed by experiments on mice. It was found that, not only did the venom of each species and subspecies differ as regards its properties and action, but also that the venom of the same species might vary when taken from specimens obtained in different localities. As was to be expected, the venoms of the majority of the European vipers were hæmolytic and coagulant in their action, but *V. berus bosniensis* and, to a lesser extent, *V. a. ammodytes* and *V. u. ursini* differed in having high neurotoxic properties.

In addition, the antivenines marketed by the different institutions throughout the world were obtained, and their efficacy tested against the venoms of the well-known poisonous snakes, both colubrine and viperine. The results obtained from all the experiments are graphically summed up in a series of charts.

Dr. Schwarz concludes the work with a review of the systematic position of the European members of the genus. Four species are recognized, each with their several subspecies. They fall naturally into two groups, *V. berus*, *V. ammodytes*, and *V. ursini*, the true European species, in one section, *V. lebetina*, an entrant into Europe from Asia, in the other. Their evolution is discussed, the distribution of each form is given and is shown on a large-scale map, and the means by which dispersal was effected is suggested. This part of the work is lavishly illustrated with plates. Each form is figured at least once, and the colour-plates are excellent.

M. A. S.

Progress of Biochemistry

Annual Review of Biochemistry

Edited by James Murray Luck. Vol. 6. Pp. ix + 708. (Stanford University P.O., Calif.: Annual Review of Biochemistry, Ltd.; London: H. K. Lewis and Co., Ltd., 1937.) 5 dollars.

DR. J. M. LUCK and his associates produced the "Annual Review of Biochemistry" for 1937 in ample time for the commencement of the new academic term, when research workers and advanced students, refreshed by their vacation, are eager to achieve new conquests in this field. The present rate of progress is amazing—10,000 papers were abstracted in the previous year—though it is quality alone which matters and one could wish for an etiquette among workers which forbade publication until substantial achievement could be reported. Unfortunately, to-day in the hustle for priority the reverse happens and far too much immature work is published.

We find the quality of the reviews themselves to be improving; they enable the reader to take a definite point of view instead of being a mere recital of results.

With so much available for comment, the reviewer is embarrassed in his choice. First mention may, perhaps, be made of two articles of a timely nature—a sound policy of the editor. One of these deals with the biochemistry of fish: the other with the application of microchemistry to biochemical analysis, entrusted to C. M. McKay of Ithaca, N.Y., and P. L. Kirk of Berkeley, California, respectively.

Fish have hitherto been rather neglected by the chemist, but their culture on the large scale for culinary and stream-stocking purposes has made it more easy to experiment with them—in the United States there are seven hundred fish hatcheries. There is a great species difference among fish, and the trout, most widely studied, conduct their life processes at very low temperatures. A systematic study of growth and physiological problems connected with fish is now under way, and with so much material available and experimentation relatively easy, very definite results may be expected to accrue.

Every major problem of the chemist has been furthered by the use of micromethods: in fact without such the science to-day would be nothing like so far advanced. The name of Fritz Pregl of Graz, who started the development, must stand high on the roll of honour.

In all, the volume contains 28 reviews by 35 authors, the subjects being classified as is now customary. There is a certain amount of overlapping or duplication with substances which come under two headings, but this is all to the good at the present time. An example is afforded by the co-ferments now described as phosphopyridine nucleotides, the nature of which has been at last worked out—their discovery by Sir Arthur Harden thirty odd years ago in connexion with cell-free fermentation aroused a lot of interest. They consist of a pyridine derivative, namely, nicotine acid amide, adenine, two molecules of a sugar, ribose, together with two or three molecules of phosphoric acid, according to their origin. Warburg and a number of other workers have been active in this field.

An attractive review by R. Schoenheimer and E. A. Evans of Columbia treats the chemistry of the steroids, a new term proposed for compounds related to cholesterol to include the sterols proper, the bile acids, cardiac aglycones, toad poisons, saponins, and sex hormones; these form as diverse and remarkable a group of natural substances as can well be imagined, and it is a great achievement largely to have cleared up their problems. Progress has been rapid this last three years since the revision of the old formula; the group is uniquely characterized by dehydrogenation with selenium to aromatic hydrocarbons in which the original cyclic carbon skeleton is intact.

Another biochemical field which is assuming increasing importance is that of sulphur compounds, reviewed by V. du Vigneaud and H. M. Dyer of Washington. Biological material has now yielded glutathione, methionine, ergothionine, vitamin B, djenkolic acid, asterubin and heparin, to which must be added a new adrenal compound, $C_4H_9O_2S$, the constitution of which has been confirmed by synthesis. Much interest attaches also to the chemical behaviour of the sulphur of proteins.

It would be easy to extract examples of marked progress from every review but space restricts us to final mention of the carotenoid pigments, of which a considerable number of new ones have been isolated from land and water plants largely as the result of the ease of isolation, purification and identification which the newer methods of adsorption, absorption and microchemical analysis have brought. There can be no active biochemist who can afford not to keep this book on his desk.

E. F. A.

The Right Hon. Lord Rutherford of Nelson, O.M., F.R.S.

ERNEST RUTHERFORD was born in New Zealand on August 30, 1871, and he was well educated at schools in Brightwater and Nelson, where his headmaster was the famous cricketer W. J. Ford, formerly a classical master at Marlborough. Rutherford went with a scholarship to Canterbury College, Christchurch, where he quickly made his mark by carrying out an interesting and important research with a magnetic detector of wireless waves. There is a striking similarity between Rutherford's work and that of the famous American physicist, Henry. Both used an aerial, a coil of many turns round a bundle of fine sewing needles and a small magnet which was deflected by the changed magnetism of the needles due to the current in the aerial produced by the wireless waves. Henry, however, detected lightning flashes up to ten miles' distance; Rutherford the sparks from an induction coil, two miles away. I once asked Rutherford if he had then already heard of Henry's work, and he replied, "No"! The two minds converged independently. The genius of Marconi afterwards developed an important magnetic detector which, before the age of valves, was in common use for wireless detection in ships.

The Commissioners of the 1881 Exhibition made a good choice when they elected Rutherford as a scholar. Indeed, has any money ever been better invested? This award enabled Rutherford to go to the Cavendish Laboratory at Cambridge, where Sir J. J. Thomson was conducting his own famous researches and guiding the first great group in England of young physicists, including such men as C. T. R. Wilson, Townsend, H. A. Wilson and Rutherford.

It was at that time a novelty for a young physicist to arrive at the Cavendish from near the antipodes, and there was a slight tendency to ridicule. However, formidable questions from the new arrival were received with some awe, and the rumour soon spread that there was "a young rabbit come from New Zealand, who burrows very deep".

The Cavendish group were at this time measuring the properties of electrons and ions, and in particular there was an interesting method of Rutherford's whereby ultra-violet light shining on a metal plate released electrons, which were made to leap up and down in cycloidal paths by a controlled intensity of alternating potential.

In the meantime the first research professor, the brilliant Hugh L. Callendar, had left McGill for the Imperial College and so the director of the

Macdonald Physics Laboratory, John Cox, visited England (1898) and was so wise and so fortunate as to secure Rutherford as successor to Callendar.

Rutherford even then had a very intimate knowledge of ions, whether produced by ultra-violet light or X-rays. In fact he once remarked, "Ions are such jolly little beggars, you can almost see them." He was therefore able to pursue with swiftness and accuracy his investigation of the radiations from radioactive substances which had been discovered by the genius of Becquerel, Pierre and Marie Curie, and others. Moreover, Sir William Macdonald presented his laboratory with a liquid-air machine, and three hundred dollars (£80) with which were bought 60 milligrams of radium at cost price from Giesel, who scorned to make a profit from a colleague.

In the Department of Chemistry at McGill University, there was a young Oxford physical chemist who joined Rutherford in the investigation of the relation between thorium and thorium X, obtaining results somewhat similar to those of Sir William Crookes with uranium and uranium X. They, Rutherford and Soddy, were able to put forth a most bold and startling theory, which was received at first with scepticism and opposition. Indeed, Lord Kelvin died in unbelief of this great principle, which has now stood the test of time and multitudinous experiments. Atoms were no longer to be regarded as permanent, everlasting and indivisible. Radioactive elements disintegrated spontaneously; they broke up by 'chance', independently of their age or their physical surroundings, or their chemical combinations. The mortality rate was constant for one species, but varied from one type of atom to another. In each case the disintegration took place by internal energy with the projection of an alpha particle (He^{++}) or of an electron (beta ray) and the residual atom was of a new type different from its parent atom. This theory was rapidly developed and applied skilfully to radium, its emanation (radon) and three successive products with the prosaic but useful terminology—radium A, B and C. Rutherford was asked to give the Bakerian Lecture to the Royal Society (1904) and was awarded in consequence the Rumford Medal, and he soon published his first book (1906), entitled "Radioactivity", written with a breathless enthusiasm.

Rutherford's direct advance along the royal road of physics—for he seldom wandered into byways and blind alleys—deterred him from adventures

in mathematical physics. Yet he never seemed to lack the necessary mathematical equipment essential for the interpretation and calculations of his work. Witness the masterly use of exponentials in his Bakerian Lecture, where nothing to-day need be altered or removed. The whole scheme of such calculations, transformations and graphs is familiar enough now to physicists, but it was all new near the beginning of the century.

In 1903, Rutherford had worked out the short-period group of the radium family, but he was faced with really puzzling properties of the long-period group, which necessarily involved observations extending over months. He had, however, 'grown' from radon, and he had detected and isolated, by most ingenious methods, both radio-tellurium (now radium E) and the first radioactive substance found by Mme. Curie—polonium (radium F). These atoms were in the direct line of descent of the radium family, but there was a gap! Radium C did not turn directly into radium E; there was some intermediate body the radiations from which Rutherford was at that time unable to detect. He therefore postulated a 'rayless' change of long period, ten or twenty years, and called the substance radium D, sometimes now called radio-lead, which really ejects beta rays, thoroughly investigated by many workers. But, at the time, this bold prediction of the existence of a material substance, of which no single physical property was known, beyond the fact that there should be an inevitable successor to C, and a forerunner to E, struck me as most remarkable, and on recalling, thirty years later, these circumstances to Rutherford, he was himself impressed. Men may well believe in an undetectable æther, because of its known physical properties, but here was belief in a substance without any properties except that of a go-between!

A great part of the scientific life of Rutherford was spent in his investigation of the properties of alpha particles, and the wisdom of this choice has been abundantly justified by a series of successes. He deflected alpha particles with a magnetic field, and proved that they carried a positive electric charge. He then deflected them to a measured extent both in magnetic and electrostatic fields and thus found both the velocities and the ratio of mass to charge of alpha particles. The inference was that an alpha particle had a mass four times that of a hydrogen atom, and a double positive, electronic charge. This result suggested helium, and the presence of that gas in pitchblende and thorianite was evidence in the same direction. In 1904 Ramsay and Soddy definitely obtained the helium spectrum from aged radon, and five years later Rutherford and Royds

collected the alpha particles, ejected from radon, after their passage through the exceedingly thin walls of a glass container, and again verified the nature of their catch with the spectrum obtained. To forestall a little, it may be pointed out here that Rutherford also used alpha particles in the scattering experiments which proved the existence in the atom of the minute massive nucleus with its positive electrical charge; and yet again in his most remarkable experiments on the artificial disintegration of nitrogen, etc., and on the transmutation of matter, it was alpha particles which he employed as his directed agents.

In the meantime, Rutherford was building up a school of research physicists in his laboratory at McGill. For example, he suggested to H. L. Cooke that because there was radium in the ground, there must be some penetrating radiation (gamma rays) coming upwards from the earth. At first Cooke was not successful in finding what was wanted, but Rutherford persisted: "Try more lead!" There followed a toilsome experiment with very much lead, and finally Cooke not only proved the existence of a penetrating radiation, but also he was astute enough to show that the radiation came from all directions, even from above. This was attributed at the time as coming from the bricks of the wall, etc., but he may have been unconsciously screening his electroscope from cosmic rays!

The arrival of Otto Hahn at McGill was a noteworthy event. He had been working with Ramsay, who had given him some thorianite with the object of extracting some radium from that ore, using Mme. Curie's method of fractional crystallization. To the surprise of both Ramsay and Hahn, the residue became more and more powerfully radioactive, while the production of radium was small. The concentration of the residues led to the discovery of a material many thousands of times more radioactive, weight for weight, than the parent thorium. This was an experience similar to that of Mme. Curie when she extracted radium from uraninite. The question was: What was the nature and position of this new substance which Hahn had discovered? He came to Rutherford at McGill to find out. Now on arrival Hahn was naturally excited and enthusiastic, and his English at that time was not altogether adequate, so that at first Rutherford seemed somewhat puzzled and sceptical, but when Hahn showed him the presence of the emanation of thorium (thoron), with a period of 53 seconds, Rutherford was enthusiastic over this discovery of *radiothorium*, an important and powerful member of the thorium family, which decays to half-value in 1.9 years. Hahn continued to work with Rutherford at McGill for a year or so, discovering radioactinium,

and carrying out further investigations of the thorium family, which he has continued with brilliancy in Berlin, and which have justly brought him fame.

Godlewski—a clever and charming Pole—came from Lemberg to work with Rutherford at McGill. We were trying, without much hope, to deflect the gamma rays of radium in a very powerful magnetic field. As expected, it was a null experiment, but Godlewski thought that there might be a better chance with the softer rays of actinium. One morning he showed me his photographic plate with two distinct lines half an inch long, branching like the two horns of an antelope. He had used a magnetic field and reversed it. Again he was dancing with joy and greeted Rutherford: "I have completely deflected the gamma rays of actinium." Rutherford glanced at the plate. "Do it again," he said with a smile. "Certainly, I will do it at once," replied Godlewski; but he tried week after week without a shadow of success, and it may well be wondered what malignant sprite had placed that flaw in just the very place to delude the enthusiastic Godlewski. Alas! he, a physical chemist, died in Lemberg the victim of a slow and undetected escape of gas containing carbon monoxide.

Rutherford and Barnes measured with fair accuracy the heating effect of radium and its products, assigning the proportions between the three types of radiation. Such measurements, in combination with Lord Rayleigh's determinations of the amount of radium in various primary and sedimentary rocks, have settled the long drawn-out controversy between Kelvin and Huxley as to the age of the earth. Indeed there is now an embarrassment of riches, for there is more than sufficient radium in the earth to prevent its cooling, so that, as Rutherford said, the geologist can fill up a blank cheque as he will, and can postulate successive heatings and coolings such as the series of ice ages, and mountain building, and volcanic activity seem to require. Moreover, the amount of lead (radium G), or of helium, accumulated in radioactive ore bodies of various ages affords a useful measure of geological time. Thus it is possible to point to a piece of pitchblende (it may be), and to state with some precision that the specimen has existed in its present compacted form for a period of 700 million years, and it is further possible to give a higher limit (2×10^9 years?) to the 'age' of the earth.

When Dewar discovered the selective absorption of various gases by coco-nut charcoal, he laid the foundation of the modern gas mask. (To Dewar, too, we owe the boon of the thermos flask.) Rutherford checked the selective absorption of radon and thoron and actinon by charcoal,

and told me to measure the amount of radium emanation in the atmosphere, which was in due course completed. Note Rutherford's love of measurement, as a chief essential in physics. He took a lively interest, too, in the scattered or secondary radiations in matter, due to the beta and gamma rays of radium, but after a few months' work by me, suggested that there was not much more to be made of it! Yet this subject has been pursued ever since, culminating in the discovery of the Compton effect, which indicates that a photon ($h\nu$) can collide with an electron, an idea which would have been considered improbable or impossible in earlier times.

Rutherford later showed much interest and gave his powerful assistance in the development of the treatment of cancer by the gamma rays from five grams of radium in the Radium Beam Therapy Research, and he was a strong advocate of a National Radiological Institute, where the great advances in physics could be furthered and made available to physicians and surgeons for the alleviation of the sufferings of mankind. Such a step would be a fitting memorial to him.

It will be noted that Rutherford gave away freely quite important researches—indeed, he gave far more than he retained for himself. Whether at Montreal, Manchester or Cambridge, he not only made discoveries himself, but also at each place he was the centre of a galaxy of workers who became remarkably prolific both in the quantity and quality of their discoveries. In common with many others, I am deeply grateful for staunch help and unruffled kindness extending over more than a third of a century.

Here was a man of the greatest intellectual power, who has altered the whole viewpoint of science, who accomplished an amazing amount of work of the first order, a physicist who obtained the highest prizes in life, who ranks among the greatest scientific men of all ages; well, it is pleasing to remember that he enjoyed life to the full. True, the sudden death in 1930 of his only child Eileen, wife of Prof. R. H. Fowler, was indeed a staggering blow, only in part relieved by his great affection for his four grandchildren.

Much as we deplore the death of Rutherford while still at the peak of his powers, much as we anticipated a rich harvest from the recent improved facilities at the Cavendish, much as we miss and shall continue to miss his crystal-clear expositions and yet more his friendly and delightful personality, yet who would wish to have seen that bright intelligence wane or gradually fade? He was always a charming blend of boy, man and genius, and it may still be true that those whom the gods love die young.

A. S. EVE.

It was in 1909 that I first came into contact with Rutherford, in my second year in the honours school in Manchester. Owing to some changes in the staff, Rutherford took over a course of lectures on electromagnetism. This was a stimulating experience, for Rutherford was interested in the subject and his account of his own early work remains with me a vivid memory. In our third year some of us were drafted into research work—into the firing line as he would put it—to our great joy and, on occasions, alarm and terror. At that time his main line of work was the study of the properties of the α -particle, already begun in Montreal and continued with increased vigour in Manchester. The counting of the α -particles and the measurement of their charge (both with Geiger) gave a value for the unit of charge which was accepted for some years and showed that the α -particle should be a helium atom. The direct proof followed in the beautiful experiment with Roysds. At the same time, the phenomena accompanying the passage of the particles through matter were investigated—the ionization, the ranges of the particles from the different radioactive bodies, the change of velocity and the scattering of the particles.

These latter experiments, carried out by Geiger and Marsden, proved to be of special importance, for they led Rutherford to his conception of the atom as a heavy, positively charged nucleus surrounded by a cloud of electrons in appropriate number. I remember well the occasion on which this idea was first put forward. It was at a meeting of the Manchester Literary and Philosophical Society, to which all workers in the laboratory were invited. Rutherford's account of his theory, backed by Geiger with a description of some new experimental evidence, created a profound impression.

The nuclear theory was the culmination of Rutherford's work on the α -rays, and the finest of all his great contributions to physics. It is scarcely necessary to say that it is the foundation on which all the subsequent developments of atomic physics have been built. The history of this discovery shows very clearly one of the most typical aspects of Rutherford's genius—his extraordinary gift for seizing on the vital point. The discrepancy between Geiger's measurements of the scattering of α -particles through small angles and the apparently trivial observation that a small fraction of the particles which fell on a thin foil were scattered backwards led him straight to the goal. These simple experiments were sufficient to give him the general picture of atomic structure, though further work was necessary to fill in the details. A complete proof of the theory was given some time later by Geiger and Marsden in a series

of magnificent experiments, which also showed that the atomic nucleus was of very small dimensions, and gave (roughly) the size of its charge.

The full implications of the nuclear theory were only gradually appreciated. There followed van den Brook's suggestion that the charge on the atomic nucleus was determined by the atomic number, established in Rutherford's laboratory by the famous experiments of Moseley on the X-ray spectra of the elements. The story of Bohr's visit and his development of the nuclear atom to explain spectroscopic series and atomic phenomena is so well known that it needs no repetition here, although this development now covers the whole field of atomic physics. There was further the application by Russell in Manchester, and elsewhere at the same time by Soddy and by Fajans, to explain the chemical properties of the radio-elements.

Meanwhile, Rutherford, continuing work on the α -rays, also began to turn his attention to the β - and γ -rays. With Andrade, he obtained for the first time a spectrum of the γ -rays by diffraction from a crystal; while, with Robinson, he investigated in great detail the line spectrum of β -rays and also showed the connexion between the γ -rays and the β -ray lines, a connexion which in later years has been used with great effect in the study of both β - and γ -ray spectra.

These years, 1907–14, were perhaps Rutherford's greatest period. A stream of papers on all aspects of radioactivity poured from his laboratory, nearly all of outstanding importance. There would be generally about twenty or so workers, including the staff of the laboratory, who in spite of heavy teaching duties yet found time for research. A large proportion of the workers were visitors, for he attracted men from many countries. It seems invidious to mention any names when it is impossible to give all, but as I have already transgressed perhaps I may be forgiven for adding those of Boltwood (a great friend of Rutherford's), von Hevesy, Fajans, Gray, Boyle, Kovarik, Darwin, Russ, Makower, Evans and Florance. And I am sure Rutherford himself would have wished me to add again the name of Geiger, who collaborated in so much of his work and who helped him in many different ways.

The period of the Great War was, of course, relatively unproductive; but in the intervals snatched from other activities, Rutherford pursued his course. He was now speculating about the structure of the nucleus, and when I returned to the laboratory at the beginning of 1919, he had just succeeded in showing that the nucleus of nitrogen could be disintegrated by bombardment with an α -particle. This was a discovery second only to his nuclear theory and the transformation

theory, but its great importance was not fully recognized at the time, probably because it remained an isolated fact for some years. With this experiment, however, he opened up a new field of inquiry, nuclear physics, in which there is now such great activity.

In 1919, Rutherford succeeded J. J. Thomson as Cavendish professor of experimental physics in Cambridge. He left Manchester with many regrets, for he had been very happy there and he had made many friends both in the laboratory and outside it. He began in Cambridge to pursue with characteristic energy the paths marked out by his work in Manchester. It was at this time that I came to know him well, for he invited me to join him in continuing the experiments on the artificial disintegration of elements by α -particles. He had long had a special love for the α -particle, but now the nucleus also was admitted to the same intimacy, and the experiments bearing on nuclear structure were his main interest. After the first rapid advances, progress became rather slow, owing to difficulties inherent in the method of experiment. But Rutherford never lost his faith in the ultimate success of this work. The development of electrical methods of counting particles enabled many striking advances to be made, elsewhere as well as in the Cavendish, and the subject of nuclear physics began to open up rapidly.

The real reward for his efforts to develop this field of work came in the spring of 1932, first with the discovery of the neutron, a particle the properties of which he had anticipated several years before and for which he, and I, and others in the laboratory, had previously searched in vain, and shortly afterwards with Cockcroft and Walton's disintegration of elements by protons—disintegration for the first time by means under human control. I mention these two discoveries particularly, not only because of their special significance but also because they are the fruit of his policy and direction. If they do not bear his name, these discoveries bear the stamp of his laboratory, and his delight in them was as great as if he had made them himself.

Many advances of almost equal importance were made during this period 1919–37, so many that it is impossible to mention them one by one. The number of men who took part in these advances is so large that a list of only the most notable names would be inordinately long. The reputation of the Cavendish Laboratory won under Maxwell, Rayleigh and J. J. Thomson was maintained and even increased. The laboratory itself spread in size and received, as an independent satellite, the Royal Society Mond Laboratory under Kapitza.

I have said that the Manchester days were Rutherford's greatest period. This is true so far

as his own direct contributions to physics are concerned, but it is not true in other ways. In Manchester his research students were mostly senior men who had already won a reputation. In Cambridge conditions were different. There were, of course, a number of senior workers, but the young men with little or no previous training far outnumbered them. Rutherford recognized very clearly that the training of such large numbers of students would hamper the progress of his own work, but he accepted it as his duty. He gave the most careful thought to the problems on which he put his students, so that these should begin within their powers and lead to a well-marked and profitable line of research. He kept his eye on every man, expecting and at times demanding the best the man could do, and inspiring him with his own enthusiasm. When the time for publication came he read the paper with the greatest care, often making what changes in presentation he thought desirable, even to the extent of re-writing whole sections. No paper left the laboratory until he was satisfied. It would be difficult to over-estimate his services and his influence in these directions, for there can be few if any universities in the British Empire which do not contain at least one of Rutherford's students. He came to regard the training of students in methods of research as of almost equal importance to the advancement of knowledge.

Even the casual reader of Rutherford's papers must be deeply impressed by his power in experiment. One experiment after the other is so directly conceived, so clean and so convincing as to produce a feeling almost of awe, and they come in such profusion that one marvels that one man could do so much. He had, of course, a volcanic energy and an intense enthusiasm—his most obvious characteristic—and an immense capacity for work. A 'clever' man with these advantages can produce notable work, but he would not be a Rutherford. Rutherford had no cleverness—just greatness. He had the most astonishing insight into physical processes, and in a few remarks he would illuminate a whole subject. There is a stock phrase—"to throw light on a subject". This is exactly what Rutherford did. To work with him was a continual joy and wonder. He seemed to know the answer before the experiment was made, and was ready to push on with irresistible urge to the next. He was indeed a pioneer—a word he often used—at his best in exploring an unknown country, pointing out the really important features and leaving the rest for others to survey at leisure. He was, in my opinion, the greatest experimental physicist since Faraday.

I cannot end this tribute to Rutherford without some words about his personal qualities. He knew

his worth but he was and remained, amidst his many honours, innately modest. Pomposity and humbug he disliked, and he himself never presumed on his reputation or position. He treated his students, even the most junior, as brother workers in the same field—and when necessary spoke to them 'like a father'. These virtues, with his large, generous nature and his robust common sense, endeared him to all his students. All over the world workers in radioactivity, nuclear physics and allied subjects regarded Rutherford as the great authority and paid him tribute of high admiration; but we, his students, bore him also a very deep affection. The world mourns the death of a great scientist, but we have lost our friend, our counsellor, our staff and our leader.

J. CHADWICK.

I HAVE been asked by the Editor to give a brief account of my personal recollections of the late Lord Rutherford. I met him first in October 1895, when a regulation had just come into force by which graduates of other universities were admitted to Cambridge as 'research students', and after two years residence were eligible for the B.A. degree. Rutherford was the first student to apply; he was succeeded in an hour or so by J. S. Townsend, who has since become Wykeham professor of physics at Oxford, so that the first two research students became professor of physics at Cambridge and Oxford respectively. Rutherford when in New Zealand had invented a magnetic detector of wireless waves and his first work in the Cavendish Laboratory was to try to improve its sensitiveness. He showed even at this early stage that he possessed exceptional 'driving' power and ability as an organizer. To test his detector, it was necessary to take observations simultaneously at two places, and the transport of the instrument required organization. He surmounted these difficulties by getting assistance from his friends, and at one time held the record for long-distance wireless in England, having observed at the Laboratory signals which came from the Observatory about two miles away. He had not worked for more than a very few weeks before I became convinced that he was a student of quite exceptional ability.

Whilst Rutherford was engaged with this research, Röntgen rays were discovered and we had found at the Laboratory that when these passed through a gas they made it conduct electricity even with the smallest electric forces. For ten years experiments on the passage of electricity through gases had been going on in the Laboratory; these were excessively difficult as the only ways

of getting the electricity to pass through the gas were to use large electric forces and so get sparks, or make the gas so hot that you got flames. Both these were exceedingly capricious in their behaviour. The Röntgen rays gave a very simple and reliable means of making the gas conduct electricity even under the smallest forces, put researches on gases on quite a different footing and promised to add greatly to our knowledge of the subject. Rutherford devised very ingenious methods for measuring various fundamental quantities connected with this subject, and obtained very valuable results which helped to make the subject metrical, whereas before it had been only descriptive.

Yet another fundamental discovery was made while Rutherford was working in the Laboratory, that of radioactivity, which in one form or another occupied his attention for more than twenty years. Henri Becquerel found in 1896 that salts of uranium gave out radiation which, like Röntgen rays, could penetrate opaque bodies and affect a photographic plate. The radiation was not all of one type: one part of it was very easily absorbed; another part could penetrate much greater distances and was deflected by magnetic force in the same direction as a negatively electrified body, and a third, present only in small quantities, seemed even more penetrating than the second. In 1918 Rutherford made a careful study of these types of radiation, which he called α , β , γ , a notation which is now universally used; he did not find any irregularities, and commenced a study of the radiation from thorium. He had not completed this when he was elected to the professorship of physics in Montreal in succession to H. L. Callendar, who was also a Trinity man and who had worked in the Cavendish Laboratory with remarkable success.

Rutherford had not been long enough in Cambridge to entitle him to be able to sit for a fellowship when he was elected to the professorship and left Cambridge for Montreal. When he got there, he resumed the experiments on the thorium radiation. These, until the clue was found, were terribly perplexing; what seemed a trivial thing such as a puff of air would produce a great difference in the radiation, while large changes in temperature produced no effect. The thorium seemed to infect bodies placed near it and make them radioactive; they recover after a time if the thorium is taken away. These anomalies, though troublesome, were really a blessing in disguise, for in his attempt to account for them, Rutherford arrived at the view about the processes going on in radioactive substances which is now universally accepted. His view was that the thorium, besides giving out radiations, gives out a radioactive gas which he

called an emanation. This may be wafted about, or settle on solids and make them appear to be radioactive. The emanation is not permanent, but after a few hours changes into non-radioactive substance.

Rutherford's scientific activity was never greater than when he was at Montreal. In the years between coming to Cambridge and leaving Montreal to be professor of physics at the University of Manchester, he had published between forty and fifty papers; a few of these were joint papers, but the great majority were about researches of his own which had led to results of first-rate importance and which could not have been obtained by anyone who was not an experimentalist of the very first order. In those days, laboratories had no funds to buy instruments as sensitive as those which are now available, and to detect small effects required exceptional skill, patience and self-criticism.

After Rutherford went to Manchester, I did not see much of him until 1915, when Mr. Arthur Balfour, as he was then, created the Board of Invention and Research for the co-ordination and encouragement of scientific effort in connexion with the Great War. Lord Fisher was the president of the Board, and I was a member of the Central Committee. The most pressing need at the moment was some means of detecting submarines. We got Rutherford to draw up a report on the methods which had been used or suggested for this purpose. He reported strongly in favour of a particular method, and we were fortunate enough to secure the services of Prof. W. H. (now Sir William) Bragg as director of a research for this purpose, and provided him with a laboratory and staff. Rutherford also visited the United States to find out what they were doing in this matter and to tell them what we were doing. His help was continually being asked on a great variety of questions and there was no one whose opinion carried greater weight.

The Cavendish Laboratory has made great progress under his direction; the Mond Laboratory, for magnetic research and the High-Tension Laboratory have been created. When he came, the supply of instruments for research was too scanty; it is now in this respect one of the best equipped physical laboratories in existence. Lord Rutherford's activities were very wide-spread; he was professor of natural philosophy at the Royal Institution, and also held with conspicuous success the very responsible post of chairman of the Advisory Council of the Department of Scientific and Industrial Research. That he could discharge so many duties was due to his powers of organization and that his claim to know a good man when he saw him was amply justified by results. With this faculty he could delegate some of his work to

others without injury to the efficiency of the Laboratory, and get time to spare for his other activities. His death just on the eve of his having in the High-Tension Laboratory means of research far more powerful than those with which he had already obtained results of profound importance is, I think, one of the greatest tragedies in the history of science.

J. J. THOMSON.

THE splendour of Rutherford's contributions to science excites a wonder as to the means by which he could achieve so much. He made no claim to great mathematical ability, and many an experimenter has had fingers more clever than his. Yet he conceived and carried out a series of researches which have played a leading part in the marvellous advances of modern physics. To begin with, he brought to his work an intense interest, a tireless vitality, a singleness of purpose, a simplicity of conception and a bravery of attempt which carried him straight to the point.

Rutherford had to a remarkable degree the power of seizing on the essentials; and he not only saw what was unimportant but also rode over it and through it remorselessly. This was true indeed of all his dealings: he had a well-earned reputation for speaking plainly. But he was very kind and generous, and a loyal friend. He was tactful, and full of consideration for all who were trying to do the right thing. One of his lovable characteristics was his constant care that all who worked for him, and indeed all workers, should have full credit for what they did. In any company of men he was extraordinarily quick to appraise the value of what each man said, and indeed the worth of the speaker himself, so that his own clearness and honesty of purpose, his force of statement and his shrewd judgment would carry the company with him. Thus he was a great administrator and guide.

In the laboratory his helpers went forward strongly and confidently towards the conclusions which he himself anticipated so clearly. So perhaps we may understand why such fine work came from the laboratories which he successively controlled, and why in these days physical science has been so greatly enriched.

W. H. BRAGG.

WITH the passing away of Lord Rutherford*, the life of one of the greatest men who ever worked in science has come to an end. For us to make comparisons would be far from Rutherford's spirit, but we may say of him, as has been said of Galileo,

*A short tribute given at the Galvani celebrations in Bologna on October 20.

that he left science in quite a different state from that in which he found it. His achievements are indeed so great that, at a gathering of physicists like the one here assembled in honour of Galvani, where recent progress in our science is discussed, they provide the background of almost every word that is spoken. His untiring enthusiasm and unerring zeal led him on from discovery to discovery, and among these the great landmarks of his work, which will for ever bear his name, appear as naturally connected as the links in a chain.

Those of us who had the good fortune to come into contact with Rutherford will always treasure the memory of his noble and generous character. In his life all honours imaginable for a man of science came to him, but yet he remained quite simple in all his ways. When I first had the privilege of working under his personal inspiration, he was already a physicist of the greatest renown, but nevertheless he was then, and always remained, open to listen to what a young man might have on his mind. This, together with the kind interest he took in the welfare of his pupils, was indeed the reason for the spirit of affection he created around him wherever he worked.

Rutherford passed away at the height of his activity, which is the fate his best friends would have wished for him, but just on account of this he will be missed more, perhaps, than any scientific worker has ever been missed before. Still, together with the feeling of irreparable loss, the thought of him will always be to us an invaluable source of encouragement and fortitude. NIELS BOHR.

RUTHERFORD'S death removes from science the most outstanding personality of the age. My most vivid memories naturally date from the autumn of 1900 and the two subsequent years when I worked with him at McGill. A born experimenter, entirely devoted to his work and with few, if any, outside interests, I can see now more clearly than I did then how he neglected no opportunity or preparation the better to advance it. Though the qualities for which in later life he was so publicly beloved were then still undeveloped, yet undoubtedly they existed and they helped to leaven the McGill of those days and to make it the enchanted place it was. The personal familiarity with the man, and his methods of work in the laboratory, that I gained in those years remained, of course, an abiding possession. Yet I do not think it was entirely, if at all, this that later was to make all his scientific communications a unique pleasure to read. True, admiration for some new and striking advances was pretty sure to be evoked, but over and above

this they seemed to radiate an entirely undefinable charm.

In the last phase, since the Great War, this extended from his writings to his public lectures and appearances. The intense absorption in abstruse scientific problems, which in others is a hindrance to wide social intercourse, was in him combined with such vitality and magnetism that others were attracted rather than repelled. As has been well said, he was able to vitalize any public gathering and make it the happier merely for his coming.

In the last letter I had from him, asking me why I had resigned, he told me he did not expect to do so for some years, as he was feeling very fit and well, and able to hold his job down. The Fates have otherwise decreed. He reached, perhaps even did not quite reach, the summit of his powers, but for him there was to be no slow and inevitable decline. F. SONDY.

It is hard to think of Rutherford as a man whose life is finished, that we shall no more see his steady eyes and hear the familiar voice, now asking placidly about some domestic trifle as any friend might, now growing hurried and excited when ideas about some physical problem were coming almost too fast for his tongue. There can seldom have been a man in whom burning genius was so closely associated with the kindly commonplace, who at any moment might suddenly become inspired, and a little later might be showing a boyish naivety about some question of another kind. His ability to excite affection was as marked as his power of commanding admiration: his foibles were essentially those of a frank and simple nature, the charm of which remained unspoiled, and was even enhanced, by successes that might well have turned the head of a lesser man.

I like to think of him as he was at Manchester, where I first came to know him. Of this time he might have said, in Newton's words, "for in those days I was in the prime of my age for invention, and minded philosophy more than at any time since." He was free from any grave cares of administration, his duties outside the laboratory were light, and he had leisure himself to experiment with his own hands and eyes, as he loved to do. He organized his students as a team for radioactive research, allotting to each a task within his capacity, and urging him on in energetic fashion if urging was needed. Our belief in him was implicit: if Rutherford said that an experiment could be done, then it could be done, and the sooner it was done the better.

Rutherford was a young man with the rest of us, sharing our jokes and showing us how to overcome our difficulties. His nickname in those days

was "Papa", perhaps arising from the paternal way in which he put us right about anything that had to do with radioactivity. But he was a very young father of a family and extremely unconventional. When things were going well, and new discoveries were coming out at the rate of about one a week, a tune recognizable by the elect as "Onward, Christian Soldiers" could be heard accompanying the Professor's steps along the corridors: when things were going less well another tune, no less holy, held sway.

It must not be thought that his interests were limited to radioactivity, or to any other particular branch of physics. I well remember him cross-examining A. D. Fokker about relativity, and any other visitor had to tell him all about the work in which he, the visitor, was expert. The theme of the laboratory in the few years before the Great War was, however, the structure of the nuclear atom, which he had put forward in 1911. In the laboratory during this period were Niels Bohr, H. G. J. Moseley, C. G. Darwin, J. Chadwick, H. Geiger, H. R. Robinson, J. M. Nuttall, E. Marsden, D. C. H. Florence, J. A. Gray, R. W. Boyle, H. B. Boltwood and A. Kovarik, to quote a few remembered names. Those were good days. Other great men will, no doubt, arise, but it is unlikely that any of us who worked with him in

those days will live to see another such genius at the height of his powers, the leader and friend of such a school.

E. N. DA C. ANDRADE.

LORD RUTHERFORD's death is a calamity for the Department of Scientific and Industrial Research. In the seven years during which he has been chairman of the Advisory Council, his influence has made itself felt throughout the Department. His broad sympathies, lively imagination, and deep insight equipped him in a wholly exceptional way to direct and strengthen the links between the Department and industry. It was an article of faith with him that the future of Great Britain depends upon the effective use of science by industry. It was this faith which induced him, a man of the highest attainment in the field of pure scientific research, to devote himself, as he did unreservedly, to our work. The development of the research association movement, now taking place, owes much to his foresight, sympathy and advocacy. Equally stimulating was his influence on the scientific work of the Department. In our counsels he leaves a blank which cannot be filled; and the loss of his unsparing service, his genial personality, and his warm-hearted encouragement, may well fill the stoutest heart with dismay.

F. E. SMITH.

The Funeral of Lord Rutherford

WITHIN the ancient walls of Westminster Abbey and in the presence of a large gathering of men eminent in many walks of life, at noon on Monday, October 25, a typical English autumn day, the last remains of Lord Rutherford were laid to rest in the Nave near the graves of Newton, Kelvin, Darwin and Sir John Herschel. Thus another link was forged binding the Empire together, for Rutherford was the first man of science born in the overseas dominions to be buried in the Abbey. The honour thus accorded him is fitting recognition of the place he held among his fellows, and the memorable service at his burial, in its simplicity, beauty and dignity, was in keeping with the passing of a man of singleness of purpose whose whole life had been devoted to unravelling the secrets of Nature. There was no pomp or pageantry such as is seen at the burial of our great naval and military leaders, no word was said of his life or achievements, but a quiet air of sincerity pervaded the whole scene and left an indelible impression that it was all as he would have wished.

Among the large congregation, H.M. the King

was represented by Lord Fortescue (Lord in Waiting). The Prime Minister was represented by Mr. G. P. Humphreys-Davies, the Lord Chancellor by Mr. Vernon Harington. Lord Halifax (Lord President of the Council), Lord Swinton (Secretary of State for Air), Sir Samuel Hoare (Secretary of State for Home Affairs), Sir Thomas Inskip (Minister for Co-ordination of Defence), Earl Baldwin and Mr. Ramsay MacDonald were present. Rear-Admiral A. Bromley represented the Secretary of State for Dominion Affairs and Admiral of the Fleet Lord Chatfield represented the Admiralty.

The ten pall-bearers were the High Commissioner for New Zealand, Prof. H. R. Dean (Vice-Chancellor of the University of Cambridge), Lord Dawson of Penn (president of the Royal College of Physicians), Sir William Bragg (president of the Royal Society), Sir Edward Poulton (president of the British Association), Prof. A. S. Eve, of McGill University, Prof. E. D. Adrian, of Trinity College, Cambridge, Sir Frank Smith, of the Department of Scientific and Industrial Research, Prof. W. L. Bragg, of the University of Manchester, and Sir George Lee, president of the Institution of Electrical Engineers.

The service began with the singing of the sentences "I am the resurrection and the life . . ." while the coffin containing the urn with the ashes was borne slowly through the Nave and Choir to the bier placed in front of the Sanctuary and beneath the Lantern. Then followed the singing of the 23rd Psalm, the reading of Ecclesiasticus, xlv, 1-14, prayers and the hymns "The King of Love my Shepherd is" and "Praise, my soul, the King of Heaven". With the congregation standing, the coffin was then carried back to the Nave, followed by the mourners and chief representatives, and the committal took place. Owing to the recent death of the Dean, the Right Rev. W. Foxley Norris, the service was conducted by the Sub-Dean, Canon V. F. Storr, and it was his voice the congregation last heard as he pronounced the Blessing. The service was brought to an end with the organist playing Harwood's *Requiem Aeternam*. After the departure of the chief mourners, those present were permitted to file past the flower-strewn spot where the urn rested, and above which will be placed the slab bearing the name of Rutherford.

On this occasion it is of interest to recall something of the other eminent men of science buried or commemorated in the Abbey; for as Dean Stanley wrote, the characteristic of Westminster Abbey which most endears it to the nation is the fact that it is the resting place of famous Britons, from every rank and creed, and every form of mind and genius. The earliest connexion of the Abbey with modern science and with the Royal Society goes back to the seventeenth century, when Sir Robert Moray, the first president of the Royal Society, was buried in the centre of the South Transept at the expense of Charles II. He died in 1673. Two years later, Dr. Thomas Willis, one of the earliest professors of natural philosophy at Oxford, was buried in the Abbey, and his interment was followed in 1677 by that of Isaac Barrow, the first Lucasian professor at Cambridge and the Master of Trinity. Both his grave and monument are in Poets' Corner. Just half a century separate the burials of Barrow and of Newton; but in the interval Dean Sprat, the first historian of the Royal Society, was buried in St. Nicholas's Chapel, and Thomas Tompion, 'father' of English clockmakers, was buried in the centre of the Nave.

Newton died on March 20, 1726 (O.S.) or March 31, 1727 (N.S.). For several days his body lay in state in the Jerusalem Chamber and then was buried on the south side of the Nave near the Choir. "His countrymen honoured him in his lifetime," wrote Voltaire, who was in London, "and interred him as though he had been a king who had made his people happy." Though there are

memorials to men of science in many parts of the Abbey, it is around the grave and monument of Newton that the greatest number are to be found. Just in front of the monument are the tablets to Kelvin, Maxwell and Faraday, a little farther off are the gravestones of Telford and Robert Stephenson, while in the grave of Tompion lies also the body of his pupil and successor "Honest" George Graham, who on November 24, 1751, at night, was brought from his house in Fleet Street and laid with his master. To the north of Newton's grave, in the Aisle, are the graves of Darwin and Herschel, and a little farther to the west those of Lyell and John Hunter. Like Boyle, Hunter was first buried in St. Martin-in-the-Fields. Boyle's grave was lost sight of through the rebuilding of the church, but Hunter's coffin in the vaults of the new church was discovered by Frank Buckland, and through the action of the Royal College of Surgeons in 1859, was removed to the Abbey.

Also in the north aisle, but to the east of the grave of Darwin, are the eight memorials clustered around the tomb of Sir John Thynne, a zealous Sub-Dean of the Abbey. Here in 1888 was placed the medallion of Darwin, and beside that are now memorials to Joule, John Couch Adams, Sir Joseph Hooker, Alfred Russel Wallace, Sir George Gabriel Stokes, Lord Lister and Sir William Ramsay. The ten windows lighting the aisle are also memorials, and on some of them are to be found the names of Richard Trevithick, Isambard Kingdom Brunel, Robert Stephenson, Lord Kelvin, Sir Benjamin Baker and Sir John Wolfe-Barry. There were once windows to the memory of Joseph Locke and Sir William Siemens, but these have been removed.

Of the other memorials in various parts of the Abbey, the group in St. Andrew's Chapel is the most interesting, for here, beside the statue of Telford, are the tablets to Sir Humphry Davy, Thomas Young, Dr. Matthew Baillie the anatomist, Sir James Simpson and Lord Rayleigh, and also the monument to Sir John Franklin. Not far away, in St. Paul's Chapel, is to be found Chantrey's great statue of Watt, whilst elsewhere are to be found the graves or monuments of Sir William Spottiswoode, Sir John Pringle and Martin Folkes, three presidents of the Royal Society, John Woodward and Dean Buckland, Major James Rennell, Sir Stamford Raffles and the young Lancashire clergyman and astronomer Jeremiah Horrocks, who on November 24, 1639, was the first to observe a transit of Venus. Horrocks died in 1641, but at the time of the transit of 1874 a memorial, placed within that of Newton's nephew, John Conduitt, at the west end of the Nave, was erected with an inscription upon it by Dean Stanley.

Science and the Community*

By the Right Hon. J. Ramsay MacDonald, P.C., M.P., F.R.S.

I MUST begin by expressing two things that are upmost in my mind at this moment: the thanks we all owe to Mr. Radford Mather, the generous founder of these lectures, and the honour I feel at having been asked by the Council of the British Association to deliver the first of them. Mr. Radford Mather has been impressed by the importance of the work of the scientist in the ordinary everyday life of our people, especially at this moment; and, after a long life enlivened by scientific and social interest, he feels keenly that a recognition of that work is not only owing to the scientific worker himself, but also will be helpful in inducing the public to use the advantages which the scientist has put at its disposal.

The history of scientific discovery and the application of scientific knowledge to human activities in every field reads like a romance, and I can imagine no more interesting career for anyone whose tastes lie in that direction. The interest and importance of the scientific career, however, are not confined to the laboratory or the classroom, but should be regarded as a major, if indeed not the major, creative influence on this generation. In national economic well-being, especially in making high standards of living possible, in the evolution of both the powers and forms of national institutions, in the efforts to create and secure social harmony and co-operation, the scientific method, if followed, would be of great assistance and would save some futile experiments, mistaken agitation and unworkable proposals. Thus, the politician as well as the professor, the housewife as well as the manager of great works, whether they are aware of it or not, depend in the performance of their work upon whether the public mind not only responds emotionally but also sets about making that response with the same care as to facts and the same anxiety as to methods as the man of science shows in his special field. What are called 'moving' descriptions of human ills, quite accurate as to facts but left without carefully studied conclusions as to treatment, often become serious obstacles in the way of satisfactory remedies.

In all public affairs I myself am an unrepentant evolutionist. There must be changes, not for the sake of change, but because social harmony and progress require it. Were it not so, civilization itself would soon become a relic, and we should have to deal with a society which has breathed its last progressive breath and has reached the stage

of disruption through evolution, because it is not adapting itself to the new conditions which are the immediate offspring of its own life. Civilization is not a static state but one of dynamic activity which requires direction. The most lasting and fruitful of changes are those which arise from the failures of existing conditions or their hitherto imperfect successes. Or we may put it this way in full accordance with the truly scientific mind: Creation was left imperfect for man to carry it on towards completion by coming to understand it, both as an accomplishment and a promise. The place where the shoe pinches either body or mind is the spot where disruptive unsettlement shows itself first. The remedy is not to curse the shoe nor to content ourselves by describing the pains. The shoe should be adapted so that it may be useful (as it was intended to be) without doing what it was never meant to do—rack us with pain.

Pain in the individual corresponds with discomfort and unrest in the community. Both are signals of harmful processes and call for study and treatment in the scientific spirit, in order to prevent more serious results—serious illness and death in the individual, revolution and disruption in the community.

By the scientific method it might often be possible to prevent even the pain and unrest. This optimism in progress, however, assumes that an awakened interest in the work of the experimental scientist will incline the public to follow, in its own special concerns, the methods and spirit of the scientist himself. I make no plea for the scientist as statesman. He will not be likely to be any better than Plato's philosopher. The plea I make is for a practical democracy, but if democracy is to triumph in the attack now being made upon it, it must have a method, and I believe that the records of the scientific worker and the way he sets about his work will steady and clarify the popular mind not only to complain eloquently, but also to conclude wisely.

In these days, when science is renewing its claims to be regarded as an essential part of cultural education and to rank in value with the humanities for that purpose, it must be able to show that its pursuit is not only to discover facts, but to influence values of life as well, and that it can not only put power into men's hands, but also quicken the human qualities of mind which take care that that power is used for human well-being

* From the first Radford Mather Lecture of the British Association, delivered at the Royal Institution on October 22.

and progress. The scientist as citizen should take a lively concern in the way his discoveries are used. Prof. Lancelot Hogben contributed a thought-provoking paper to the Blackpool meeting in which he emphasized this dictum: "The cultural claims of science rest on the social fact that the use and misuse of science immediately affects the everyday life of every citizen in a modern community."

If at the end of a generation the great contribution that scientific activity has made to the life of the community is to produce a power of destruction which can be used to appal the most indifferent to human suffering and injustice, the labours of the scientist of our time run the risk of being permanently deplored. This is now being widely recognized by scientists themselves. On the other hand, the part which our present scientific research can play in social well-being and solidarity depends upon an enlightened popular view of the value and significance of those researches and their uses.

Standards of life have undoubtedly been raised and opportunities for improving wages provided, whilst leisure has been extended and the conditions under which people work, even in spite of some serious shortcomings, greatly improved. Human stress and strain have become considerations in work, and the adaptability of the individual to employment has greatly eased the discomforts and disappointments of the worker. These tendencies have by no means exhausted themselves, and an enlightened determination to maintain the conditions of uninterrupted consumption of products by increasing the share of the worker will minimize the hardships of any at-present-uncontrollable slackening in the market demands for production and labour.

The needs dealt with by these scientific investigations cover an extraordinarily wide field indicated with interesting clarity in the annual reports of the Department of Scientific and Industrial Research and its organizations, such as the National Physical Laboratory. From these it is seen that organized research extends apace, and that the co-operation between scientists and industrialists has become a well-marked feature in our industrial life. Industry is no longer satisfied with sporadic consultations with science. This has led, as the last annual report of the Department of Scientific and Industrial Research records, to a steady improvement of the efficiency of our industry and the comforts of the working staffs.

Furthermore, there is a steady growth of the acceptance of scientific effort on the part of industrialists, and a spirit of co-operation between the scientist and industrialist has been developed to an encouraging degree, so much so that we may well say that we have been witnessing the creation

and development of a new industrial organ with a well-marked function.

I must limit my excursion into those fields to which modern scientific discoveries are leading us, which have been so interestingly dealt with in papers read at the Blackpool meeting of the British Association last year, and which find a voice in some most challenging articles in recent issues of the scientific press. Nor will scientists fail to observe the meaning of that most significant resolution passed by the recent Trade Union Congress agreeing to a Committee of Scientists with whom Congress can consult on policy, outlook and methods of handling their special work. Thus a scientific front is being created, with the co-operation of all classes and interests, to encourage scientific inquiry and to use it to promote communal well-being.

The advance in the investigations of the scientist is not, however, universally welcomed. The reason is that science and machinery mean pretty much the same thing in the public mind, and two accusations are made against machinery which are in very many minds as they see what wonderful things science has done in recent years. The first expresses a general doubt whether this machine age has brought us any benefit at all, and is anything more than an unfortunate by-road in world history. It is argued that, in pursuing the machine, man has lost his soul and those qualities which proved that he had a soul. That great question in aesthetics cannot be dealt with in this lecture even as a side issue. I believe that a very large part of the case for it is based upon the misuse of science for which the man of science has nothing to do, and cannot be blamed. But, further than that, I am not at all sure but that science will be found to provide the antidote—conditions of leisure and culture which will enable us to rediscover the qualities of life which modern society is said to have lost.

In many quarters science is regarded as the enemy of human beings who desire to live as self-supporting workers. So has it always been at times of great change in industrial production. A reply which reminds us of the experiences of labour in history, that the displacement of men by machinery has always been but temporary and that with an increase in national wealth we also have an increase in the national demand for labour. There is some evidence that that experience is being repeated to-day. It is, however, rather unconvincing to the man who actually finds himself unemployed because a machine more efficient than himself as a producer has taken his place in mine and factory. Be that as it may, machinery which takes the place of the hard, uninspiring and deadening drudgery of human

beings is all to the good, and that which multiplies the efficiency of human skill is also all to the good. Human safeguards and benefits come from other directions—mainly from an increase in leisure, the enjoyment and use of which are amongst the most pressing of social problems to-day. And there is another pressing problem in front of us. How to reduce cost of production without lowering standards of life? Scientific invention properly used, I believe, will give us a chance to solve both problems.

The other trouble is kept fresh and urgent by what we read every day in our newspapers of the great advance due to science in the destructive forces of the world, as shown in China and Spain, and will be repeated with increased horror wherever war breaks out. If we cannot avoid war, we cannot avoid the very worst that can happen in warfare. But this raises issues which depend upon other considerations than those of the field of science. Science increases power which can be applied both to life and death. The men who have made air forces possible, for example, have also created civil air fleets, and if the communities cannot make and keep peace, or if they are so blind as to follow the aggressive actions of their rulers, democratic or dictatorial, the consequences are theirs. If peace is not secured by, say, diplomacy and the will not of one but of all nations, it is both a false judgment and a cowardly one to blame the scientific engineer and worker. The action of the farmer in growing corn and food for war is exactly of the same kind as the engineer who makes flying engines. Peace or war is not the responsibility of scientists *as scientists*, except in very special cases, so long (and it will always be) as the discoveries which increase our peaceful and beneficial resources can be used for war machinery.

At the same time, there is a feeling amongst many scientists that the ease by which their labours may be misused in this way should make them, as citizens, sharers in creating and upholding the public opinion of the nations to which they belong, interested in protecting their work from being outrageously abused as beneficial poisons can be.

I have presided over various international conferences of chemists, engineers and others interested in this question, and one and all gave a hearty response to every mention of this interest and duty of theirs. Scientists will also remember that from that distinguished scientific body, the Royal Academy of Sciences at Amsterdam, came a resolution which after discussion at the general assembly of the International Council of Scientific Unions, in April last, led to the appointment of a committee with the following terms of reference:

"The Committee, at suitable intervals, should prepare a survey of the most important results obtained and of the directions of progress that are

opening and of points of view brought forward in the physical, chemical and biological sciences, with reference to:—

"(1) their interconnections and the development of the scientific picture of the world in general; "(2) the practical application of scientific results in the life of the community.

"The work of the Committee is limited strictly to scientific activity." (See *NATURE*, April 24, 1937, p. 697, and May 22, 1937, p. 869.)

This is the concern of the political organization of citizens, including scientists, but not specifically as scientists. In any event, we ought to be careful not to go upon altogether false scents, or set up issues which are too narrow to end the ills from which we suffer. We can go back to bows and arrows but that will not remove the grievances of nations for which they will fight, nor supply the enlightened diplomacy which can keep the peace without injury to a nation's sense of injustice. Do not let us be misled by thinking that the scientist as such can stop war. The military leader can use the triumphs of science to disgrace warfare. That is all. In any event, science cannot cease to follow the exhortation of Carlyle to "Produce in God's name", and it would be bad for humanity generally if it tried. It is not scientific to deal with the offshoots of evil. The scientific method goes to their roots.

Let us face our present conditions in the historical and biological spirit, and much progress in the science and art of applying science to society and government can be recorded. I am familiar with the complaint that the average scientist in Great Britain has been in despair about his difficulty of getting the discoveries of science which directly affect public welfare appreciated by Government. It would be well for Governments to remove this grievance so far as it is sound, and the creation of the Departments which I have mentioned is a start in better conditions and prospects, and is already having a beneficial effect on administration. Still, departmental contacts with science ought to be extended without delay, and India and the Empire—especially the Colonial Empire for which we have more direct responsibility—should not be overlooked, as indeed everyone acquainted with the work of Manson and Ronald Ross knows has not been done.

It must be evident to everyone who has thought about the social consequences of advances in scientific research that they call for a reinvigoration of social science. The experience of later years points out the urgent desirability for close co-operation between the scientist, the industrialist, and the man of affairs, to enrich the lives of human beings, to help such changes as will diminish the disruptive forces in society, and to promote social solidarity which lies at the root of human progress and happiness.

The Biology of Crossing-over

By Dr. C. D. Darlington

SEXUAL reproduction consists of two alternating processes: *fertilization*, by which two germ cells containing each a single set of chromosomes fuse and produce a zygote with the double number of chromosomes, and *meiosis*, by which the double number is reduced and germ cells are again formed with the single number. As Weismann first pointed out, the biological importance of these processes is that they enable the hereditary differences between the chromosomes to be recombined in the greatest number of ways to give the greatest number of different individuals and therefore the greatest scope for natural selection to act in directing evolutionary change.

In recent years we have come to know precisely how this recombination takes place, not merely in one organism, but probably in all sexually reproducing organisms. The method is both more complicated and more efficient than Weismann imagined. In the mother-cells which are to undergo meiosis, the chromosomes are present as single, instead of the usual double, threads of particles. By a combined study of ultra-violet photographs of the particles in

Drosophila, and of the genetic effects of breaking the threads with X-rays at a series of points along their length, the particles have been identified as genes, the atomic units of heredity¹. The chromosome threads correspond, as we should expect, in pairs, and come to lie side by side in pairs, gene by gene. Their attraction is therefore specific. They then coil around one another, and this coiling proves that they have two properties that might well be expected of them. It proves that they are each in a state of torsion such as that which determines the ordinary contraction of a chromosome into a rod-shaped body at mitosis. It proves also that the threads do not slip around one another. They stick together like two threads of wool placed side by side. The attraction of their genes for one another must therefore be specific in position, that is, not merely between the genes but between the parts of the gene².

If we imitate the physical condition of the chromosomes while they are paired and coiled by placing two woollen threads under torsion side by

side, we find that they coil round one another but at the same time necessarily uncoil themselves internally. The relational and internal coiling (as we may call them) are opposite and in equilibrium. The stability of this system is attested by its use in all spinning operations.

The coiling equilibrium of the paired chromosomes is upset by their division, and we then find that the half-chromosomes, or chromatids, arising in this way are as we should expect coiled round one another. But other changes take place at almost the same time as the division and are presumably

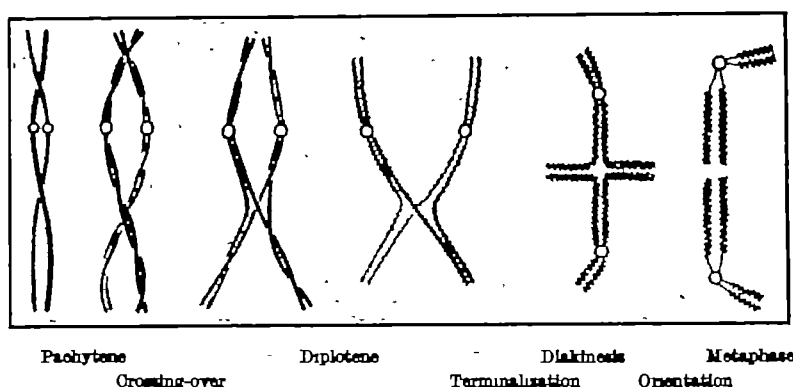


Fig. 1.

DIAGRAM SHOWING THE SERIES OF CHANGES BY WHICH CROSSING-OVER DETERMINES CHIASMA FORMATION AND THE LATER ASSOCIATION, ORIENTATION, AND SEPARATION OF A PAIR OF CHROMOSOMES. THE CIRCLES REPRESENT CENTROMERES OR SPINDLE FIBRE ATTACHMENT CHROMOSOMES.

determined by it. First, the divided chromosomes separate: they no longer attract one another. Secondly, chromatids of partner chromosomes break at opposite points and the broken ends uncoil and rejoin so that exchanges of chromatids occur between the separating chromosomes. The chromosomes, although no longer attracting one another, are held together by these exchanges, or chiasmata, which appear in varying numbers and positions in different chromosomes and in different cells.

The special mechanical situation of chromosomes dividing while they are paired thus determines the breakage and reunion which we call crossing-over. In the absence of crossing-over the partner chromosomes fall apart and are unpaired at all later stages. On this process, therefore, the later reduction in number and segregation to opposite daughter-cells equally depend (Fig. 1). Thus crossing-over, which is the only regular genetic change that the chromosomes undergo in their history, is the immediate condition of

reduction and segregation, which are the external changes essential for sexual reproduction. Special exceptions to this rule we will consider later.

Crossing-over within every pair of chromosomes is thus essential to sexual reproduction, but, leaving out this primary consequence, we can sort out its secondary biological consequences into several convenient groups.

First we must take the simple effect of crossing-over in recombining parts of chromosomes, the effect which has been made the basis of genetic analysis in *Drosophila*. Without crossing-over, each chromosome would be a permanent individual, varying and being selected as an individual like a plant clone or any other asexually reproducing organism. With crossing-over, the individual unit of variation and selection will be the unit of crossing-over, which in practice is the gene. Cytological observation has therefore shown that

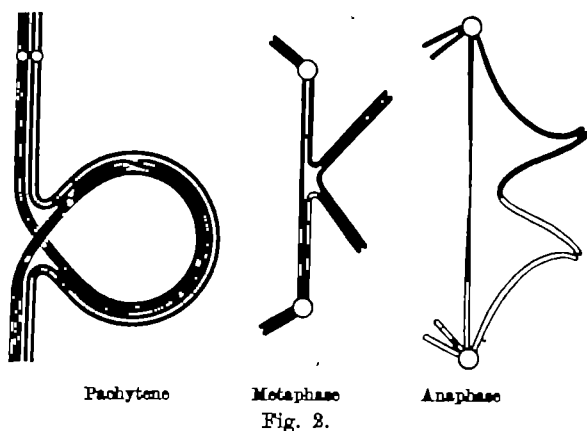


DIAGRAM SHOWING THE SERIES OF CHANGES BY WHICH A PAIR OF CHROMOSOMES, DIFFERING IN REGARD TO THE INVERSION OF A SEGMENT, HAVE CROSSING-OVER IN THAT SEGMENT WITH THE CONSEQUENT FORMATION OF ONE DICENTRIC AND ONE ACENTRIC CHROMATID.

the gene structure established by crossing-over experiments in *Drosophila* is applicable to all sexually reproducing organisms. The sizes of the genes and their physiological activity or inertness will be different in different organisms, but their methods of inheritance, variation and selection will be essentially similar. We may expect, for example, that, as in *Drosophila*, chromosomes or parts of chromosomes in which crossing-over is reduced or suppressed will mutate to an inert state in which they will continue until by chance breakage they are lost³.

One respect in which species differ most significantly is in the amount of crossing-over taking place in their whole chromosome complements. This is one factor affecting the amount of total recombination that will take place among the genes at meiosis. The other factor is the number of pairs of chromosomes themselves. By adding

this number to the average total frequency of chiasmata in the mother-cell, we can obtain a *recombination index* which will be a measure of the average total number of independently segregating gene-blocks in the species. This index is 6 in male *Drosophila melanogaster*, 12 in the female, 36 in *Zea Mays* and about 75 in man⁴. It is clear that these enormous differences will affect the character of variation in a species, though in what way it remains for us to find out.

One general property of the recombination index may be noted. A low index has a positive selective value. This may be shown in the following way. The chiasma frequency is under genotypic control; it is therefore capable of selection and is usually as low as is consistent with regular pairing of the chromosomes. On the other hand, it is much easier to increase chromosome numbers, both by doubling individual chromosomes and whole sets, than it is to reduce them. Nevertheless we have to-day a very large proportion of organisms with low chromosome numbers. More than half the angiosperms have twelve pairs of chromosomes or fewer. It follows that while some recombination is a great advantage, too much is a disadvantage. Presumably a certain stability in combination gives the maximum efficiency in the selection of different combinations. In this regard Fisher has remarked⁵ that there is more crossing-over in Nature than would seem desirable. The reason is now clear: each pair of chromosomes has to have at least one chiasma in order to undergo meiosis.

There is another genetic effect of crossing-over that is entirely different from that of recombination; namely, its effect in certain kinds of structural hybrids. Most organisms that have not been closely inbred are structural hybrids of one kind or another. The commonest kind is the inversion hybrid, which has a segment of a chromosome inverted relative to its partner. When crossing-over takes place within such a segment two new chromatids are produced, one joining the two centromeres of the chromosomes and the other joining their two ends and lacking any centromere (Fig. 2). When the bivalent formed in this way attempts to divide, the 'dicentric' chromatid forms a bridge between the daughter nuclei, and the 'acentric' one, incapable of movement, is lost. The bridge may break anywhere along its length, so that new chromatids are produced having some genes in excess and others lacking. Thus the primary structural change of inversion gives rise to secondary changes such as reduplication and deficiency. These are changes of 'balance', and rank with intra-genic changes and position changes as one of the three effective means of variation. The original variation becomes the basis of future variability. This does not mean that variation

within an endogamous group will be cumulative. Equilibrium is presumably reached by the effect of structural change in decreasing fertility, or a new system is established by the breaking up of the group into two smaller genetically isolated groups, that is, by the fission of the species. This property of genetic isolation brings us to the last important relationship of crossing-over.

So long as we have a structurally homozygous stock with crossing-over taking place at intervals between all the varying genes, no stable combination of variants can be maintained without elimination of cross-overs and loss of fertility. Optimum adaptation always demands such a combination, for adaptation depends on the integration of the whole gene system. The most generally recognized way of securing stable combinations is by geographical or ecological isolation. In the same way inter-sterility may secure a genetic isolation of two types of combination. All these methods depend on an isolation of zygotes. But an equally important method is the isolation of chromosomes or parts of chromosomes by structural change. When a small inversion or translocation occurs in one chromosome of a species, crossing-over is restricted or abolished between this changed segment and its normally arranged partner. Any gene differences occurring within this segment are held together in a more or less permanent combination. A new unit, a new order of integration, is established in this way.

It is through this special type of unit that three important types of discontinuity arise in Nature. The simplest type is that by which two groups which remain interfertile diverge within a species. It is probably the basis of the discontinuity between *Avena fatua* and *Triticum Spelta* and their allied forms, which differ essentially in a group of genes lying in a part of one chromosome. A second type is that by which the sex-determining chromosomes (X and Y) come to be distinguished. Originally one pair of genes in these chromosomes determines the sex difference by their segregation. Later other genes become associated with them in two groups which show no crossing-over. Their crossing-over may be suppressed structurally by an inversion or some other similar change. It may also be suppressed genotypically, and here we come to the exceptions in which crossing-over does not take place at meiosis at all. This situation arises in the heterozygous sex in certain insects where a new pairing mechanism is introduced instead of chiasmata. It is only one sex, however, that is affected, and this shows us that in the last resort it is not chiasmata which are indispensable for meiosis but crossing-over which is indispensable for the species. The exclusion of one sex from crossing-over has a special effect on one chromo-

some, the Y-chromosome. Where sex is determined by the segregation of X and Y, the Y, being confined to the heterozygous sex, is permanently excluded from crossing-over. The result of this is shown in evolutionary series when we compare different animals. First the Y becomes inert as in *Drosophila*, later it becomes smaller as in the Mammalia, finally it is lost as in many Orthoptera¹. The intermediate stages show different transitions according to the positions in which crossing-over is localized before its eventual suppression. In whatever way crossing-over may lapse, a group discontinuity arises between the two sex-determining chromosomes. This discontinuity differs in its effect from that arising between species merely in that the two types it distinguishes are mutually adapted for sexual reproduction².

The third type of discontinuity occurs in plants. It is that which arises between chromosomes in establishing a permanent hybrid of the *Eurothera* type. Here an interchange of segments between two different chromosomes is the origin of the system. It operates by suppressing crossing-over between the middle segments of the chromosomes, and when all the members of the complement are affected by the interchanges and are held together in a single ring at meiosis, only two types of gamete are produced, and all the chromosomes of one type are prevented from crossing-over with those of the other in their middle segments. Thus complex differences arise owing to the isolation not of zygotes nor of parts of one pair of chromosomes but of parts of all the chromosomes of the gamete, a gametic isolation. The differences between the two gametes are of the same order as the differences between two species.

Other mechanisms occur in the dog roses and with certain kinds of parthenogenesis whereby, as in *Eurothera*, a large part of the genes are prevented from recombining. With such systems stability has been achieved at the expense of variability, and we have arrived at what we may call a sub-sexual method of reproduction.

In these various ways and in many others the study of crossing-over shows us that this simple and universal mechanical property underlies most of the important relationships with which we are concerned in genetics. Variation and adaptation, hybridity and discontinuity, sex-determination and species-formation operate and develop according to the varying occurrence or suppression of crossing-over. Crossing-over is the primary variable in the evolution of genetic systems.

¹ Muller, H. J., and Prokofyeva, A. A., *Proc. Nat. Ac. Sci.*, **31**, 16-20 (1935).

² Darlington, C. D., *J. Genet.*, **31**, 185-212 (1935).

³ Darlington, C. D., "Recent Advances in Cytology" (London, 1937).

⁴ Koller, P. C., *Proc. Roy. Soc. Edin.*, **57**, 194-214 (1937).

⁵ Fisher, R. A., "The Genetical Theory of Natural Selection" (Oxford, 1930).

⁶ Muller, H. J., *Amer. Nat.*, **66**, 118-138 (1932).

News and Views

Sir P. C. RAY, C.I.E.

SIR PRAFULLA RAY has retired from the Palit professorship of chemistry at the University College of Science, Calcutta, a post which he has held since 1916, and has been elected professor emeritus. His retirement is a noteworthy event in Indian science. The whole of Sir Prafulla's active life has been spent in Calcutta. After receiving his early training in chemistry at the Presidency College under the late Sir Alexander Pedler, he worked for some years in Edinburgh under Prof. Crum Brown, graduating there with the degree of D.Sc. On returning to Calcutta he in due course succeeded Sir Alexander Pedler as professor of chemistry at the Presidency College, where he remained until his retirement from Government service in 1916. Sir Prafulla's own investigations, carried out in collaboration with numerous students, were for many years concerned mainly with the chemistry of the nitrites, to which he made a notable contribution, whilst more recently he has added to our knowledge of thio-compounds and metallic complexes. Sir Prafulla was the first to organize in India a true school of chemistry; he gathered around him a brilliant band of workers whom he imbued with his own enthusiasm for scientific research. Many of these have attained positions of eminence.

THE activities of Sir Prafulla Ray, however, have not been confined within the laboratory walls. He found time to write a history of Hindu chemistry, which has become a classic, and to found, and become honorary director of, a large chemical works, the Bengal Chemical and Pharmaceutical Company. In his later years he has been much interested in political and social questions. His students have for him an extraordinary veneration and affection, which is not surprising since he embodies all that is best of the true Indian "Guru". Outward marks of the esteem in which he is held have not been lacking; he was appointed C.I.E. in 1912 and knighted in 1919. He was president of the Chemistry Section of the Indian Science Congress in 1915 and of the Congress in 1921, whilst he was the first president of the Indian Chemical Society (1924-26). In 1933, in celebration of his seventieth birthday, the Society published a commemorative volume, to which contributions were made by chemists of all nationalities. Into his well-earned retirement Sir Prafulla will take with him the best wishes of all scientific workers.

British Association: Mather Lecture

MR. G. RADFORD MATHER, to whom the British Association owes the foundation of the Radford Mather lecture, is a retired engineer, now living at Wallingborough. Mr. Mather, who combines wide scientific knowledge with a deep appreciation of the necessity for social service, has many and varied

interests. He has given special attention to the study of those forces which govern minimal surface relations, and it was during a correspondence dealing with such matters that the attention of Mr. Mather was directed to the increasing interest shown by the British Association in the repercussions of advances in scientific knowledge on the well-being of the community. Mr. Mather has endowed a triennial lecture, to be given in London or the provinces, to be called the Radford Mather lecture, and to deal, for the most part, with the social implications of the advancement of science. Mr. Ramsay MacDonald gave the first lecture of the foundation, and portions of his address appear elsewhere in this issue. The scientific world is much indebted to Mr. Radford Mather for this foundation, and it is a matter for regret that, in view of his great age—he celebrated the ninety-sixth anniversary of his birthday on October 17—he was unable to be present at Mr. MacDonald's address.

Science and the Community

IN the first Radford Mather lecture of the British Association entitled "Science and the Community" delivered at the Royal Institution on October 22, the Right Hon. J. Ramsay MacDonald paid an eloquent tribute to the value of the scientific method and its broad application to human needs. Science is one of the greatest creative forces of this generation, and the guidance of scientific research is indispensable in treating many of the ills arising in a civilization which is not a static state but one of dynamic energy calling for direction. The most lasting and fruitful of changes are those which arise from the failure or imperfections of existing conditions; discomfort and unrest in the community, like pain in the individual, are danger signals which call for scientific study and treatment. Such pain and unrest may even be preventable by scientific treatment, and while making no plea for the man of science as statesman, Mr. Ramsay MacDonald indicated a wide field in which the scientific method might assist in the development of a rational and broad policy. Health and the home life of the people are two directions in which fundamental changes and advances may be possible in this way, and he suggested, too, that the example of the scientific worker is in itself of value in steadying and clarifying the popular mind not only to complain eloquently but also to conclude wisely.

THE dual plea that the man of science as citizen should take a lively interest in the way his discoveries are used and that the contribution of science to social welfare depends upon an enlightened popular view of the value and significance of these researches and their uses, led to a final plea for a reinvigoration of social science, which is of special interest in view of Lord Nuffield's recent offer to the University of

Oxford for building a new college especially for social sciences. Mr. Ramsay MacDonald claimed that close co-operation between the man of science, the industrialist and the man of affairs is needed to assist the changes which diminish the disruptive forces in society and promote the social solidarity lying at the root of human progress. This reminder of the futility of blaming science and scientific workers for the horrors of war is equally timely. Although science has increased the power which can be applied both to life and to death, peace or war are not the responsibility of men of science as such, and they may well claim that by making war more widespread they have driven home the responsibility for warfare, which lies in the moods of man rather than in his mechanical inventions.

The Evolution of Torpedo Craft

It was but natural that in his presidential address to the Institution of Mechanical Engineers on October 22, Sir J. E. Thornycroft should deal with the development of torpedo craft. He was a child five years of age when at Chiswick his father, Sir J. I. Thornycroft (1843-1928) built the *Lightning*, the first torpedo boat in the British Navy, and he has thus witnessed the growth in size, speed and power of torpedo boats, torpedo boat destroyers and the newest motor torpedo boats. Together with Sir Alfred Yarrow and Jacques-Augustin Normand, of Havre, Sir J. I. Thornycroft was a pioneer of water-tube boilers, forced-draught and high-speed engines, and from the works he founded at Chiswick and Woolston have come many of the most notable vessels ever launched. Towards the end of his address, Sir John Thornycroft made some interesting observations on the skimming principle applied to boats, and on the need for simplification in warships. As is well known, the motor torpedo boat, first brought into use in the Great War, is of such a design that when sufficient speed is attained it skims or planes along the surface of the water. Some people think the principle might be applied to larger vessels, but Sir John pointed out that whereas a 50-ft. motor-boat will skim at 30 knots, a 300-ft. destroyer would have to attain a speed of 70 knots, and this would necessitate engines of 200,000 horse-power. Apart from the propelling machinery, ships to-day are filled with mechanism. The very complexity of this raises the question as to means by which it is to be kept in order, and this led to the suggestion that the work of mechanical engineers should be in the direction of simplification.

Co-ordination of Fuel Interests

In his presidential address to the Institute of Fuel on October 14, Sir Philip Dawson traversed the whole range of fuel-producing and fuel-using industries, pointing especially to the leakages and inefficiency resulting from the absence of co-ordination between the different interests. Although the different fuels are to a considerable extent complementary, the system of free competition leads to internecine

conflict, while desirable goals such as the elimination of smoke and the greater production of liquid fuels receive inadequate attention. Such surveys have often been made in the last fifteen years, and Sir Philip comes, like others before him, to the conclusion that the Government should set up a strong central advisory body to co-ordinate the fuel activities of Great Britain. Hitherto, such proposals have passed unheeded, but now he holds that the national interest demands action. Coal should become the raw material for satisfying modern demands in new form. The future requires a smokeless, pure atmosphere in which to live, and suitable solid, liquid and gaseous fuels for every side of national activities.

The Appraisal of Lighting

FOR the twenty-second Guthrie Lecture before the Physical Society on October 22, Dr. C. O. Paterson discussed "the Appraisal of Lighting". Dr. Paterson pointed out that as techniques have become available during the past thirty years, the art of appraising lighting has changed and advanced greatly. Like so many other subjects, however, that of lighting and seeing has been and is held in check by the inevitable tendency of those who practise it to define it at any epoch in terms of the quantities which they understand. Whereas research can stretch out where it pleases, it is difficult for a practical art to advance faster than the established techniques for appraising its merits. The earliest standard ever adopted, specifying a candle of a certain weight in a lantern, is one which has many advantages and which under a changed form is still probably the most widely adopted. The most easily measured characteristic of a light source is luminous intensity, but a measure which is of more value in estimating the aid to seeing is that of luminous flux. With the advent of differently coloured light sources difficulties of such measurements have grown. The adoption of an internationally accepted relative luminosity curve for the average human eye has brought the measurement of intensity of illumination to a high state of accuracy for sources with continuous spectra. The use of the photocell has added to speed and repetitive accuracy, but not to absolute accuracy.

THE measuring of light sources giving a few lines only of the spectrum offers a very much more difficult problem which has been met by the use of sub-standard lamps and carefully selected and calibrated filters. However, with different colours errors creep in. Seeing is fundamentally a matter of contrasts in colour and in brightness, and it is these factors which should be measured. There are several methods of measuring brightness. Photography has been used for registering the effects of lighting on the human eye and recording them permanently on photographic plates. When the brightness of two contrasting surfaces has been measured, we still have no accepted methods of expressing them in terms of their aid to vision. Frischnier's fraction, which is an approach in this direction, deals only with threshold values, and our interests lie in values far above those. The new

technique of television offers an opportunity of controlling contrast. Details of the original picture and the reproduced picture at one stage are both held in terms of electrical energy and can be manipulated. With coloured light our problem is not merely to measure colour, but also to measure and specify colour and colour-rendering properties. The colour of light can readily be specified on the I.C.I. trichromatic system, and a rapid technique for indicating the colour of a light source directly on this system has recently been evolved. No standard has yet, however, been set up for the colour-rendering properties of light.

Devil's Dyke, Wheathampstead

THE presentation to the public of land at Wheathampstead, which has been made by Lord Brocket, chairman of the Hertfordshire Society of the Council for the Preservation of Rural England, as a personal gift commemorating the coronation of King George and Queen Elizabeth, preserves as an open space in perpetuity a site which, as has been shown by the excavations of Dr. R. E. Mortimer Wheeler, is of outstanding archaeological and historical significance. For in addition to the four acres of the prehistoric earthwork, known locally as the Devil's Dyke, as Lord Brocket announced in handing over the 999 years' lease to the Wheathampstead Parish Council on October 23, the adjacent area of one hundred acres will also be preserved as an open space under an arrangement he proposes to make with the Hertfordshire County Council and the National Trust. It was here, Dr. Wheeler has shown, that there was situated the fortress, or *oppidum*, of more than a hundred acres in extent, the largest and strongest in Britain as yet known in its period, which was held by the Belgic tribes who had settled in Britain not long before, and of which the capture as the headquarters of the British forces was the climax of the campaign in the second of Caesar's invasions of Britain; while almost immediately after that event, it would seem, it became the parent city of the British stronghold, also excavated by Dr. Wheeler, at Verulamium, which preceded the Roman occupation. The importance of the site for the history of pre-Roman Britain lays a debt of gratitude to the donor for his gift upon circles far wider than those immediately affected by its preservation of local amenities in the future development of the district.

Archaeological Evidence and 'Development'

It is unfortunately only too true that in many instances no private benefactor has been available, nor has public interest been sufficiently strong, to save relics of the past thought by many worthy of preservation, as the Wheathampstead site will be preserved. At the same time, land development and public improvement have not invariably run entirely counter to the interests of the archaeologist. Not only have they brought to light antiquities of which the existence under the surface of the ground was unsuspected, but also on occasion they have made possible archaeological investigations which other-

wise it would probably have been impossible to undertake. The exploration of so large a site as that recently excavated at Colchester would have been difficult, if not definitely impossible, had it not been carried out in conjunction with the making of the new road. It is, however, not only the destruction of antiquities that is to be feared. Among other dangers there is the possibility of serious confusion of evidence which may follow the removal of archaeological material from one area to another. An instance in point is mentioned by Mr. S. E. Winbolt in a communication to *The Times* of October 22, in which he records the discovery of a Roman house in the course of widening a road at Wiggonholt near Pulborough. The soil from this site is being transported by lorry to Pulborough Causeway, two and a half miles away. The discovery was made on the site of cottages called Lickfold (cabbage patch); and in the soil have been found fragments of Roman pottery, Samian and Castor, the foot-ring of a large Samian bowl, and a complete upperstone of a diak quern, fourteen inches in diameter, as well as a mortarium of first- to second-century type. Mr. Winbolt points out that future excavation on the Causeway, which is being widened on both sides, might bring to light Roman material from the Wiggonholt site, which would lead to quite erroneous conclusions as to the relation of the Causeway to Stone Street. Local societies might well be at pains to record any such shifting of material from sites within their respective areas.

British Museum (Natural History): Acquisitions

THE most important recent zoological accession to the Zoological Department of the British Museum (Natural History) is perhaps a collection of mammals and birds made by Messrs. Charles and Edward G. Bird in the Mygybuktá region of North East Greenland. The collection is of special interest since it contains examples in breeding plumage and chicks of birds well known in the British Isles in winter, such as the knot, sanderling, turnstone and Brent geese. There are also specimens of the ptarmigan in breeding plumage, as well as young birds and small ducklings of the king eider—a rare visitor to Britain. Among the mammals are specimens of the lemming, skulls and skeletons of arctic foxes, and various seals. Another important acquisition to the Department is the mounted head of a chobe situtunga (*Linnostragus spekei selousi*) presented by Major Henry Abel Smith. This rare antelope is known only from about a dozen specimens and enjoys a distribution to the south of the Zambezi between the Chobe Swamps and Lake Ngami in Bechuanaland. Among the accessions to the Department of Entomology is the very valuable collection of butterflies formed by Major P. P. Graves in the Near East, particularly in Palestine, Asia Minor, Syria, the southern Balkans and Greece. This collection is made up of more than 9,000 specimens, and is particularly rich in material from historic localities which were extensively worked by German and Austrian collectors in the middle of the last century.

THE Department of Geology has recently acquired, through the generosity of Mrs. E. M. Reid, a valuable collection of fruits and seeds from the Pliocene of County Durham, Germany and Russia, most of which have been figured by her in the *Journal of Botany* and the *Quarterly Journal of the Geological Society*. In conjunction with M. P. Marty, Mrs. Reid has also presented nearly 700 fruits and seeds from the Pliocene of France. The Department of Botany has been presented with more than seven hundred drawings by the late Dr. A. H. Church. Most of the drawings were made in connexion with the preparation of further volumes of "Types of Floral Mechanism", of which only one volume, that of spring flowers, was published in 1908. A number of the drawings are in colour, but probably those which are of most interest are line and wash drawings of stages in the development of the different floral types. The drawings, accompanied by descriptions and manuscript notes, mostly ready for publication, are probably among the most accurate that have been made. The Department has also received about 900 gatherings of flowering plants and 400 gatherings of lichens and mosses which have been made by C. G. and E. G. Bird in the Mackenzie Bay area of the east coast of Greenland. The collection is well preserved and is valuable as coming from so far north. H. G. Ververs has collected about 500 numbers of flowering plants and cryptogams on the Oxford University Exploration Club's Faroes Biological Expedition. The Museum Herbarium has been so far very poor in plants from this area, and the collection, therefore, is the beginning towards filling an important gap, for many of the forms described appear to be very similar to some occurring in the British Isles, the land nearest to them.

North Pole Station

NEWS from the Soviet North Pole Expedition is given by the Soviet Union Year Book Press Service. It would appear that the floating station is drifting southward towards north-east Greenland. This was to be expected from what is known of the general trend of Arctic currents. Under wind action there are easterly or westerly deviations from this main direction. The drift to the south has averaged 2.35 miles a day since the establishment of the station, and the speed is increasing as the East Greenland Current is approached. During the first month the drift to the south was 84 miles and during the fourth month it was 95 miles. A sounding in the vicinity of the Pole showed a depth of 2,346 fathoms, and it is unlikely that much greater depths occur in the Arctic Sea. The intermediate warm layer of water which Nansen discovered north of Spitzbergen and explained as being saline Atlantic water has been found near the Pole at depths between 12 and 30 fathoms. At a depth of 36 fathoms the water temperature was found to be almost zero, with a steady fall with increasing depth to -0.67°C . at the bottom. It is of interest to note that the inner parts of the Arctic Sea in the vicinity of the Pole are rich in plankton and have much larger animal

life. The floes are even and flat. The smooth floes were, of course, reported by Peary, and did much to facilitate his march to the Pole.

The Indian Oil Industry

ON the whole, the Indian oil industry figures less prominently in the general Press than that of other countries, notably the United States of America. The erroneous conclusion may, therefore, be drawn that methods of exploration, production and refining are not so far advanced in that country as in others. A recent paper by P. Evans (*Current Science*, 5, March 1937), however, clarifies this position by giving a succinct account of modern technique with particular reference to its application to conditions encountered in India and Burma. The main producing oil-fields are at Yenangyaung, Singu and Lanywa in Burma; Digboi in Assam; and Khaur in north-west India. Exhaustive geological mapping has been carried out over a vast area of India and Burma, and maps are available ranging in scale from 4 to 16 inches per mile. Numerous exploratory wells have been drilled, and the fact that the six leading companies in India have spent six crores of rupees on unsuccessful drilling indicates that neither time nor money has been spared in the search for new producing fields. Failure to locate such fields can in no circumstances be attributed to lack of scientific aid, for the help of the geophysicist and the geologist has been freely enlisted in India and Burma. The former has such adjuncts at his disposal as the torsion balance, seismograph, magnetometer and potentiometer; and the latter the aeroplane for field reconnaissance of large areas, the core-drill for putting down shallow-bores to check structure, and laboratory methods of palaeontology, micro-palaeontology and micro-petrology for the examination of core-samples.

IN India, as in most other countries, the rotary drilling system is extensively used for all deep drilling, and such cognate problems as the best type of mud fluid to employ, the accurate diagnosis of strata traversed by the drill, and the prevention of crooked drilling have all been encountered and combatted scientifically by experts. Depths such as those attained in America have not yet been achieved in India, but there are records of wells drilled to more than a mile and a half, and in some cases very difficult territory has had to be negotiated. Though problems of optimum rate of production from individual wells and from fields as a whole are not absent in India and Burma, they are fortunately less acute than in some other countries. This is largely due to the fact that in India the mineral rights, with a few exceptions only, are vested in the State, and in several cases a field is worked by one company alone, while in Burma drilling is regulated by the warden of the oil-fields assisted by an advisory board. The principle of employing competent, fully-qualified geologists, chemists and engineers is followed in both India and Burma, and the technical literature now available as the result of exhaustive research and

correlation of data from the results of past experience on the part both of the oil companies and of the Geological Survey of India is ample testimony of the progress made in the Indian oil industry since its inception.

Lister Institute of Preventive Medicine

At the annual general meeting of the Lister Institute, held on June 2, the Governing Body presented the Institute's forty-third annual report. The report contains an interesting summary of the research work done during the year. Respecting viruses, a team of workers has continued the study of a possible virus agent in the causation of acute rheumatism and rheumatic diseases. Dr. Salaman has continued his investigation of the antigenic structure of vaccinia virus, and Sir John Ledingham has studied the peculiar relationship that exists between the filterable viruses of rabbit myxomatosis and rabbit fibroma. Dr. Felix and Miss Pitt have continued their investigations on the antigenic constitution of the typhoid bacillus, and on the virulence and immunizing properties of bacteria. Much work has also been carried out on vitamins and nutrition, and Prof. Robison has continued his studies on calcification. The two Svedberg ultracentrifuges, provided by a grant from the Rockefeller Foundation, have proved satisfactory, and have been used in the investigation of virus bodies and of proteins. The National Collection of Type Cultures, housed at the Institute, has distributed during the year some 5,000 cultures, and 200 new strains of micro-organisms have been added to the Collection.

The Night Sky in November

THE moon is new on November 3 at 4^h and full on November 18 at 8^h U.T. On November 20, the moon occults the 3rd magnitude star ζ Tauri, the disappearance as seen from Greenwich taking place at 5^h 33^m and the reappearance at 6^h 28^m. On November 21, ν Geminorum (magnitude 4.1) is occulted, the reappearance being observable at Greenwich at 0^h 8^m. Conjunctions of the moon with the planets occur as follows—Venus on November 1^d 8^h; Jupiter on November 9^d 7^h; Mars on November 9^d 21^h; Saturn on November 14^d 16^h. On November 4, Uranus is in opposition to the sun; on this date the planet may be located between α Arietis and ω Arietis, stars of about the same apparent magnitude as that of Uranus, which presents a small disk of about 3½" in diameter. Both Jupiter and Mars are low in the early evening sky, but Saturn, southing at about 20^h in the middle of the month, is better placed for observation. Venus is a bright morning star and is near Spica (α Virginis) on November 6. The variable star Algol (β Persei) is well placed for observation throughout the night. The change in light may be easily seen about 1½ hours before and after the following times: November 10^d 2.2^h, 12^d 23.0^h, 15^d 19.8^h and 20^d 3.9^h. The Leonid meteors are expected between November 9 and 20, the radiant point being about 10° north of the bright star Regulus. The maximum of the

Andromedids is due about November 20, the radiant being near γ Andromedæ. By midnight in mid-November, the brilliant collection of our winter stars comprising those of the constellation of Orion, preceded by Aldebaran and the Pleiades and followed by Procyon and Sirius, is well above the eastern horizon.

Announcements

DR. GÜNTHER JUST, director of the Institute of Genetics at the University of Greifswald, has been appointed director of the corresponding institute of the Health Office of the Reich at Berlin-Dahlem.

At the annual statutory meeting of the Royal Society of Edinburgh, held on October 25, the following Council was elected: *President*: Sir D'Arcy Wentworth Thompson; *Vice-Presidents*: Prof. F. A. E. Crew; Lieut.-Colonel A. G. McKendrick; Principal J. C. Smail; Prof. J. Walton; Dr. James Watt; Prof. E. T. Whittaker; *General Secretary*: Prof. James P. Kendall; *Secretaries to Ordinary Meetings*: Dr. A. O. Aitken and Dr. C. H. O'Donoghue; *Treasurer*: Dr. E. M. Wedderburn; *Curator of Library and Museum*: Dr. Leonard Dobbin.

PROF. M. POLANYI writes with reference to his article on the recent international scientific meeting at the Palais de la Découverte (NATURE, Oct. 23, p. 710): "In my article on the International Congress in Paris reference is made to a conversation with German delegates. This statement originates from an editorial correction of the manuscript. My own report stated that the remarks on a better understanding between German and French peoples were made at the opening meeting." Prof. Polanyi's original words, to the editorial modification of which he refers, were as follows: "Later in the evening I noticed a spy thrusting himself into my conversation with one of the German delegates. The German spoke about a better understanding of the German and French people—three delegates using the same no doubt officially approved phrase."

THE Oxford University Press announces that the treatise on the "Science of Petroleum", under the editorship of Dr. A. E. Dunstan, Prof. A. W. Nash, Sir Henry Tizard and Dr. Benjamin T. Brooks will be published in December or January. It has been decided to issue the work in four volumes instead of three, as previously announced. The preparation of a Supplementary Volume, with accounts of work which has appeared while the treatise has been in the press, is under consideration.

ERRATUM.—In the paragraph, based on Dr. J. Needham's Herbert Spencer Lecture, and entitled "Organization of Human Society", which appears in NATURE of October 16, p. 679, there is a sentence which reads: "He suggests that a democracy which produces is the form of society most in accord with what we know of the biological basis of human common life." The word "experts" should have been printed after the word "produces".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 774.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Spontaneous Chromatin Rearrangements in *Drosophila*

SPONTANEOUS chromosomal rearrangements are considered to be rare in *Drosophila*. (Pale and blond are the known cases.) During the past few years I have found two new cases of considerable interest, the detailed analysis of which was delayed by external circumstances. Both cases occurred in pedigree and closely watched cultures, the abnormal broods being among numerous identical normal ones.

The first case started with an uncontrolled change of a standard plexus culture, which began to exhibit an extreme plexus character with blisters on one wing. It was found that here a 'mutation' to an allele of blistered had been added to the plexus stock. In studying some interesting peculiarities of this line, another change occurred. After this had happened, the plexus-blistered line was examined more closely, and it was found that the change to blistered had already entailed a rearrangement involving at least the additional loci white, echinus, rudimentary and extreme left end of the first chromosome. The new rearrangement resulted in the simultaneous appearance of the original plexus, of wild type, of rudimentary, identical with the classic one and of a recessive type 'mutant' with pointed wings, at the left end of the first chromosome. Also what seems to be an ebony allele appeared and a few less viable forms with spread plexus-blistered wings, or with only blisters. The analysis of the rather complex details is nearing completion.

The second case is still more remarkable. In one of numerous crosses of wild type and blistered a rearrangement occurred which involved, as it seems, only a second chromosome. This rearrangement produced simultaneously with the disappearing of blistered, the appearance of (1) dumpy, identical with the classic one; (2) vortex-thoraxate, the same; (3) purple, the same; (4) a plexus-like form still to be localized; and (5) a recessive 'mutant' with folded soft wings. Thus three well-known 'mutants', and possibly five, were produced as the result of an intra-chromosomal rearrangement.

It is remarkable that in both these cases the rearrangement hit a whole brood, thus indicating its occurrence in primordial germ cells.

These facts and others not yet ready for presentation, as well as the results of other workers, have convinced me—as repeatedly expressed in lectures within the past three years—that the time has come to acknowledge that gene mutations have as little existence as genes themselves. (A number of geneticists

have already played with this idea, but hesitated to drop the old conception of the gene. They took refuge in position effects and mutations near the locus of a break.) The idea of a position effect, made to save the gene concept, will also have to disappear when it is recognized that the position effect is actually identical with what was called a gene. The chromosome as a unit will be found to control normal development or wild type. The changes of the correct order within its chain produce deviations from normal development, called mutants. Though they are localized, there is no such a thing as a gene and certainly no wild type allelomorph. Details will be published later.

RICHARD GOLDSCHMIDT.

Department of Zoology,
University of California.
Sept. 27.

Ionization by Radioactive Gamma and Cosmic Rays in Different Gases

THE ionization by radioactive gamma and cosmic rays in different gases has been investigated by V. Masarik¹ since 1932 and by me since 1936*. For all measurements we used the same Kolhörster apparatus, the zero of which was separately determined at a depth of 406 m. in the Berlepsch salt mine of Steinfurt.

The effects of a radium C gamma ray source, filtered by 6 mm. of lead, of cosmic rays filtered by 5 cm. and 10 cm. of lead and of the penetrating radiation (unfiltered cosmic rays plus radium C gamma rays from soil and free air) gave the results shown in the accompanying table.

	Density	Penetrating radiation	Cosmic rays		RaC γ -rays*	
			5 cm. lead filter	10 cm. lead filter	Our measurements	Ziemeckl
He	0.0001787	0.50 I	0.30 I	0.26 I	1.00 I	
Ne	0.900	2.40	1.29	1.27	4.25	
Ar	1.7829	4.59		2.45	8.51	7.55 I
Kr	3.545	10.53	5.46	5.13	19.4	20.1
X	572	21.25	8.77	7.83	31.9	
H ₂	0.089865	0.31		0.14	0.80	
N ₂	1.2508					3.70
Air	1.2928	2.91		1.50	5.06	
O ₂	1.4323	3.23	1.88	1.78	5.32	
CO ₂	1.9768				8.70	

* On an arbitrary scale.

In Fig. 1 the ratio ionization/density is plotted as a function of the density of the gases concerned.

The ionization is directly proportional to the density of the gases only in the case of the hard components of the cosmic rays at sea-level. With softer components the curves bend more and more. The effect

of ionization by radioactive gamma rays is therefore different from that by cosmic radiation at sea-level, so much so that this behaviour may be utilized in distinguishing between gamma and cosmic rays¹.

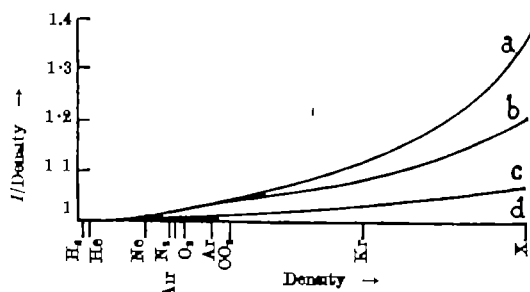


Fig. 1.

THE RATIO $I/\text{Density}$ PLOTTED AGAINST DENSITY. *a*, UNFILTERED PENETRATING RADIATION; *b*, RADIUM C GAMMA RAYS FILTERED BY 6 MM. LEAD; *c*, COSMIC RAYS FILTERED BY 5 CM. LEAD; *d*, COSMIC RAYS FILTERED BY 10 CM. LEAD.

A short time ago Ziemecki⁴ gave the following results for the ratio of ionization by radioactive gamma rays in nitrogen, argon and krypton to air:

$$I_{N_2} : I_{Ar} : I_{Kr} = 0.49 : 1 : 2.66;$$

while the densities are

$$\rho_{N_2} : \rho_{Ar} : \rho_{Kr} = 0.77 : 1 : 2.06.$$

These data for argon and krypton at 12 atm. agree with our results for one atmosphere ($I_{Ar} : I_{Kr} = 1 : 2.28$) showing the same behaviour. However, Ziemecki believes the effects of ionization by gamma and cosmic rays to be roughly proportional. Our numerous measurements show only the hard components of the cosmic radiation at sea-level causing ionization in the ratio of the density of the gases examined.

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Sept. 15.

¹ Masuch, V., *Z. Phys.*, **79**, 234 (1933).

² Juilfs, J. and Masuch, V., *Z. Phys.*, **104**, 458 (1937).

³ Juilfs, J., *Phys. Z.*, **38**, 691 (1937).

⁴ Ziemecki, St., *Nature*, **140**, 150 (1937).

Two Spectrometers for X-Ray Analysis

SOMETIMES a conical camera has been used to obtain good pictures of high-order layer-lines from a rotating crystal, the angle of the cone in most cases being about 60° or 90°.

In several respects this method is awkward. By making that angle 180°, the difficulties will be less; the camera becomes more simple, the film easier to handle, and the identification of reflections will be more readily surveyed, every layer-line being a circle. Only the 0- and perhaps one or more of the lower order layer-lines will be missing on that photograph.

It is possible to take a photograph on a stationary film and on a moving film at the same time. Another possibility is to couple the movement of the film in some manner to that of the crystal, for example, by moving the film parallel to the crystal rotation axis (but not around that axis). In this way it will

always be possible to assign the appropriate indexes to the spots on the film.

A simple camera design of this type is shown in Fig. 1; a circular stationary film, *a*; another film at the same distance from the crystal, but rotating with the crystal, *b*; whereas the 0-layer-line is recorded on a narrow cylindrical film, *c*.

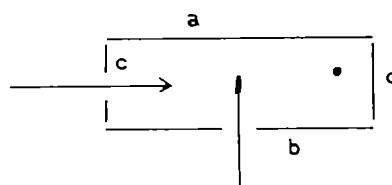


Fig. 1.

For the investigation of powders it may be advantageous to use a camera with the film cylinder having the same axis as the X-ray beam (see Fig. 2). The reflected beams, lying on cones, will cut the cylindrical film in circles; when spreading out the film after developing, the picture of straight lines will resemble a diagram taken with an ordinary optical spectrograph. Especially for purposes of identification, as well as for back-reflection X-ray

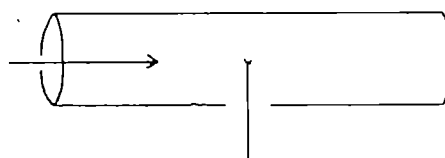


Fig. 2.

photographs, the method described may be useful. Taking a series of exposures on the same film, a narrow strip may be taken parallel to the primary beam. In that case a flat film or plate can be used.

I am indebted to Prof. Ir. J. A. Grutterink, who enabled me to design the cameras described.

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Spacing of the Resonance Neutron Levels of Silver, Rhodium and Bromine Nuclei

FROM recent work on group and thermal neutrons¹, the constants describing the resonance absorption of an element can be calculated fairly accurately. This simplifies the estimation of the average spacing of the resonance neutron levels in the experiment of Chao and Fu² and makes it possible to work with a thinner paraffin scatterer so as to obtain a beam of neutrons distributed more uniformly over the energy spectrum. We have now made measurements with a paraffin scatterer of only 2 mm. thickness. The neutron source consisted of 100 mgm. radium surrounded with 12 gm. beryllium, and the scatterer in the form of a spherical shell was of 4 cm. outer diameter. Detectors of silver, rhodium and bromine, approximately 3 cm. x 3 cm. in size, were exposed at a distance of 1.2 cm. from the paraffin, and the induced activity was measured with a Geiger-Muller counter.

Let the neutron capture cross-section due to the existence of a single resonance level be written as

$$\sigma = \frac{A}{E^{1/2}[\Gamma^2 + (E - E_r)^2]}$$

here E_r and 2Γ are the energy and half width of the level, both to be expressed in volts. Then the ratio of the capture cross-sections of the resonance and thermal neutrons with self induction is given by

$$\sigma_r : \sigma_0 = \frac{A^2}{2E_r^{1/2}\Gamma^2} : \frac{A\pi^{1/2}}{(0.026)^{1/2}E_r^{3/2}} = \frac{(0.026)^{1/2}E_r^{3/2}}{2\pi^{1/2}\Gamma^2}$$

this formula when applied to the capture cross-sections of the group and thermal neutrons, should give an approximate value of Γ and hence of A , except in the case where the first negative resonance level is closer to zero energy than the first positive level (as might be the case of bromine).

Let E_0 be the upper limit of the continuous spectrum of the neutrons scattered from paraffin, N_0 the number of scattered neutrons received by the detector per unit energy range and per second, μ the absorption coefficient of the β -rays per atom of the detector, and n_1 the average density of the resonance levels per volt. Assuming Γ and A to be constant for the resonance levels located in the continuous neutron spectrum, we can easily deduce the following approximate expression* for the total number of β -rays given in one second by a thick detector in the saturation state:

$$\Sigma N = \frac{N_0 \pi A n_1 E_0^{1/2}}{\mu \Gamma}$$

To calculate N_0 , we make the photo-electric cross-section of beryllium nuclei equal to 2×10^{-28} cm.², the proton-neutron scattering cross-section equal to 0×10^{-28} cm.² and E_0 equal to 1.42×10^6 v. Knowing Γ , A , E_0 and N_0 , we can evaluate n_1 from the measured values of μ and ΣN . Various quantities used in our calculation are collected in the following table, where column Δ gives the average spacing of the resonance levels, all referring to the short period. For Ag, the second value is obtained with a thin detector of surface density 0.06 gm./cm.².

	$\sigma_p \times 10^{28}$	$\sigma_n \times 10^{28}$	E_0	Γ	$A \times 10^{24}$	$\mu \times 10^{24}$	$N_0 \times 10^6$
g	3500	535	2.5	0.063	30.5	1000	2.5
h	690	102	1.2	0.066	13.5	1000	2.0
c ^a	740	7.3	62	0.42	2050	1200	2.1

*Neutron absorption coefficients of this element determined by T. H. Wang.

The values of Δ here obtained are seen to be in good conformity with the location of the ordinary neutron groups. It is, however, to be noted that the present calculation is based on various cross-sections which are only known approximately, and it can be further improved when the accuracy of these quantities attains a higher degree.

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¹ Amaldi and Fermi, *Phys. Rev.*, **59**, 809 (1936); Goldsmith and Amaldi, *Phys. Rev.*, **58**, 328 (1936); Breit and Wigner, *Phys. Rev.*, **6**, 519 (1936); Bethe and Placzek, *Phys. Rev.*, **51**, 450 (1937).

² Chao and Fu, *Chinese J. of Phys.*, **2**, 125 (1936); *NATURE*, **139**, 25 (1937).

³ This formula can be obtained from formula (12) of the paper in *Chinese J. of Phys.* by neglecting the long factor.

Changes of Colour by Injection of Pituitary Extracts in a Dogfish (*Scylliorhinus canicula*)

INJECTIONS of pituitary extract were performed on an exceptionally light-coloured dogfish obtained in the Aquarium at Dinard in August 1937; in this fish the usual large patches were very faint, and so were the small spots or maculae. At a distance of ten yards from the tank, the lack of colour of the integument made the animal very easily distinguishable from its fellows. The condition could not properly be described as albinism, the pigment not being altogether lacking: apart from a certain amount of pigment, faintly but evenly extending over the whole of the back, there was a dark spot, about one third of an inch in diameter, behind and above the right gills. With the exception of the pallor of the skin, this male fish was quite similar to the others in size and shape.

The extract used (Post-hypophyse Choev No. 4) contained half of the posterior lobe of ox-pituitary per c.c. and the injections were made intraperitoneally.

RESULTS

The first injection (0.25 c.c.) was without apparent effect.

The second injection (0.7 c.c.) caused the following changes: 15 minutes after—a slight darkening of the skin; 30 minutes after—a very distinct darkening: the patches appeared sharply, the spots became darker, the fish could only be distinguished from the others by a mark made on the fin, its colour being as dark as that of the nine or ten normal fish in the tank; 3 hours after—condition unchanged; 18 hours after—the fish had almost resumed its original whitish colour.

The third injection (1 c.c.) gave exactly the same results.

A control injection was then given of 1 c.c. of seawater: it did not influence the colouring in the least.

The fourth injection of the same pituitary extract was then made (1 c.c.). The darkening was as great as before, but lasted only about three hours.

A fifth similar injection (1 c.c.) produced darkening which lasted twenty to twenty-two hours.

At that stage an injection of anterior lobe of pituitary was tried (0.5 c.c.) of an extract containing 0.25 gm. of gland per c.c. (Zoo-Antelobyl Roussel). It gave no results.

An injection of another brand of posterior lobe extract (Zoo-Postlobyl Roussel) containing 5 International Units per c.c. was given and the results were:

First injection (0.5 c.c.) (2.5 International Units)—10 minutes after—the fish was getting darker; 30 minutes after—the fish became indistinguishable from the others in the tank; 3 hours after—original colour nearly restored.

Second injection (1 c.c.): Same results but more lasting (12 hours).

Forty-eight hours after this last injection, the fish died, without having quite resumed its original colour: possibly the last dose of hormone had been too great.

A constant reaction to all the injections of posterior lobe extracts, especially at the beginning of the absorption period, was an increase in the rate of breathing: 70-80 respirations per minute, instead of 50-60 normally.

The post-mortem examination showed, first of all,

that a severe wound which the fish had received from a metal fitting in the tank, four or five days previously, had left a fairly deep cavity filled with blood-clot, completely destroying the right spiracle and surrounding area.

The organs seemed to be quite normal except the gall-bladder, which had apparently been perforated by the injection needle.

The base of the brain revealed a peculiar type of pituitary body. The ventral, nervous lobe, with its connecting stalk and infundibulum, seemed slightly smaller than usual in this fish; the vascular body (situated dorsally to the nervous lobe, between it and the brain) was smaller than usual, displaced laterally and seemed to be grafted on to the right angle of the optic chiasma. In the normal fish, the two lobes are in contact, but can easily be separated. In this one the gap was evident.

Histologically, both lobes appeared normal, but in the vascular body chromophobe cells tended to prevail.

No trace of traumatic lesion of the roof of the mouth was found, and the aspect of the gland seemed to point to a congenital condition.

The congenital malformation of the gland might explain the insufficiency of the pigmentary system merely by lack of its development, or perhaps the gap between the two lobes prevented proper circulation between them.

The fish reacted to the posterior pituitary extract in the same way as the hypophysectomized fish, as observed in successful operations performed on normal dogfish during the course of injections mentioned.

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Self-arrangement in the Mitotic Spindle under Mechanical Influence

In a previous communication¹ it was pointed out that in all types of protoplasm hitherto used, fibrils or linear units are really present, although only visible if the protoplasm is flowing through the capillary of a deformation apparatus.

The following are more recent observations concerning the appearance of the mitotic spindle fibres after mechanical gelation of the anaphasic nucleus. No traces of spindle fibres are to be seen at any stage of mitosis in living connective tissue cells cultivated *in vitro* under the usual conditions². But they become visible as soon as acid is added (M. R. Lewis), or when a similar gelation is brought about by means of a gentle tapping or pressure of the culture (J. Ellenhorn³ on living cells of *Tradescantia*), or by a stretching of the jelly film of the culture spread out within a little glass frame (H. H. Pfeiffer). All recent evidence supports the view that the spindle is a comparatively rigid structure. Experiments of R. Chambers show quite clearly that it is like an *elastic gel* capable of considerable mechanical distortion.

It is generally assumed that the energy for movement of the daughter chromosomes towards the poles is derived either from the spindle, the fibres of which are looked upon as contractile fibrillae (*Zugfasern*), or from a body driving asunder the chromosomes (*Stammkörper*). The spindle fibres have been proved to exist

as positively doubly refractive bodies between crossed nicols⁴. Such a phenomenon cannot occur except by a flowing or pulling process. Therefore, W. J. Schmidt supports the hypothesis of contractile pulling, and compares the spindle fibres with other contractile fibrillae of protein nature showing positive double refraction⁵. This comparison, however, may not be valid, because the anaphasic chromosome moving towards the pole intersect the spindle fibre in spite of their rigidity. From observations between crossed nicols it seems correct to conclude that the spindle fibres arise in a similar way to Zöcher tactoids⁶. In the geloid stage of the mitotic nucleus the anisotropic particles may approach each other owing to a dehydration process, but the contractibility of the fibres does not explain the mechanism of the movement of chromosomes.

From a theoretical point of view, there is a number of interesting problems involved in the physics of a dividing cell nucleus, and I hope to give a detailed communication of my experiments at the Fifth International Congress for Experimental Cytology at Zurich. At present I wish to show that owing to a weak mechanical influence, in the nucleus of mesenchyme cells of *Salamander* embryos cultivated *in vitro*, distinct spindle fibres with positive double refraction arise and give further evidence for anisotropic and linear structure within the cell.

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Sept. 29.

¹ Pfeiffer, H. H., *NATURE*, 136, 1054 (1936); *Cytologia*, Fujii Jubé vol. (1937); *Verh. Deutsch. zool. Ges. Bremen*, 106 (1937).

² Fischer, Alb., "Gewebestichtung", 3. Aufl. (München: R. Müller, Steinkopfe, 1930); Levi, G., *Erg. Anat. u. Embryol.*, 31, 125, 316 u. (1934).

³ Ellenhorn, J., *S. Zellf. u. mikr. Anat.*, 30, 288 (1934).

⁴ Schmidt, W. J., *Biochimica*, 22 (1936).

⁵ Schmidt, W. J., "Die Doppelbrechung von Karyoplasma, Zytoplasma und Metaplasma", p. 151 sq., 251 (Berlin: Gebr. Borntraeger, 1937).

⁶ Zöcher, H., *Z. anorg. Chem.*, 147, 91 (1925); Freundlich, H., *Annal. O.*, und Soellner, K., *Protoplasma*, 17, 489 (1923).

Interaction between Cell Nucleus and Cytoplasm

The assumption has been made frequently that the genes exert their effects upon the cytoplasm during the 'resting' stage of the cell. This implies that nuclear end-products of genic reactions can pass through the nuclear membrane or at least react with cytoplasmatic components at the nucleocytoplasmatic interphase. However, no explicit demonstration of this assumption has been given as yet. On the other hand, it has been proposed, again without proof, that the genic end-products in the nucleus are released into the cytoplasm during the mitotic breakdown of the nuclear membrane only.

It is the purpose of this note to indicate that the two opposing views can be tested and that data are available for a decision. If the genetic constitution of a cell is changed, and if a cytoplasmatic effect of the new constitution becomes apparent in this single cell before nuclear division has occurred, it is obvious that the gene concerned has interacted with the cytoplasm during the resting state of the nucleus. If on the other hand, the cytoplasmatic effect of a changed genetic constitution becomes visible only after nuclear division and in the two ensuing daughter cells, then the conclusion is suggested that the disappearance of the nuclear membrane is necessary

the release of the gene-dependent substances. Changes in genetic constitution occur in somatic tissues as the result of mutations or of chromosomal processes like segregation, non-disjunction, etc.; and germ cells as the result of recombination of genes during the maturation divisions.

An analysis of the few cases in which genetically determined characters can be observed in single cells, in *Dolphinsium*, *Zea Mays*, the smut fungus *Ustilago* and *Chlamydomonas*, indicates that specific genes can interact with the cytoplasm during the resting state of the nucleus. These genes are concerned in the production of anthocyanes, of specific sexual reactions, and of different morphological characteristics. Further work undoubtedly will increase the number of known cases. It remains to be seen whether examples will be found in which gene-controlled substances exert visible effects after the breakdown of the membrane only, as is possible in some cases of pollen dimorphism.

A more complete discussion of the data will appear in the *American Naturalist*.

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Action of Pancreatic Extract on Fatty Liver

Kaplan and Chaikoff¹ have shown that the fatty infiltration of the liver in depancreatized insulin-treated dogs can be inhibited by the addition of raw pancreas to the usual diet. Dragstedt² and his co-workers then showed that the active factor can be extracted from pancreas by the aid of alcohol. In conjunction with these investigations, we sought to answer the following two questions: (1) whether in normal rats the fat content of the liver can be influenced by a diet of pancreas; and (2) whether a variation in the fat content of the liver is linked with variation of the carbohydrate content.

Pancreatic extracts were prepared by a method most identical with that of Dragstedt. Each rat received a quantity of extract per week corresponding to 100–150 gm. of fresh pancreatic tissue.

In normal fed rats (20 per cent casein, 70 per cent starch, 10 per cent fat), no definite differences in the fat content of the liver were evident when the pancreatic extract was added to the diet. When, however, a fatty liver had been produced by diet, an average decrease from 12.8 per cent liver fat content to 5.2 per cent was obtained by administration of pancreatic substance in fourteen experiments. The nutrition period lasted 6–14 days and in two cases 30 days. The diet was as follows: saccharose 45 per cent, butter fat 40 per cent, casein 5 per cent, marble 5 per cent, salt mixture 5 per cent (Channon³).

Extracts of spleen, brain or liver prepared in exactly the same fashion and fed in the same manner were generally without effect or very much weaker effect than those of pancreas. No uniform differences in fat and sugar content of the blood or in the excretion of total acetone bodies were observed as between control rats and rats treated with extract. If the quantity of acetone bodies is assumed to be a measure of fatty acid oxidation, it must be concluded that the pancreatic extract under consideration is without effect on fat oxidation. This conclusion is supported by the fact that in the two experiments of longest duration, no less body fat was found in rats treated

with pancreatic substance than in the control animals. The weights in the treated animals were in general better maintained than in the controls.

As regards the second question, it can be stated that in conjunction with the decrease of fat content of the liver of treated animals no increase of glycogen content could be established in our brief experiments, so that for our conditions at all events the antagonism between fat and glycogen in the liver does not exist. Experiments in this connexion extending over longer periods will be reported later.

It is clear that the rat method possesses great advantages in the investigation of the pancreatic substance. This substance could not be demonstrated in the outer medium after extended dialysis through parchment membranes. Positive results could be obtained, however, after a brief period of dialysis through 'Cellophane' and cuprophane. A strongly positive effect is obtained with pancreas autolysate. It is not quite clear as yet, however, if this effect is absolutely specific. The question whether the active principle in pancreas is choline (Best) has to be clarified. The fact that the quantity of choline necessary according to Best could not have been contained in the quantities of extract fed by us is against this conclusion, as is also the ineffectiveness of extracts of the other organs mentioned. Moreover, choline is adsorbed by Lloyd's reagent and can be eluted by barium hydroxide. These tests failed with the pancreatic substance under consideration.

After the experiments here reported had been concluded, a paper was published by Eaton M. MacKay⁴, in which the rat method for the demonstration of the action of pancreas on liver fat was used. His results are consistent with ours.

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¹ Kaplan, A., and Chaikoff, J. *Biol. Chem.*, 108, 201 (1935); 119, 435 (1937).

² Van Prosser, L., Dragstedt, L. R., and Harms, H. P., *Amer. J. Physiol.*, 118, 122 (1936); 117, 166, 175 (1936).

³ Channon, H. J., and Wilkinson, H., *Biochem. J.*, 26, 1033 (1936).

⁴ MacKay, R. M., *Amer. J. Physiol.*, 119, 783 (1937).

Specific Action of Ferricyanide on Aerobic Glycolysis of Tumour Cells

It has been found¹ that ferricyanide (10^{-3} mol./litre) stops aerobic glycolysis of mammalian tumour cells, but it does not affect anaerobic glycolysis of any cell in mammals. In this respect, ferricyanide differs fundamentally from all other substances which have been found to check glycolysis (fluoride², moniodoacetic acid³, glyceric aldehyde⁴).

Ferricyanide is reduced by tumour cells, probably combining with and inactivating some part of their glycolytic system. The action of ferricyanide outlasts the time of its application: tumour cells once deprived of their aerobic glycolysis by ferricyanide do not glycolyse aerobically for many hours if kept in a medium no longer containing ferricyanide.

In order to find out whether the action of ferricyanide would be restricted to glycolysis of tumour cells and thus be specific, experiments were done with medulla of kidney, which has been found^{5,6} to be the only normal mammalian tissue with aerobic glycolysis. Rat, cat and guinea pig kidneys were used. In no case did ferricyanide check the aerobic

glycolysis of kidney medulla; in some experiments aerobic glycolysis was even stimulated slightly by ferricyanide. Glyceric aldehyde, on the other hand, was found to inhibit both aerobic and anaerobic glycolysis in kidney medulla as it does in tumours⁴.

These experiments (see Tables 1 and 2) were carried out with O. Warburg's manometric method⁵, the results being controlled by chemical determination of lactic acid⁶.

POTASSIUM FERRICYANIDE

	Mol./litre	O ₂ Q CO ₂	N ₂ Q CO ₂
Medulla of kidney (rat)	0 10 ⁻³	10.5 12.8	28.7 29.5
do. (rat)	0 10 ⁻³	11.7 12.4	28.6 28.2
do (cat)	0 10 ⁻³	15.7 16.1	
do (guinea pig)	0 10 ⁻³	14.2 15.3	19.7 20.5
Belogh tumour (mouse)	0 10 ⁻³	22.1 2.3	28.9 27.5

D,L-GLYCERIC ALDEHYDE

	Mol./litre	O ₂ Q CO ₂	N ₂ Q CO ₂
Medulla of kidney (cat)	0 2 × 10 ⁻³		14.6 1.9
do (rat)	0 4 × 10 ⁻³	14.2 2.3	
Belogh tumour (mouse)	0 4 × 10 ⁻³	19.9 3.7	32.3 2.8

Ferricyanide thus seems to act exclusively and specifically on aerobic glycolysis of mammalian tumour cells.

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¹ Mendel, B., *Angew. Chemie*, 48, No. 2 (1933). *Amer. J. Cancer*, 30, No. 3 (1937).

² Dickens, F., and Stmer, F., *Biochem. J.*, 23, 936 (1929).

³ Lundsgaard, M., *Biochem. Z.*, 117, 102 (1930).

⁴ Mendel, B., *Klin. Wochenschr.*, 8, 169 (1932).

⁵ Gyorgy, P., Koller, W., and Brehme, Th., *Biochem. Z.*, 200, 356 (1928).

⁶ Dickens, F., and Well-Malherbe, H., *Biochem. J.*, 30, 659 (1936).

⁷ Warburg, O., "The Metabolism of Tumours". (Constable and Co., London, 1930).

⁸ Mendel, B., and Goldschneider, T., *Biochem. Z.*, 104, 103 (1925).
Mendel, B., *Biochem. Z.*, 208, 390 (1928).

Oestrogenic Activity of some Hydrocarbon Derivatives of Ethylene

In an earlier preliminary communication¹, we reported the activity of some substituted derivatives of ethylene including the hydrocarbon diphenyl ethylene (stilbene). Before making any further publication, we decided to investigate other hydrocarbons of the same series as extensively as possible.

Robson and Schönberg², however, have since reported the activity of triphenyl ethylene, and as these workers made no reference to the communication in which we initiated this series of oestrogenic substances, we feel that the full publication of the series now completed will be of interest. The following table shows our results.

Substance	Dose (mgm.)	Percent Fecundity
Styrene ..	100	Nil
Propenyl benzene ..	100	Nil
Stilbene ..	25	100
α : α-Diphenyl ethylene ..	100	Nil
Triphenyl ethylene ..	10	100
	5	50
Tetraphenyl ethylene ..	25	Nil
α : β-Di-1-naphthyl ethylene ..	25	Nil
α-Methyl stilbene ..	25	Nil
α : γ-Diphenyl propylene ..	25	Nil
β-Methyl-α : γ-diphenyl propylene ..	25	Nil
α : δ-Diphenyl butadiene ..	25	100

The long duration of oestrus and the induction of mating are usually associated with this type of compound. Working with substances supplied by Dr. Hemmingsen and Krarup³ have demonstrated maturation instincts of high degree in the ovariectomized rat and enhanced spontaneous muscular activity, while Wolfe⁴ has shown that our substances are capable of preventing the development of castration cells in the anterior lobe of the pituitary.

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¹ Dodds, E. C., and Lawson, W., *Nature*, 139, 627 (1937).

² Robson, J. M., and Schönberg, A., *Nature*, 140, 196 (1937).

³ Hemmingsen, A. M., and Krarup, K. B., *Det Kong. Danske Vidensk. Selskab., Biol. Med.*, 13, 8 (1937).

⁴ Wolfe, J. M., *Amer. J. Physiol.*, 115, 665 (1936).

Dust Control in Industry

IN a recent letter¹ Prof. H. V. A. Briscoe and collaborators report on some work done in connexion with the solubility of quartz and other dust. Speculating on the practical indications of their results, they suggest that "admixture of a dust such as that of fresh cement . . . might well serve to mitigate the effects of dangerous (that is, silicosis-producing) dusts".

While the suggestion is not sufficiently concrete to afford ground for a fruitful discussion, we are nevertheless curious to learn whether the authors contemplate the possibility of entirely supplanting present unproblematical methods of silicosis prevention by others involving the increase of industrial dust concentrations. We venture the following trivial, but apposite, remarks.

The known positive method of preventing the onset of silicosis among those engaged in dusty trade is to remove the dust from the air they breathe. This can be accomplished either by obliging persons working in a dusty atmosphere to wear adequate filter masks, air-supplied respirators and the like, or to suppress the dust itself. The former method, although cheaper, possesses many obvious disadvantages, including the difficulty of enforcement, and should be superseded wherever practicable by the latter. Of course, the reduction of dust concentrations to an absolute zero is impossible, for both

engineering and economic reasons. Fortunately, however, in a great majority of cases their reduction to a hygienically satisfactory level is quite feasible. In fact, it is safe to say that if funds and engineering talent were as readily available for dust suppression as a health measure as they are when it becomes a question of protecting an article in process of manufacture from injury by dust, silicosis would soon be of historical interest only.

The procedures are well known: essentially they consist in the control of dust at its sources by means of properly designed and adequately ventilated hoods and enclosures. The expenditures involved are moderately high, but not inordinately so when comparison is made with the annual costs of silicosis compensation, or with the benefits to be achieved. These benefits include, besides the safeguarding of health, many of an intangible but none the less real nature. Almost invariably the brighter and cleaner conditions which follow a serious programme of dust elimination are reflected in increased interest and efficiency on the part of the workers. Fundamentally, dust is an asset in no industry: we have yet to meet the plant manager, however resistant to the invasion of new and expensive ideas, who would assert that it was. Less, not more, dust is desirable from every point of view.

For a number of years public health authorities, insurance companies and similar bodies have been waging an active campaign aiming at the suppression of dust in industry. They have been met half-way by the more progressive sections of industry. The advocacy, in other quarters, of an opposite policy might, however, seriously retard the campaign among the laggards.

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HAVING been invited to comment on the foregoing letter, I would first say that I am entirely in sympathy with its main thesis: a plea for the suppression of dangerous dusts by all known means. Unfortunately the authors' enthusiasm for dust suppression leads them to damage a perfectly sound case by overstatement. They seem, indeed, almost to imply that silicosis can be so completely and satisfactorily prevented by masks and ventilation that the investigation of its cause and cure is superfluous.

There are numerous cases, typically in mining and quarrying, where the suppression of dust to anything approaching a safe level is extremely difficult. Moreover, as the authors admit, "the reduction of dust concentrations to absolute zero is impossible", and the whole tendency of our recent work is to show that the finest fraction of active dusts, which is the most difficult to suppress, is by far the most dangerous. It is possible, therefore, that reasonably good ventilation, and still more the wearing of masks, may give a false sense of security.

In these circumstances I am unrepentantly keen to find out why dangerous dusts are dangerous. The fact that some dusts are safe, in the sense that they quite certainly do not cause silicosis even where workers are continuously subjected to relatively high concentrations, is clear proof that the dangerous dusts must differ from them in kind and possess

certain chemical properties wherein their danger lies. Knowing what I know, I would cheerfully work for years in cement dust at a concentration of 10 or 20 mgm. per cubic metre, but I would not willingly work a month in flint or felspar dust of one tenth that concentration.

It seems obvious, therefore, that it is likely to be advantageous to add to a dangerous dust any material, solid, liquid or gaseous, which can be proved to eliminate or even to minimize its dangerous properties. Whether the total concentration of dust is thereby increased is a point of quite minor importance.

Our general findings in the matter of active dusts¹ have speedily been confirmed by the very interesting results recently published by certain Canadian workers², who have not only succeeded, where others have failed, in producing silicosis in small animals by subjecting them to freshly produced (live) dangerous dusts but also have shown that the addition of aluminium powder to these dusts makes them much less liable to produce silicosis.

While I respectfully differ from these workers in holding that much remains to be done before any definite recommendation may properly be made about preventive measures, it is, in my view, now proved that the study of the *qualitative* properties of dusts will yield valuable results, and we must be prepared, in due time, to follow without prejudice wherever the new knowledge may lead.

H. V. A. BRISCOE.

Imperial College of Science
and Technology,
London, S.W.7.
Oct. 6.

¹ NATURE, 139, 753 (May 1, 1937).

² Briscoe, H. V. A., Matthews, J. W., Holt, P. F., and Sanderson, P. M., *Bull. Inst. Met. and Met.*, April, 1937; June, 1937.

³ Denny, J. J., Robson, W. D., and Irwin, D. A., *Canadian Med. Assoc. J.*, 37, 1 (July, 1937).

Designation of "the Time-Space Continuum"

CUMBERSOME language is the enemy of thought. If, as seems likely, the above quadri-verbal septapadialion vocable is to remain a centre of interest and discussion, it needs a handy name.

To this end let authorities bend their fancy and devise a crisp word symbol for the thought. Could this be on the agenda of any learned society? I doubt it. It is the normal job of mathematicians to decree that a simple symbol shall represent a complex; for they know well the advantage of this procedure. Shall the ordinary man be deprived of similar aids?

The new name would no longer need to be wedded to the indicative article 'the'. Just as we say 'time' or 'space' we would say, not 'the time-space continuum' but 'tispaceon', or 'espatem', or whatever the name is. My own leaning is for 'spatecon'; but no matter what the word is so it be short.

MERVYN O'GORMAN.

The Athenaeum,
Pall Mall, S.W.1.
Sept. 18.

Hyperbolic Space

IN NATURE of October 9, 1937, under the heading 'Red shifts and the Distribution of the Nebulae', there is repeated a statement of Dr. Hubble's to the effect that hyperbolic space of negative curvature

leads to a distance-distribution of nebulae which is contrary to observation. It is, however, well known that the distances of nebulae are in no sense 'observed': they are defined by means of theoretical formulae in terms of the observed apparent magnitudes of the nebulae. Moreover, the definitions vary with the process of distance-measurement envisaged. Dr. Hubble's statement is, therefore, only true if (a) we accept his particular definition of distance in terms of apparent photographic magnitude, and if (b) we also accept his identification of this distance with a certain one of the quantities figuring as 'distance' in the model universes of general relativity.

In a detailed investigation, to appear shortly in the *Zeitschrift für Astrophysik*, I have shown that, by retaining (a) and rejecting (b), all Dr. Hubble's observational formulae are in complete accord with a hyperbolic space of infinite extent. His two alternatives, namely, that we must abandon either the homogeneity of the nebular distribution or the expansion of the universe in order to obtain a satisfactory interpretation of the data, do not, therefore, exhaust the possibilities. Both homogeneity and expansion may be retained provided that we modify Dr. Hubble's theory of 'distance'.

G. C. McVITTIE.

King's College,
London, W.C.2.

A Cosmic Ray Burst at a Depth equivalent to 800 m of Water

UNDER the above title we announced in *NATURE* the results of our measurements in a railway tunnel in which we observed a burst of the size of about 10^7 ions at an equivalent depth of more than 800 m. of water. In the note, however, we regret to have made the following statement, which we should like here to withdraw:

"Both Kolhorster and Corlin¹ made measurements with an ionization chamber down to 800 m. water equivalent underground. The cosmic ray intensity at this point was tentatively assumed to be zero. From the above results, however, we see that there still remains a very small part even at this depth."

The fact is that Kolhorster² published, contrary to our statement, the results of his underground measurements by means of the coincidence method, which is independent of any residual ionization.

Y. NISHINA.

O. ISHII.

Cosmic Ray Sub-Committee of the Japan
Society for the Promotion of Scientific Research,
Institute of Physical and Chemical Research,
Tokyo.

Sept. 24.

¹ Nishina Y. and Ishii O., *NATURE*, 133, 721 (1935).

² Kolhorster, W., *Sitz. Protok. Ak. Wiss.*, 699 (1935); *NATURE*, 133, 407 (1935); *Z. Phys.*, 83, 536 (1934). Corlin, A., *NATURE*, 133, 67 (1934); *Astr. Observatory Lund*, No. 4, A, 95 (1934).

Points from Foregoing Letters

PROF. R. GOLDSCHMIDT describes two cases of spontaneous mutations in *Drosophila* cultures in which three well-known mutants, and possibly five, were produced by intra-chromosomal rearrangement. The observed mutations, the author states, do not agree with the theory postulating the existence of genes or gene mutations; he would explain mutations as due to changes in the 'correct order' within the chromosome chain, without attaching particular characters to special regions of the chromosome.

A table and graph comparing the ionization produced in various gases by cosmic rays and by gamma rays from radium C, are submitted by J. Jullis. The ionization is directly proportional to the density of the gases only in the case of the more penetrating cosmic rays, and this fact may serve to distinguish between such cosmic rays and the less penetrating gamma rays.

Two simple camera designs, for X-ray spectrum analysis, are described by W. F. de Jong, who points out a number of advantages resulting from the use of a cylindrical in place of a conical camera.

Using a thin (2 mm.) paraffin layer as 'scatterer' so as to obtain a beam of neutrons distributed more uniformly over the energy spectrum, C. Y. Chao and T. H. Wang have measured the induced radioactivity in silver, rhodium and bromine. Accepting certain approximate values for the cross-sections of their nuclei, the authors calculate the spacing of the resonance neutron levels in the nuclei of these three elements.

Changes in colour produced in a light-coloured dog-fish by injection of pituitary extract are described in detail by D. R. Barry.

Dr. H. H. Pfeiffer discusses the possible nature of the forces acting on chromosomes during mitotic

division, and states that in the case of the nucleus of mesenchyme cells of *Salamander* embryos, cultivated *in vitro*, distinct spindle fibres with positive double refraction arise through the action of a weak mechanical influence on the protoplasm.

Prof. C. Stern suggests a method by means of which it may be decided whether or not end products of genic reactions within the nucleus can exert an influence upon the cytoplasm prior to the breakdown of the nuclear membrane at mitosis.

B. Shapiro and Prof. E. Wertheimer state that, in the rat, excessive liver fat of nutritional origin can be removed by administration of alcoholic extract of pancreas. The treatment does not lessen the body fat, does not increase the acetone body excretion in the urine and does not change the quantity of fat or sugar in the blood. No antagonism between liver fat and liver glycogen was found in these experiments. The effective principle seems to be specific to pancreas.

Further experiments by Dr. B. Mendel and Miss F. Strelitz show that potassium ferricyanide, which stops the transformation of glucose into lactic acid (glycolysis) in the presence of air by tumours, does not prevent this process from taking place in kidneys; the inhibitive effect of the ferricyanide appears to be specific for tumours.

A number of ethylene derivatives have been tested for oestrogenic activity by Prof. E. C. Dodds, M. E. H. Fitzgerald and W. Lawson. In addition to stilbene and triphenyl ethylene, diphenyl-butadiene has been found to affect the mating instincts of rats from which the ovaries had been removed.

Dr. G. C. McVittie points out that the distribution of spiral nebulae can be interpreted in terms of hyperbolic space provided that some modifications are made in Dr. Hubble's theory of distance.

Research Items

Paleolithic Succession in England

MR. T. T. PATTERSON has inaugurated a study of the paleolithic succession in England with an examination of flints at Barnham St. Gregory (*Proc. Prehist. Soc.*, 3, 1; 1937). This site, a pit from which brick-earth has been dug, is situated in a small shallow valley running parallel to the Little Ouse near Cambridge. It was discovered in 1933, but implements had been found there previously on several occasions in the brick-earth. The implements now under consideration are found in the gravels and sands, with intercalated beds of clay and silt, in all more than sixty-four feet deep, which underlie the brick-earth. *Coups de poing* were found in the brick-earth, three feet above the gravel surface. In the implements, six industries, five from the gravels, are distinguished by geological horizon, state of wear and patination, and typology. Industry A, the earliest, is heavily rolled and battered and deeply patinated. It is found at depth in the gravels, whereas the others are confined to the top layer. These latter are distinguishable by their depth in the gravel and their patination and wear. Both A and B have suffered from the effects of solifluxion. The sixth industry comes from the brick-earth and is essentially Acheulean, whereas the earlier gravel industries are flake implements. More than 1,500 implements have been taken from the pit, apart from those of tabular flint and rejects. Here then at Barnham is a series of industries showing progressive development along indigenous lines uncontaminated by contact with other cultural techniques. It belongs neither to Clactonian nor proto-Levalloisian; and it is suggested that it be called the Barnham sequence of the Clactonian.

Origin of Tuberculosis and Nature of the Tubercle Bacillus

TUBERCULOSIS in man and animals is almost universally regarded as being caused by infection with a parasitic bacterium, the tubercle bacillus. Prof. J. Tisot, professor of general physiology in the Muséum national d'Histoire Naturelle, Paris, combats this view in an elaborate histological study of tuberculous tissues ("Constitution des Organismes, Animaux et Végétaux: Causes des Maladies qui les Atteignent". Vol. 2, Cause et Nature de la Tuberculose. Paris, at the Muséum, 7 Rue Cuvier: 1936). He maintains that the tubercle bacillus is not a rod-shaped organism (bacterium), but is a dumb-bell-shaped structure derived from embryonic cells in the tuberculous nodules. Tubercle bacilli, according to his view, are the mitochondria of these cells, and so-called cultures of tubercle bacilli are in reality cultures of these mitochondria. Prof. Tisot believes that he has established the fact that tuberculosis develops spontaneously in the individual, and is not usually the result of contagion. He does, however, speak of the 'tuberculous mitochondria' as being a *virus*, and it is not clear from his monograph in what manner he considers cultures of the so-called tubercle bacillus of the bacteriologist act in inducing tuberculosis, as they certainly do, when inoculated into a susceptible animal.

Embryology of the Ferret

IN a previous paper, W. J. Hamilton dealt with the early development of the ferret from fertilization to the formation of the prochordal plate. A recent communication (*Trans. Roy. Soc. Edin.*, 59, (1), No. 5, 1937) carries on the investigation from that point up to the formation of the notochord and the meso-blast. The work is based on a full series of blastoderms from the appearance of the primitive streak up to the formation of seven somites, and in the interpretation the experimental work on Amphibia and Aves has been taken into consideration. The meso-blast differentiates from the ectoderm at the hinder end of the disk and no contributions are made to it by Henson's knot, the notochordal process or the prochordal plate. The anterior end of the differentiation of the primitive streak ceases when Henson's knot appears a short distance in front of it and thereafter it only grows by additions at its hinder end. The downward growth of Henson's knot fuses with the underlying endoderm.

New Species of Mysidacid Crustaceans

PROF. WALTER M. TATTERSALL describes some interesting new mysids ("Reports on the Collections obtained by the first Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep". Johnson Fund. Smithsonian Miscellaneous Collections, 91, No. 26; 1937. Pub. 3413). In addition to the new species, the rare *Lophogaster longirostris*, *L. spinosus* and *Petalophthalmus oculatus* are recorded. A key is given to the species of the genus *Paralophogaster* and a new species *P. atlanticus* added, which differs from *P. glaber*, the type of the genus, in the eyes, antennal scale, rostral plate and telson. All these Atlantic species are closely related, and it is a question whether *P. macrops* described by Colosi from the Red Sea may not be a young form of *P. glaber*. *Gastrosaccus johnsoni* n.sp. is peculiar in its male pleopods, which are very distinctive, especially those of the second and third pairs, and at once distinguish the species from all others of the genus, the females differing only in minor characters.

Asiatic Flower-Birds and American Bird-Flowers

IN the warmer regions of Africa, Asia and America, many flowers are pollinated by birds. In America the birds visiting the flowers are mostly hummingbirds which hover as they drink the nectar; in Asia the birds climb over the branches and extract the nectar when in a hanging or sitting position. W. L. Van der Pijl has therefore spent some time examining the efforts of the sun birds (*Nectariniidae*) and white-eyes (*Zosteropidae*) to visit American bird-flowers introduced into Java (*Ann. du Jard. Botanique de Buitenszorg*, 48, Pt. 1; 1937). The original paper must be consulted for details; but, as might be expected, though often visited by the birds, most of these flowers remain sterile; in many cases the calyx or corolla tube has been punctured to enable access to be obtained to the nectar.

Insolation and Relief

THE indirect importance of relief in mountain regions in determining the distribution and intensity of sunshine on different slopes is demonstrated for selected alpine valleys in Switzerland and Austria in a monograph entitled "Insolation and Relief" by Miss A. Garnett (Publication No. 5. The Institute of British Geographers, 1937). From values assessed for sun altitude and direction, valley azimuth and degree of slope, maps and graphs are constructed for the two solstices, the equinoxes and days in early and late summer. The features which they portray are correlated closely with field studies giving details of land utilization, upper limits of crop production, and the distribution of permanent settlements. The results suggest that long duration rather than high intensity of insolation is the factor of most importance geographically, both in determining the upper limits and distribution of cereal cultivation and the position of permanent winter settlements. It is also shown that at some seasons of the year *ubac* (north-facing) slopes that are generally assumed to have low duration of sunshine, in actual fact may have a longer duration than the *adret* (south-facing) slopes, notably in the critical periods of early and late summer. This helps to explain what otherwise seems to be an unusual distribution of habitations and of cultivations in the valleys selected for study.

Crust Displacements in Japan

SEVERAL of re-levellings recently made in Japan show that, in many districts, chronic crustal deformations are now taking place. In order to study the connexions between such movements and the occurrence of earthquakes, revisions of the levelling have been made in various parts of the country, and especially in 1936 in the southern island of Kyûshû. A comparison between these measurements and those made, for the most part, about forty years ago, has been made by Prof. N. Miyabe, to whom we are indebted for much useful work of the same nature (*Proc. Tokyo Imp. Acad.*, 13, 257-260; 1937). The island is almost bisected by an east-west line between Udo and Nobeoka. In the northern half, the general movement is a tilting of the crust towards the north, the northern end having subsided relatively by about 7 in. To the south of the median line, from Udo to Minemata, the crust has risen as a whole, but, to the south of the latter place, the displacements show marked fluctuations, so that the curve representing them consists of segments of lines. In other words, the movements recorded are those of crust-blocks rather than of the island mass as a whole.

Potential of the Iodine Electrode

THE normal potential of the mercury-mercurous iodide electrode, previously known only by calculation, has been determined by R. G. Bates and W. C. Vosburgh (*J. Amer. Chem. Soc.*, 59, 1188; 1937). The cell consisted of a mercury-mercurous iodide electrode, with electrolytes of potassium iodide and hydrochloric acid, or potassium iodide, acetic acid and sodium acetate, combined with a hydrogen electrode. The *E.M.F.* values were extrapolated by an equation involving the activity coefficient of hydrochloric acid. In a second series of cells the electrolyte consisted of potassium iodide, sodium acetate and acetic acid, and the extrapolation now involved the molality of unionized acetic acid. The two sets of values were in good agreement, extra-

polarization to infinite dilution giving the value $E^\circ = -0.0405$ volt. By combining this with the value of the electromotive force of the cell consisting of lead amalgam, lead iodide, mercurous iodide and mercury, a value for the normal potential of the iodine electrode could be calculated. This was found to be $E^\circ = -0.5356$ volt, in better agreement with the value given by Lewis and Randall, namely, -0.5357 volt, than that in the International Critical Tables, -0.5345 volt.

The β -rays from Lithium and Boron Isotopes

THE radio-elements ^6Li and ^{10}B , obtained by bombarding lithium and boron with fast deuterons, give β -rays with energies up to 12 million volts. D. S. Bayley and H. R. Crane (*Phys. Rev.*, 52, 604) have investigated the upper energy limits of these spectra, and J. J. Turin and H. R. Crane (*ibid.*, 610) have used the elements as a source in a study of the energy loss of energetic electrons in lead and carbon plates. The β -rays were investigated by a cloud-chamber in a magnetic field, the target being bombarded with deuterons immediately before the expansion. Both β -ray spectra have by inspection upper limits at 12.0 ± 0.6 Mev. Since the masses of the atoms involved in the formation and disintegration of ^6Li , ^{10}B , are known, the spectra may be used for testing the validity of the theoretical formulæ of Fermi and of Konopinski and Uhlenbeck for the shape of the upper limit. The question is complicated by the fact that protons are produced with unknown energy in the formation of ^6Li and ^{10}B ; but accepting indirect evidence for the energy of these particles from the excitation functions, it is found that the Konopinski-Uhlenbeck theory gives considerably too high extrapolated values for the maximum energy of β -emission. The energy loss of β -particles up to 11 Mev. going through carbon is in good agreement with the Bethe-Heitler theory, the loss in lead is more than 50 per cent greater than predicted, but much of this difference is to be accounted for by the scattering of the electrons in the lead, which causes the path in the metal to be considerably greater than that directly measured.

Physical State of Jupiter's Atmosphere

ABOUT three years ago, Dr. H. Jeffreys suggested that Jupiter was composed of a rocky core surrounded by a thick layer of ice, the latter being covered by an atmosphere with a depth of more than 8,000 kilometres. Mr. B. M. Peek (*Mon. Not. Roy. Astro. Soc.*, 97, 8, June 1937) suggests that such an atmosphere cannot exist, his method being an examination of an adiabatic model, an isothermal model, and finally an intermediate model which is a compromise between the first two. For the purpose of numerical evaluation, in the adiabatic and isothermal models the atmosphere is considered to be methane, and in the case of the intermediate type different proportions of hydrogen and methane are taken, and pressure-depth curves are drawn which show the depth at which the solid state is reached. If the atmosphere were composed of pure methane, this depth would be only about 35 km., and if pure hydrogen it would be 270 km. Whatever model be adopted, the depth of the atmosphere is probably limited to about 1 per cent of the radius of the planet. Mr. Peek directs the attention of meteorologists studying Jupiter to the fact that great densities are rapidly attained in the atmosphere, which would almost certainly lose its familiar characteristics below a depth of 25 km.

Science News a Century Ago

Kew Gardens

THE botanic gardens at Kew were founded by Princess Augusta, mother of George III, who began the formation of an exotic garden in 1759 with William Aiton (1731-93) as gardener. The small temples in the grounds were designed by Sir William Chambers in 1760-62. From 1772 until 1819 the gardens were under the care of Sir Joseph Banks. After his death they were neglected, and on October 31, 1837, *The Times* published a communication "From a Correspondent", directing attention to the state of the Gardens. "The great fault in the management at Kew-gardens", said the writer, "appears to be the adherence to a system of niggardly expense and exclusiveness. There does not appear to have been the slightest progress in improvement for many years; the old conservatories and hot-houses seem crammed with plants, in a state of decay or stagnation; everything looks dingy and dirty. . . . There are not sufficient persons in the grounds to attend properly to the cultivation; it is understood that nine or ten men is the whole strength of the establishment, to look after the botanical-garden and also the 'Arboretum', which two divisions it is believed cover nearly six acres of ground. . . . It may as well be mentioned, that a little repair would not hurt one or two of the temples in the pleasure-grounds; and it would also be quite as well if the piece of water, once called the lake, but now an unseemly pond, were emptied of its mud and filth, or quite filled up."

The gardens were rescued from this state of neglect by the work of Sir William Jackson Hooker (1785-1865), who was appointed director in 1841.

The Civil Engineer and Architect's Journal

IN October 1837 appeared the first number of the above monthly journal. In the prospectus printed in the first number, it was stated that the journal would contain descriptions and particulars of important buildings, manufactories, warehouses, railways, docks, bridges, piers, harbours, canals, rivers, water-works, gas-works, drainage, mining, steam navigation and machinery, together with notices of the transactions of British and foreign societies, new inventions, patents, books, parliamentary proceedings and "such other useful information connected with the Profession as may make it a work of general reference". The journal was published at 6d. a copy.

The Zoological Society

AT a meeting of the Zoological Society held on November 2, 1837, attention was directed to the falling off of the receipts for admission to the gardens, and suggestions were put forward for providing further attractions. Mr. Vigors, M.P., suggested that a suspension bridge should be built to communicate with the grounds of the Society on the opposite side of the Regent's Canal and that bands should be introduced occasionally. In replying to the discussion the chairman, the Rev. John Barlow, F.R.S., said the Council had appointed a committee to report on the deficiency in the garden receipts and that a spirited attempt was being made to introduce two living hippopotami into the collections.

Gresham College

UNDER the above heading, *The Times* of November 3, 1837, said: "Yesterday being the first day of term these lectures commenced in the lecture-room over the east side of the Royal Exchange, when Dr. Southey gave the first of his course on physis. The number of the auditory was 35 persons, or about half the number to which the room could afford accommodation, and which being greater than on previous occasions is to be attributed to the greater additional interest felt by the inhabitants of the city on the subject of this endowment from the steps which have recently been taken to render it more public and useful. The subject chosen by the learned lecturer was the history of medicine."

Dr. Henry Herbert Southey (1783-1865) was the younger brother of Robert Southey, the poet. He was physician to both George IV and Queen Adelaide. He was appointed to the chair of physis in Gresham College in 1834.

Baron Alibert (1768-1837)

JEAN LOUIS ALIBERT, the founder of modern dermatology in France, was born on May 26, 1768, at Villefranche-de-Rouergue in the Aveyron department of France, the son of a magistrate. He studied medicine in Paris, where his principal teachers were Pinel and Bichat, and qualified in 1799 with a remarkable thesis on pernicious fevers, of which several editions were published. His rise in the profession was very rapid, as two years after qualification he was made assistant physician and in the following year full physician to the Hôpital Saint-Louis, which he made the Mecca of dermatologists throughout the world. In addition to several books on diseases of the skin, of which the most important was published in parts between 1806 and 1814, and in which coloured plates appeared for the first time in the history of dermatology, Alibert deserves recognition for his works on therapeutics, of which he was the first professor in the Paris faculty, and a monograph on hydrology. He also won the Montyon prize for a work entitled "Physiology of the Passions", which was translated into German and Spanish. He was the recipient of many honours both at home and abroad. He was physician to Louis XVIII and Charles X, who created him a baron. His death, due to cancer of the stomach, took place on November 4, 1837.

Schönbein and Faraday

IN a long letter to Faraday dated November 5, 1837, Schönbein said: "The French papers have been talking for some time about a discovery (said to have been made by a certain Mr. Sorel a Frenchman) which if it should turn out to be something more than a mere news-papers' invention, would be indeed a most wonderful thing. By dint of god knows what sort of substance, the news-papers call it voltaïo-powder, Mr. Sorel is said to be able of changing Iron and any other readily oxidable metal such as to give them (with regard to their chemical bearings to oxygen) the properties of the precious ones. Such a discovery, of course, cannot be made in our days without being turned to practical advantage and so, indeed, the papers tell us, that Mr. Sorel is going to enter into partnership with the well-known Mr. Cookerill in order to make use of his discovery in the large establishments of the latter gentleman."

University Events

CAMBRIDGE.—R. L. M. Synge, of Trinity College, has been appointed to the Bann W. Levy studentship in biochemistry.

The following grants have been made from the Belfour Fund: £50 to Dr. D. G. MacInnes for research on Tertiary and Quaternary fossil Mammalia of the Rukwa Basin; and £25 to H. W. Lissmann for research at Naples on animal locomotion.

The degree of master of arts has been conferred upon Prof. T. Dalling, professor of animal pathology.

In accordance with its usual practice, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Candidates must not have reached the age of twenty-six years before May 1, 1938. Trinity College also offers, as usual, Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40, but the College Council has power to award an additional payment. A candidate for a studentship or exhibition should apply through the principal authority of his university, and his application should reach the Senior Tutor (from whom further particulars may be obtained) by May 1, 1938.

LONDON.—The title of emeritus professor has been conferred upon Dr. G. W. Watson, formerly professor of medicine in the University.

LONDON.—Mr. T. O. Stamp has been appointed to the University readership in bacteriology tenable at the British Postgraduate Medical School. Since 1933 he has been lecturer in bacteriology at the London School of Hygiene and Tropical Medicine.

Dr. A. R. Todd has been appointed as from October 1 to the University readership in biochemistry tenable at the Lister Institute of Preventive Medicine. Since 1936 he has been an assistant in the Biochemistry Department of that Institute.

The title of reader in zoology in the University has been conferred on Mr. H. R. Hewer, in respect of the post held by him at the Imperial College of Science and Technology.

The title of emeritus professor of plant physiology in the University has been conferred on Prof. V. H. Blackman, on his retirement from the University professorship in plant physiology at the Imperial College—Royal College of Science.

An offer by Mr. A. Chester Beatty to provide a scholarship in radiology of £400 a year for two years has been accepted with the cordial thanks of the University. This scholarship will enable a student of radiology, after obtaining the academic diploma in medical radiology, to spend a year in one of the great radiological clinics of the United States.

READING.—The honorary degree of D.Sc. will be conferred on the following at a Congregation to be held on November 29, on the occasion of the installation of Sir Samuel Hoare as chancellor of the University: Prof. James Chadwick, Sir Warren Fisher, the Right Hon. the Earl of Iveagh, Sir Thomas H. Middleton and Sir Edward B. Poulton.

Societies and Academies

Paris

September 6 (*C.R.*, 205, 453–472).

ARNAUD DENJOY: The singularities of the analytical function defined by a Weierstrass element.

MARCEL BRELOT: The best or smallest harmonic majorants of sub-harmonic functions.

MME. NATHALIE DEMASSINUX and BASILE FEDEROFF: The dehydration of the double sulphate of copper and potassium. The changes produced by loss of water on gradual heating have been followed by means of X-ray diffraction diagrams (Debye and Scherrer method). The X-ray photographs for $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and $\text{K}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ for ten stages of heating are reproduced.

TRYPHON KARANTASSIS and CONSTANTIN VASILIADES: The preparation of the stannic alkyl diiodides and their action on aromatic amines.

ANDRÉ MEYER and HENRI DRUTEL: The condensation of the 2, 6-dimethyl and 2, 8-dimethyl 4, hydroxyquinolines and their derivatives with aromatic aldehydes.

HENRY HUBERT: Storm squalls in western Africa.

ROGER GAUTHERET: Some properties of the apical cells of *Lupinus albus*.

GASTON RAMON: The utilization of anatoxins in the treatment of toxic-infections in the course of development. Sero-anatoxitherapy.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 6, 1937).

L. GODHAUX: Remarks on algebraic varieties of bigenus one.

G. A. BOULANGER: Some advice to naturalists on how to express themselves in their publications, and on the subject of certain errors to be avoided.

M. KOURNENSKY: The integration of linear partial differential equations of the first order in two or more unknown functions.

P. BURNIAT: Hypersurfaces and canonical varieties.

MISS D. CRESPIN: The spectral classification of stars of type B and the distribution of absorbent elements in the interior of stellar atmospheres.

M. NICOLET: Note on the hydrogen molecule of stellar atmospheres.

P. LEDOUX: The equilibrium of molecular dissociation in the interior of a stellar atmosphere.

MISS F. DEHALU: New researches on the $\Sigma - \Sigma$ band system of the AlO molecule and astrophysical applications.

B. ROSEN and MISS J. MAT: Isotopic effect in the resonance series of Te_2 .

M. NICOLET: Identification of new lines of NH in the spectrum of the sun's reversing layer.

G. A. HOMBS, M. BRUNIN and P. DUWZ: The state of dislocation of cold-worked metallic crystals.

J. CLAEYS and H. SACK: Some remarks on the absorption of ultra-sound in tubes.

L. MARTON: The electronic micrography of biological objects.

Bull. Classe Sci., 23, No. 7, 1937.

L. GODMAUX: Cyclical involutions belonging to an algebraic variety of genera one.

TH. DE DONDER: The velocity of a coupled reaction.

TH. DE DONDER and J. PHILIPPE: The velocity of propagation of light according to Descartes. Contrary to the opinion prevailing at the time of its publication, Descartes' theory did not imply the instantaneous propagation of light.

J. F. COX: Some remarks on a note by Nisoli and Gérard on a new determination of the vertex of the cluster in Taurus and of the star stream in Scorpio-Centaurus.

MRS. J. HENRY-CORNET and L. HENRY: Estimation of bilirubin in blood serum by the spectrographic method.

N. BOUTAKOFF: The flow northwards of Lake Tanganyika during the Pleistocene.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 351-421, July 15, 1937).

C. C. TAN: 'Compressed deficiency' and the location of the spindle attachment in the X-chromosomes of *Drosophila pseudo-obscura*.

G. W. BEADLE and B. EPHRUSSI: Ovary transplants in *Drosophila melanogaster*: meiosis and crossing-over in superfemales. The ovaries of superfemales (individuals containing three X-chromosomes and two antosomes) have been successfully transplanted into normal females. Although such females are low in viability and always sterile, the transplanted ovaries gave fertile eggs. Mortality of eggs and larvae was high, however, and this and other results suggest that this particular lack of chromosome balance interferes with crossing-over and hence with the mechanism of meiosis.

A. H. STURTEVANT: An effect of the Y-chromosome on the sex-ratio of inter-racial hybrids of *Drosophila pseudo-obscura*.

A. MARSHAK: Effect of X-rays on chromosomes in mitosis. For both plant and animal tissue, chromosomes are most sensitive to X-rays at the onset of prophase; the frequency of induced abnormalities is independent of wave-length but varies directly as the total length of the chromonemata. The diameter of the 'sensitive volume' of all the chromonemata studied is of the same order of magnitude, and agrees with that of the average diameter of a polypeptide chain or a protamine molecule. Changes in sensitivity to X-rays induced by treatment with ammonia and carbon dioxide also suggest that the 'sensitive volume' consists of material of the type of the protamines or histones.

A. TYLER and N. H. HOROWITZ: The action of certain substituted phenols on marine eggs in relation to their dissociation. 2,4-Dinitrophenol and various substituted phenols increase the respiratory rate of sea-urchin eggs and at maximum stimulation prevent cleavage; the effect is reversible. The effect on cleavage depends on the concentration of undissociated compound present. Once inside the cells, however, it is the dissociated form that is active.

G. N. SNELL and P. O. AEBERSOLD: The production of sterility in male mice by irradiation with neutrons. As with X-rays, the first result of irradiation with neutrons is reduction of litter size, followed by

temporary sterility; but neutrons, as measured by ionization in the bakelite-walled thimble chamber of a standard roentgen meter, are 5-6 times as effective as X-rays.

T. M. SONNENBORN: Sex, sex inheritance and sex determination in *Paramecium aurelia*. In a certain race of this organism, it was found that the individuals could be divided into two classes, sex I and sex II; members of different classes unite for conjugation, while those of the same class do not. Provided neither endomixis (disintegration of meganucleus and its replacement by a fission body of the micronucleus) nor conjugation occurs, all products of fission are of the same sex as their progenitor. At conjugation or endomixis, sex differentiation occurs.

W. J. ROBBINS and MARY A. BARTLEY: Thiazole and the growth of excised tomato roots. While excised tomato roots do not grow in a nutrient solution of mineral salts and pure cane sugar, addition of yeast enables them to grow satisfactorily. For the yeast, one of its constituents, crystalline vitamin B₁, can be substituted. Since vitamin B₁ has been synthesized from pyrimidines and a thiazole derivative, these parent substances were tested, and it was found that the thiazole compound enabled growth to continue. Presumably the thiazole radical of vitamin B₁ is the active substance.

W. J. ROBBINS, MARY A. BARTLEY, A. G. HOGAN and L. R. RICHARDSON: Pyrimidine and thiazole intermediates as substitutes for vitamin B₁. Neither of these classes of compounds can cure experimental polyneuritis in pigeons, but 5 mgm. doses of each, if given not more than 24 hours apart, are effective. It is considered that vitamin B₁ is synthesized from these intermediates *in vivo*.

L. H. GERMER and K. H. STOKES. The structure of Langmuir-Blodgett films of stearic acid. Electron diffraction patterns were obtained from such multiple films deposited on a block of chromium-plated nickel. These patterns indicate that the carbon atoms in these crystals are arranged in zigzag planar chains, the axes of which are nearly, if not accurately, parallel to each other, this direction being inclined downward towards the water surface from the plane of the supporting block. Crystallographic constants have been deduced and the cross-section of the stearic acid reciprocal lattice constructed. The results have been confirmed by the examination by transmission of similar built-up films deposited on a very thin transparent backing foil.

C. STOCK: A peccary skull from the Barstow Miocene, California.

F. D. MILLER: Note on galactic structure: the Milky Way from Aquila to Cygnus.

O. ZARETSKI: Some results in the arithmetic theory of algebraic functions of several variables.

N. A. HALL: Binary quadratic discriminants with a single class of reduced forms in each genus.

D. LEWIS and M. J. LARSEN: The cancellation, reinforcement and measurement of subjective tones. Experimental results indicate that an audible subjective tone can be increased or decreased in loudness by the introduction of a harmonic of pitch the same as that of the subjective tone. Reinforcement seems to be due to constructive interference, and cancellation to destructive interference; hence the magnitude of the subjective tone can be measured in terms of an equivalent amount of sound pressure. It is suggested that subjective tones have representation in terms of actual vibrations in the cochlea.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 1

INSTITUTION OF ELECTRICAL ENGINEERS (MURPHY AND NORTH WALES (LIVERPOOL) CENTRE), at 7.—Prof. J. Chadwick, F.R.S.: "The Elementary Particles of Matter" (Kelvin Lecture).

Tuesday, November 2

CHADWICK PUBLIC LECTURE (at Manson House, 26 Portland Place, W.1), at 5.30.—Dr. J. M. H. MacLeod: "Leprosy in Great Britain at the Present Time" (Malcolm Morris Memorial Lecture).*

INSTITUTION OF CIVIL ENGINEERS, at 6.—S. B. Donkin: Presidential Address.

Thursday, November 4

INSTITUTE OF FUEL (at the Junior Institution of Engineers, 39 Victoria Street, S.W.1), at 6.—Symposium on "Waste Heat Boilers".

Friday, November 5

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. F. W. Lanchester, F.R.S.: "The Gas Engine and After" (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 7.—Dr. G. S. Baker: "Development of Hull Form of Merchant Vessels" (Andrew Laing Lecture).

INSTITUTION OF GAS ENGINEERS, November 2-3.—Ninth Annual Research Meeting to be held at the Institution of Mechanical Engineers.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TEACHER OF ELECTRICAL ENGINEERING in the Norwich Technical College—The Principal (November 3).

CHIEF (male) at the Royal Ordnance Factory, Irvine—The Under-Secretary of State (O.S.), The War Office, London, S.W.1 (November 5).

SCIENTIFIC OFFICER (chemistry), SCIENTIFIC OFFICER (physics), ASSISTANT (grade I, male), and ASSISTANT (grade III, female) in the Research Department, Woolwich, London, S.E.18—The Chief Superintendent (November 5).

PRINCIPAL of the St. Helen's Education Committee—The Director of Education, Education Office, St. Helen's (November 6).

LECTURER IN ELECTRICAL ENGINEERING in the Forest of Dean Mining and Technical School—The Secretary, County Education Office, Shire Hall, Gloucester (November 8).

ASSISTANT LECTURER AND DEMONSTRATOR IN CHEMISTRY in the King's College of Household and Social Science, Campden Hill Road, London, W.8—The Secretary (November 8).

LECTURER IN PHYSICS in the West Ham Municipal College, Romford Road, London, E.15—The Principal (November 10).

PROFESSOR OF MECHANICAL ENGINEERING in the Bengal Engineering College—The High Commissioner for India, General Department, India House, Akiwyth, London, W.O.2 (November 12).

ASSISTANTS (grade III) in the Admiralty Chemical Pool—The Secretary of the Admiralty (O.M. Branch) (November 13).

PROFESSOR OF BOTANY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.O.1 (November 30).

ELECTRICAL ENGINEER in the Copper Development Association, Thames House, Millbank, London, S.W.1—The General Manager.

LIBRARIAN in the University of Liverpool—The Registrar.

British Museum and British Museum (Natural History). Annual Report of the General Progress of the Museum for the Year 1936; with a Return of the Number of Persons admitted to the Museum and a Statement of the Principal Objects added to the Collection. Pp. 24. (London: H.M. Stationery Office.) 4d. net. [1510]

Universities Bureau of the British Empire. Report of the Executive Council together with the Accounts of the Bureau for the Year 1st August 1936 to 31st July 1937. Pp. 24. (London: Universities Bureau of the British Empire.) [1510]

Other Countries

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 15. Pp. iii+193. (Paris: Les Presses universitaires de France.) [1510]

Ministère de l'Éducation nationale: Université de Paris, Faculté des Sciences: Institut de Physique du Globe. L'Observatoire géophysique de Chambon-la-Forêt. Pp. 20. (Paris: Imprimerie Gauthier-Villars.) [1510]

Indian Lac Research Institute. Bulletin No. 27: A Technical Process for Washing and Refining Stick Lac. By A. K. Thakur. Pp. 12+2 plates. (Nankum: Indian Lac Research Institute.) 3 annas. [1510]

Bulletin of the American Museum of Natural History. Vol. 73, Art. 8: Skull Structure of the Multituberculata. By George Gaylord Simpson. Pp. 727-763. (New York: American Museum of Natural History.) [1510]

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 2: Report on Hydrographic Observations at a Series of Anchor Stations across the Straits of Florida. By Albert Wade Parr. Pp. 62. (New Haven, Conn.: Yale University.) [1510]

Royal Agricultural Society, Cairo. Technical Bulletin No. 31: Experiments in Egypt on the Interaction of Factors in Crop Growth. 7: The Influence of Manuring on the Development of the Cotton Crop. By Dr. Frank Crowther. Pp. 70. Technical Bulletin No. 32: Experiments in Egypt on the Interaction of Factors in Crop Growth. 8: Manuring of Cotton in Egypt. By Dr. Frank Crowther, Adolf Tomford and Ahmed Mahmoud. Pp. 38. (Cairo: Royal Agricultural Society.) [1510]

Bulletin of the National Research Council. No. 100. An Experimental Study of the Problem of Mitogenic Radiation. By Alexander Hollender and Walter D. Clum. Pp. 96+4 plates. (Washington, D.C.: National Research Council.) 1 dollar. [1510]

U.S. Department of Agriculture. Circular No. 439: Parasitization of the Mediterranean Fruitfly in Hawaii, 1914-33. By H. F. Willard and A. O. Mason. Pp. 18. 5 cents. Picture Sheet No. 1: Tomato-Hookworms. Pp. 2. 5 cents. Picture Sheet No. 2: Mexican Bean Beetle. Pp. 2. 5 cents. Picture Sheet No. 3: Colorado Potato Beetle. Pp. 2. 5 cents. (Washington, D.C.: Government Printing Office.) [1510]

Brooklyn Botanic Garden Record. Vol. 25, No. 3: Botanic Gardens of the World; Materials for a History. Pp. 149-354. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 2 dollars. [1510]

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 79: Les fossiles du Jurassique de la Belgique avec description stratigraphique de chaque étage. Par Prof. Henry Joly. Pp. 246+3 plates. Deuxième partie. Les inférieurs. Mémoire No. 80: The Crocodile of Marasmar (Doleschovia doleschovi Owen). By W. M. Swinton. Pp. 46+1 plate. Deuxième Série, Fasc. 8: Limites jurassiques de l'est du bassin de Paris. Par Dr. Olette Deshayes. Pp. 58+3 plates. Deuxième Série, Fasc. 10: The Anatomy of some Protobranch Mollusks. By Prof. Harold Heath. Pp. 28+10 plates. Deuxième Série, Fasc. 11: Revision des Onitides. Par André Janssens. Pp. 200+2 plates. Hors Série: Résultats scientifiques du voyage aux Indes orientales Néerlandaises de J.L. A.A. R.R. le Prince et la Princesse Léopold de Belgique. Vol. 5: Vertébrés. Fascicule 4: Oiseaux, par Ch. Dupond, Säugetiere, von H. Schwarz. Pp. 72+3 plates. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique.) [1510]

U.S. Department of Agriculture. Farmers' Bulletin No. 1780: How to Fight the Chinese Bug. By C. M. Packard and Curtis Benton. Pp. H+22. (Washington, D.C.: Government Printing Office.) 5 cents. [1510]

National Research Council of Canada. Moisture on Windows. By R. Ruody. Pp. 8. (Ottawa: National Research Council.) [1510]

State of Illinois: Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 21, Article 9: Studies of Nearctic Aquatic Insects. 1: Nearctic Alder Flies of the Genus *Stelma* (Megalyptera, Stelidae), by H. H. Ross; 2: Descriptions of Plecoptera, by T. H. Frison. Pp. 53-99. (Urbana, Ill.: Illinois State Natural History Survey.) [1510]

Meddelanden från Statens Skogsforskningsanstalt. Häfte 30, 1937. Pp. iv+716. (Experimentalfältet: Statens Skogsforskningsanstalt.) 12.00 kr. [1510]

Astronomical Catalogue 1900-0. Sydney Section, Dec. -51° to -66°, from Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 16: R.A. 124 to 184, Dec. -54° to -66°, Plate centres Dec. -55°. Pp. 64. Vol. 16: R.A. 184 to 244, Dec. -54° to -66°, Plate centres Dec. -55°. Pp. 32. (Sydney: Government Printer.) [1510]

Catalogues, etc.

Apparatus for the Testing and Analysis of Oil, Tar and their Products. (Catalogue No. 15B, Section X.) Pp. iv+108. (London: Griffin and Tatlock, Ltd.)

Mandelol (Compound Calcium Mandelate B.D.H.) in the Treatment of Urinary Infections. Pp. 8. (London: British Drug Houses, Ltd.)

Instruments for the Measurement of High Vacua. (Misc. 1.) Pp. 8. (London: W. Edwards and Co.)

Numismatik: Bücher, Abhandlungen, Zeitschriften. (Antiquarische katalog Nr. 714.) Pp. 128. (Leipzig: Gustav Fock, G.m.b.H.)

Official Publications Received

Great Britain and Ireland

Sale of Food and Drugs. Extracts from the Annual Report of the Ministry of Health for 1936-37 and Abstract of Reports of Public Analysts for the Year 1936. Pp. 16. (London: H.M. Stationery Office.) 4d. net. [1510]

Bacon Development Board (Research Department). Report No. 7: Selected Abstracts on Pig Production made during the Year ending June 30th, 1937. Pp. lxi. (London: Bacon Development Board.) 2s. 6d. [1510]

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Vol. 140

Higher Education for African Natives

ONE of Mr. Ormsby-Gore's first acts on his return to the Colonial Office was the appointment of a representative Commission, under the chairmanship of Earl De La Warr, to make a comprehensive survey of the educational facilities provided in East Africa, to report on the development of its higher educational institutions, and to make detailed proposals for the establishment of a college of university standing for East Africans. The Commission spent from January 11 until February 19 in East Africa, and a few weeks ago presented its report.*

The outstanding features of the report are its freedom from cant, its warm sympathy with, and appreciation of, the potentialities of the Africans, its realization of the composite conditions which have been created by the impact of the European theory of progress on the African theory of traditionalism, and its desire to provide education services to enable Africans to cultivate their undeveloped powers, not for their good alone, but also for the benefit of the world. Throughout its labours the Commission had prominently before it the application of the two principles of trusteeship: the development of the peoples, and the development of the natural resources of the territories they inhabit. It rightly concludes that the better education of the African is essential to both kinds of development. As axiomatic to its report it states the two propositions that the primary need of East Africa is the improvement of health and agriculture, and that such improvement can best be achieved through the general education of Africans and by training sufficient numbers of qualified African experts.

There have been several commissions on East African development. All have expressed the conviction that only from the Africans themselves can enough qualified men and women for the medical, agricultural, veterinary, forestry, railway, public works and education services be obtained at an economic cost. To this Commission belongs the distinction of being the first to give details of the requirements of these essential services for qualified African personnel. It states that within the next ten years, Uganda, Kenya, Tanganyika and Zanzibar will require at least nine hundred college-trained African men and women for these services and about the same number of Africans who have had a full course of secondary school training. Taking into consideration other avenues of employment for those who have received a secondary school training, and assuming that the average college graduate will look for a wife who has at least had that advantage, the Commission estimates that useful occupations can be found for more than four thousand secondary school pupils.

The absorption of an average of four hundred educated Africans a year for the next ten years in the service of nearly twelve million of their fellows does not appear too ambitious a project at first sight. There are, however, obstacles which cannot be surmounted without a thorough overhaul of the education services. A great and courageous effort has to be made to broaden the base of the pyramid on which the education of the African is built. The local governments must assume a much greater responsibility for the finance and guidance of education agencies, and cease to regard expenditure on education as one of those luxuries

* Higher Education in East Africa. Report of the Commission appointed by the Secretary of State for the Colonies. (Colonial No. 145). Pp. 156. (London: H.M. Stationery Office, 1937). 2s. 6d. net.

on which to practise self-denial in times of economic depression. The task cannot and should not be left so largely to the Christian missions. The local governments must supplement missionary pioneer effort by the provision of model institutions while encouraging the missions to improve those under their care. After sixty years of education in Uganda—and Uganda is the brightest spot in East African education—there are still not more than forty schools fit to provide a full primary course of six years. The fact that upon this small basis it was possible to recruit pupils to Makerere College in Uganda for a training to enable them to take places in the government services is evidence of the keenness of the African for education, rather than a matter for complacency. Makerere and its allied institutions are still unable to deal with the requirements of the Uganda Government alone for trained unqualified assistants for the public services, and it is neither equipped nor staffed to provide the territories with university-trained, professionally qualified staffs. It is clear, therefore, that "a large expansion and improvement will be required in all stages of education, primary, secondary, and post-secondary" throughout the East African territories. The instruction in all types of schools, in spite of the advice and assistance persistently given by the Colonial Office Advisory Committee on Education, is mostly of the kind that was discarded as unsuitable in European schools years ago. It is certainly not calculated to give an African an intelligent appreciation of his own surroundings.

It was suggested in the evidence given to the Commission that the paramount need of the territories was for African assistants to work under European officers, and that plans for the establishment of university courses were therefore premature. The reality the Commission faces, however, is the demand by Africans for university training and full professional status, and that unless they find means to attain it in Africa they will seek it overseas. The governments need Africans of the highest qualifications to undertake an ever-increasing share of the responsibility in every department. To restrict Africans permanently to a low standard of employment is impossible. It would foster discontent. It would be a denial of the policy of trusteeship which, as the Commission says in a trenchant passage,

"has been proclaimed as the policy of His Majesty's Governments. It is a policy which will have to confront inconvenient problems, and which already

inspires young energies and fresh ambitions. Yet if the concept of trusteeship, if the method of Indirect Rule, are to be anything more than glacial evasions of responsibility they must assert that the African shall in due course reach full maturity and take his place among the peoples of the world".

The Commission therefore recommends that the East African Governments should announce forthwith "a policy offering facilities for training Africans in due course to full university standard and of giving them opportunities thereafter to rise in the service to the highest responsibilities commensurate with their abilities". This policy obviously implies the provision of primary and secondary education on a most liberal scale in all the East African territories, to act as feeder institutions to the higher college.

The Commission definitely recommends the establishment of a university college in the near future and of a university at no very distant date. It is aware of the "present very flimsy foundation of primary and secondary education upon which such institutions will need to be based, and realizes the possible risks of too rapid advance and of a top-heavy structure". Nevertheless, it is convinced that the risk should be taken, believing that Africa can profit by our long and painful experiments, and can advance at a pace far greater than was possible for Europe a hundred years ago.

The Commission proposes that the constitution of the higher college should be similar to that of institutions of university rank in the United Kingdom; in other words, that it should be under the control of an autonomous independent body with trustees, appointed by the Secretary of State for the Colonies, to administer an endowment fund of at least £500,000, which it is hoped will be forthcoming from the local governments, the Imperial Exchequer, and private donors. The initial capital outlay required for buildings and equipment is estimated at less than £200,000. Of the total sum required Uganda is expected to contribute £300,000 from its surplus balances, which leaves less than £400,000 to be provided from other sources. This appears a small price to pay for the provision of an institution which should, if it is properly staffed and equipped and directed by an inspiring personality, become a centre of learning and research from which East Africa should be able to draw on the intellectual resources of the world through the medium of its own people.

A. G. C.

Mineral Chemistry and Crystal Structure

Atomic Structure of Minerals

by Prof. W. L. Bragg. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University). Pp. xiii + 292. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1937.) 18s. net.

THOUGH only twenty-five years have elapsed since in June 1912 the interference phenomena of X-rays on crystals were discovered by M. von Laue and his collaborators, experimentally determined atomic arrangements are to-day available in sufficient number to form the subject-matter of a notable book. This advance has to a large extent been the result of work carried out in the laboratories of Sir William Bragg and of Prof. W. L. Bragg, and mineralogists will be grateful to the latter for having given them a first-hand and illuminating account of the results achieved. Prof. Bragg's book shows clearly, as do in a more detailed fashion the "Strukturberichte" published by the *Zeitschrift für Kristallographie*, the amazing extent to which crystallography has been developed by the united researches of physicists, chemists and mineralogists. A single new method of experimental investigation has served not merely to solve—or at least to define more clearly—a multitude of old problems, but also by opening up entirely new vistas has enabled many questions not thought of hitherto to be precisely formulated.

After giving a short but instructive introduction on the fundamental principles of space lattice crystallography and on crystal analysis by X-rays, Prof. Bragg proceeds to what is the main subject of his book, the description of actual mineral structures. Aided by a large number of excellently drawn figures, he discusses in turn the elements, halides, sulphides, arsenides and related compounds, oxides, oxygen salts and silicates, thus adhering to the traditional sequence followed in mineralogical text-books. It is obvious that the description of the silicate group, comprising as it does by far the most important minerals, must occupy most space. Actually, about half the book is devoted to their structures, and the introduction to this chapter shows clearly that X-ray data have furnished quite new principles for the classification of the minerals concerned. The author makes it clear that the various types of silicon-oxygen framework in the silicates are due to a linking of the tetrahedral silicon-oxygen groups which resembles polymerization, and accordingly subdivides the silicates into the following classes: silicates containing separate SiO_4 groups, aluminosilicates, structures containing

complex silicon-oxygen groups, pyroxene and amphibol groups with silicon-oxygen chains, mica and clay groups with sheets of linked silicon-oxygen tetrahedra, a felspar group with a silicon-aluminium-oxygen framework, zeolite, and other framework structures with acid radicals or molecules of water or other compounds in the cavities. This enumeration alone suffices to show how great the changes are which have been introduced into our conceptions of silicate chemistry by the use of X-rays, and it is a remarkable fact that idealized atomic arrangements can already be given for nearly all the important rock-forming minerals such as the plagioclases, alkali-felspars, feldspatoids, micas, amphibols, pyroxenes, zeolites, and of olivine, garnet, chlorite, talc, kaolin, vesuvianite, melilite, titanite, cyanite, sillimanite, andalusite, staurolite, etc.

In some of these silicates, hydroxyl groups are present as well as the aluminosilicate anions, and an important part is played not only by the silicon-aluminium-oxygen arrangement, but also by octahedral units with Al, Mg, Fe, Ti, etc. as co-ordination centres and O, OH or F grouped around them. A somewhat more detailed consideration of these circumstances might, perhaps, have been the starting-point for a stricter systematic arrangement of silicate structures. It is clear, however, that Prof. Bragg's book can offer only the foundation for a mineral chemistry based on crystal structure. Of many problems, such as the limits of isomorphic replacement in relation to structural types, the variation in composition of many minerals, the limits of stability of various structures, their possible deformations, etc., which to the mineralogist appear of fundamental importance, he can give but brief indications. The many new problems which present themselves in these connexions can only be solved by the united efforts of analytical-chemical, paragenetic and structural investigations. The relations which exist between structure on one hand and morphology, cleavage, twinning, etc., on the other, have not been neglected by Prof. Bragg, though it was not, of course, his intention to enter very deeply into these subjects. It may be said, however, that such excursions as he does make into these side-issues are admirably adapted to remind the mineralogist that a thorough knowledge of atomic arrangements is a fundamental necessity for the solution of his major problems.

Taken as a whole, the book provides a typical example of modern trends of development in the field of natural science. The barriers which formerly existed between the various branches

have fallen, and subjects such as the nature of matter, the structure and grouping of atoms, etc., have come to be of equal interest to astronomy, physics, chemistry, mineralogy and biology. Each of these has its own part to contribute towards the

solution of common problems. Mineralogists are greatly indebted to the physicist whose book does so much to place mineral chemistry on a new foundation.

P. NIGGLI.

Lomonosov and Early Science in Russia

Trudy M. V. Lomonosova po Fizike i Chimii By B. N. Menshutkin. Pp. 537 + 5 plates. (Moscow and Leningrad: Izdatelstvo Akademii Nauk SSSR, 1936.) 13 rub. (In Russian.)

M. V. LOMONOSOV (1711-1765), the first Russian man of science, has often been described by his fellow-countrymen as a 'Samorodok', a word meaning 'nugget'. This translation, however, does not convey quite the meaning which Russians attach to 'Samorodok'. It actually conveys something "of a spontaneous nature coming to life without an external incitement".

To realize what an exceptional man Lomonosov was, one has only to refer to the history of the Russia of two centuries ago. Peter the Great was putting the finishing touches to gigantic reforms and "hacking the window" in the wall surrounding dark Russia. One of the new institutions established by the Tsar was the Academy of Sciences, in which Lomonosov was to lay the foundation stone of Russian experimental science.

Prof. Menshutkin's book on Lomonosov's achievements in physics and chemistry has been the work, with some unavoidable interruptions, of some thirty years. It presents a summary of many manuscripts found in the rich archives of the Academy of Sciences of the U.S.S.R. and of many other documents relating to this Russian man of science, discovered among the papers in various State institutions. As many of the "Discourses" and "Dissertations" of Lomonosov were originally written in Latin, Prof. Menshutkin has translated them into Russian, giving very interesting explanations and, whenever necessary, commentaries, adding to this most valuable material numerous notes on contemporary men of science with whom Lomonosov came in contact in Russia and abroad.

In his preface to the book, Prof. Menshutkin remarks that one cannot realize the full significance of Lomonosov in the history of the Russian science unless one knows something about the life of the great man.

Lomonosov was born in 1711 of peasant parents in a village, some hundred miles away from the White Sea. Already in 1723 we find his signature appended to certain village documents which he signed on behalf of his illiterate relatives. At that

time, we learn, he read psalms in the church and knew by heart a score of books available in the village. At the age of nineteen years, in 1730, he went to Moscow to study at the Academy, a school conducted by the monks of a monastery. There he distinguished himself, and in 1736 was sent with other young students to the Academy of Sciences founded by Peter the Great (1725) in St. Petersburg. It happened that the Academy was requiring "an experienced chemist with knowledge of mining" to be sent to Kamchatka. As no such man was available in Russia, it was decided to send three Russians to Germany to acquire the necessary knowledge. Among these three was young Lomonosov.

His first place of study was Marburg, where he worked under Prof. Chr. Wolfe. Lomonosov spent five years abroad, and upon his return to St. Petersburg submitted to the Academy several dissertations, among which was one on an optical instrument invented by him, as well as several other works: "On Silver and Mercury", "Elements of Mathematical Chemistry". One of the theses of the latter was "Chemistry—the Science of Substitutions taking Place in a Compound Substance". This paper, says Prof. Menshutkin, shows Lomonosov's great ability in handling a complex theory and demonstrates the vast amount of general knowledge and facts acquired by him in the University of Marburg under the guidance of Wolfe.

The learned administration of the Academy was very favourably impressed by Lomonosov's dissertations, and he was soon appointed junior professor at the Academy. His next contribution was a translation of Wolfe's experimental physics, a work done, according to Prof. Menshutkin, in a most brilliant way. No Russian scientific vocabulary existed at that time, and Lomonosov had to create new words and expressions, many of which are still being used in Russia.

In response to Lomonosov's request, funds were granted for erecting a laboratory, where he pursued researches on most varied subjects. One of them was a theory of atmospheric electricity. A machine "Thunder Machine", was built and experimented with, and one day his colleague, the academiciar Prof. Richman, was killed by an electrical discharge from it. However, a few months later

Lomonosov read at a meeting of the Academy, to commemorate the untimely death of Richman, a paper on "Aerial Phenomena due to Electricity".

Lomonosov was strongly under the influence of the then widely discussed corpuscular theory of matter. On his return to Russia, he devoted himself seriously to the development of this theory. All his dissertations and discourses bear witness to that, and throughout all his works we find the same familiar theme. While propounding the corpuscular theory, Lomonosov, however, submitted it to an original and constructive criticism. The *Proceedings of the Academy of Sciences* of 1744 contain an elaborately prepared dissertation "On Inanimate Physical Corpuscles forming Part of Bodies, in which Sufficient of the Peculiar Rudiments of the Whole Body is Enclosed".

Heat as a complex molecular motion was the next theory Lomonosov brought to the notice of his learned colleagues. It had an indifferent reception, and he was criticized for his irreverent treatment of Boyle. The study of the elasticity of the air, of its composition, hydrodynamics, etc., followed as a logical sequence to Lomonosov's work on the corpuscular theory. A dissertation "On the Origin of Light and a New Theory of Colours" was presented to the Academy in 1756. His work "On the Ratio between the Quantity of Matter and Weight" was discussed at the Academy the same year. After these followed:

"On Solid and Liquid Bodies", "On the Action of Chemical Solvents", "The Nitre", etc.

The profoundly scientific treatment of any subject under discussion, Prof. Menshutkin says, is the main characteristic of all Lomonosov's works; for Lomonosov, chemistry was a pure science and not an art. "It is curious to note", remarks Lomonosov himself in his preface to the translation of Wolfe's "Physics", "how little attention learned men pay nowadays to the ideas born in their own heads, and strive more and more to make deductions from the results of experiments".

Lomonosov was a great experimenter and brilliant theorist. His work on physical chemistry, envisaged in the light of the history of science and of the contemporary achievements in this domain loses none of its interest and originality. A comparison of Lomonosov with Mendeléeff at once suggests itself, says Prof. Menshutkin. They both show a remarkable similarity of their genius. Both were physical chemists, whose interest centred chiefly in a particular class of research—that of solvents. Both adopted a serene philosophical attitude in their teaching, and yet both remained practical workers; throughout their lives Lomonosov and Mendeléeff remained great Russian patriots endeavouring to bring scientific conquests within the reach of their Fatherland. "Lomonosov was the Mendeléeff of the eighteenth century, and they were both Titans of Science". S. S. IVANOFF.

Scientific Study of Folk-Lore

Volkstumsatlas von Niedersachsen

Von Wilhelm Peseler. (Veröffentlichungen der Historischen Kommission für Hannover, Braunschweig, Schaumburg-Lippe und Bremen, 14). Lief. 1. Pp. 20 + 8 maps. Lief. 2. Pp. 12 + 5 maps. (Braunschweig: Georg Westermann, 1933, 1936).

FOLK-history is beginning to supplement the accounts of Church and State which have hitherto been our guide to the past. The thoughts, customs and actions of a people are, indeed, the most reliable index to their state of culture, and a true understanding of any race can scarcely be obtained without a knowledge of its folk-lore. Dr. Wilhelm Peseler is writing the folk-history of Lower Saxony, the province of Germany between the lower parts of the Rivers Ems and Elbe, with Hanover as its principal city, and the publications under notice represent a contribution to the personal and agricultural customs of the province. A series of large, detailed maps shows the distribution of methods of yoking draught oxen, the

stooking of rye, the use of children's cradles, and even of less tangible affairs, such as the charming (*Besprechen*) of ailments, the most suitable days for marriage, and belief in luck. An explanatory text accompanies each map, and provides illuminating information. Charming of ailments, for example, thereby appears as a practical psychology of medicine rather than a survival of archaic custom. The information has been gathered together as the result of a large number of questionnaires sent to about 1,800 people in all parts of the province, and is part of a more comprehensive scheme fostered by the *Notgemeinschaft der deutschen Wissenschaft*. The "Volkstumsatlas von Niedersachsen" is published under the aegis of the *Historische Kommission zu Hannover*.

Results portrayed on the maps sometimes show well-marked divisions of ideas and interests in various parts of the province. Methods of stooking rye, for example, exhibit sharp variation by districts. There is, however, strong support to be gained for the view that man is not largely

dominated by his environment. Given a set of ideas which satisfy his reason, he will hold them and put them into practice, without undue reference to geographical surroundings. This is seen more on the maps relating to folk customs than on those which refer to agricultural practice, though the latter sometimes exhibit the same phenomenon.

Dr. Pessler is to be congratulated upon the artistry of his maps, the scholarly nature of the text, and the completeness of his investigation. The human appeal of such studies in folk-lore finds a strong expression in the Niedersächsisches Volkstummuseum at Hanover, of which Dr. Pessler is director. A number of exhibits, particularly of houses, are presented there with a

reality which commends itself to remembrance. Some re-erected houses and rooms are quite open to the visitor, who can thus make a quiet excursion into a different historical environment, whilst a extensive series of models interprets the development of farm-houses in Lower Saxony. Dr. Pessler has also written many papers upon this aspect of folk-lore. Mention may be made of "Harze Häuser" (*Monatsschrift für Kultur- und Heimatpflege Niedersachsen*, Jan. 1937), which is a study of house architecture and types of dwellings in the Harz mountains, and "Das Niedersächsisch Bauernhaus", a study of the development of farm houses in Lower Saxony (from the Niedersächsisches Volkstummuseum, Hannover, 1936).

J. G.

A Census of Periodicals

Union Catalogue of the Periodical Publications in the University Libraries of the British Isles, with their respective Holdings, excluding Titles in the World List of Scientific Periodicals, 1934. Compiled on behalf of the Joint Standing Committee on Library Co-operation by Marion G. Roupell. Pp. xii+712. (London: National Central Library, 1937.) 52s. 6d.

THIS publication provides for the first time a list of periodicals both humanistic and scientific, English and foreign, whether still appearing or not, so far as they were possessed by the library of any university or university institution in the British Isles at the end of December 1935, but excluding those published in the years 1900-33, and referred to in the "World List of Scientific Periodicals".

The term 'university institution' has been interpreted broadly, since the libraries of the Lister Institute, the Rothamsted Experimental Station and the Pharmaceutical Society are among those included.

23,115 different periodicals are listed with full particulars of the original title and all subsequent changes, volume numbers, dates and places of publication. In addition, the same alphabetical sequence includes some 32,000 cross-references from all changes of title, and from the various bodies responsible for publication. With the help of these informative cross-references, research workers faced with an unknown abbreviation, or knowing only the name of the publishing body, will rapidly find the necessary clue.

To test the accuracy of the work, a number of publications were looked for which were known to be obscure and difficult to trace, and in every instance the quarry was tracked with extreme ease.

Whilst the work will be of particular value to workers in fields other than scientific, it will also be of considerable use to scientific investigators containing as it does those periodicals which lived and died prior to 1900, or came into being after 1933, and thus do not come within the scope of the "World List".

Of a necessity the editors have had to exclude certain weekly periodicals, if only to prevent the work becoming unwieldy, but the method of discrimination is not very obvious in cases such as the *Athenaeum*, which is omitted, whilst the *Academy* is retained. This, however, is a minor detail, and does not detract from the extreme usefulness of the work.

The preface contains an expression of belief that the volume will be of service to libraries in revising their own buying of periodicals, etc., but it is much to be hoped that should any process of 'weeding' be indulged in, those responsible will consult the Joint Standing Committee before taking definite action. Otherwise two libraries may each dispose of a rare set on the grounds that it is possessed by the other, as has already occurred since the publication of the "World List".

The Catalogue has been compiled under the direction of a distinguished editorial board, whilst the trustees of the Carnegie United Kingdom Trust have generously rendered financial assistance both in compilation and in publication. All concerned are to be heartily congratulated upon having produced a great census and directory of the wealth of periodicals contained in the university libraries of the British Isles, which at the same time constitutes a bibliographical list of permanent value.

F. W. CLIFFORD.

Rapports sur la photoluminescence présentés à la réunion Internationale de Photoluminescence, Varsovie, 20-25 Mai 1936

Publiées par la Société Polonaise de Physique sous la rédaction de Prof. Dr. S. Pieńkowski et Dr. W. Kapuściński. (Vol. 5 des *Acta Physica Polonica*.) Pp. ix + 431. (Wilno: *Acta Physica Polonica*, 1936.)

THE first International Conference on Photoluminescence, which was held at Warsaw in May last year, was presided over by Prof. P. Pringsheim and attended by many eminent European physicists. It served to bring to the forefront the important scientific results which the subject is at present yielding. Some twenty-seven papers on the various aspects of phosphorescence and fluorescence were presented. They have now been published by the Polish Physical Society in the volume under notice.

It is only possible to mention here a few of the interesting topics which came up for discussion. Among the papers dealing with the line fluorescence of atoms, that by W. Hanle is of considerable importance as it deals with the influence of electric and magnetic fields on the polarization of resonance fluorescence. This constitutes one of the main methods of measuring the lifetime of an excited atomic state. The continuous absorption and fluorescence of van der Waals' molecules (as formed, for example, from an excited mercury atom with a rare gas atom) is treated by W. Finkelburg. The interesting paper by V. Kondratjew on the luminescent emission of flames discusses very clearly the difference between thermoluminescence and chemiluminescence as revealed in their respective behaviour towards quenching by foreign molecules. A number of papers are devoted to fluorescent, phosphorescent and predissociation phenomena in the gaseous state. Another section deals with these phenomena in solution and in the adsorbed state. Finally coming to the rare earth phosphors and R. W. Pohl the absorption spectra of the alkali halide crystals.

While most of the papers are in the nature of reports summarizing the work of the different authors in their respective fields, they also contain original material, and the discussions following each paper contain valuable contributions to the subject.

W. C. PRICE.

The Biochemistry of the Lipids

By Dr. Henry B. Bull. Pp. ix + 169. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

WHEN an author apologizes so profusely as does Dr. Bull for writing a book on a particular subject, the reviewer is to a great extent disarmed. There are, however, several comments which may be made for the purpose of general information.

As usual in a text-book on a specialized part of biochemistry, terminology is discussed, since the leading workers in this field are still not agreed among themselves. British workers have generally adopted the classification proposed by Dr. Smedley-Maclean, who has herself made so many notable contributions in this field. "Lipides" may be confused with "lipins",

and both these words together with "lipoids" generally signify substances of a fat-like nature yielding on hydrolysis fatty acids or derivatives of fatty acids, and containing in their molecule either nitrogen or nitrogen and phosphorus. This is the well-known and generally accepted definition given by Maclean and Maclean. Some confusion may therefore arise since "lipids" as used by the author signifies not only the above substances but also the simple fats and waxes and even the sterols.

The author has therefore aimed at comprehensiveness rather than completeness and has supplemented his description of individual substances by a detailed bibliography. The treatment of the fatty acids and the soaps is especially good and up to date, but the treatment of other classes of the "lipids" suffers considerably by the severe condensation.

An unusual formula is given, without comment, for sphingosine and consequently for sphingomyelin, but, apart from this, the book forms a good if rather hurried introduction to an important class of biochemical substances on which much investigation is being made.

C. S. G.

Les plantes alimentaires chez tous les peuples et à travers les âges:

histoire, utilisation, culture. Vol. 4: Les plantes à boissons. Par Prof. D. Bois. (*Encyclopédie biologique*, Vol. 17.) Pp. iv + 601. (Paris: Paul Lechevalier, 1937.) 120 francs.

THIS volume of the "Encyclopédie Biologique" deals entirely with those plants that are used by man in various parts of the world for preparing beverages. All the more important species are dealt with, but those regarded as purely medicinal are omitted. They are arranged in three main categories—plants yielding alcoholic beverages such as wine, beer, cider, perry and distilled spirits; non-alcoholic drinks such as fruit syrups obtained by expression, and aromatic, non-alcoholic beverages, made by infusion or decoction, such as tea, coffee and cocoa. As might be expected in a work of this sort emanating from France, the grape and its numerous beverages receive detailed attention. Brief descriptions of all the leading varieties of wine grape, including synonyms, are given. Among the beverages of the tropics are the various palm wines or toddy and the spirits they yield (arack), also the spirits and native beers prepared from millets and other cereals. Maté or Paraguay tea and guarana, so well known in South America, are fully discussed. No fewer than eighty substitutes for ordinary tea are given and twenty for coffee.

A good deal of useful historical information and facts not usually recorded appear within the pages of the book. It is interesting to read, for example, that the flowers of the Indian 'mahua' tree, *Madhuca latifolia* (syn. *Bassia latifolia*), used in India for sweetening and making fermented liquors, were imported into France in 1880 to the extent of 400,000 kilogrammes for the manufacture of alcohol. Their importation and use in this manner, however, was afterwards banned by the French Government.

Indiana

By Prof. Dr. Leonhard Schultze Jena. 1: *Leben, Glaube und Sprache der Quiché von Guatemala*. Pp. xii+304+24 plates. 34 gold marks. 2: *Mythen in der Muttersprache der Pipil von Izalco in El Salvador*. Pp. xii+364+12 plates. 32 gold marks. (Jena: Gustav Fischer, 1933 and 1935.)

THESE two volumes give a detailed and comprehensive account of the social and religious life of the natives of the Quiché tribe of Guatemala and the Pipil of Salvador. Though collected in modern times, the legends and observances are obviously survivals from the early days when the great cultural development of the Maya peoples gave rise to the most spectacular architectural achievements of the aboriginal American.

The author collected his information in the native idiom, which is given in full, with a translation into German on the opposite pages. Chapters dealing with the languages, and grammatical notes and full vocabularies complete a work which will be essential not only to all students of early American culture but also to those who specialize in sociology or linguistics. The account of the Maya peoples recorded by the early Spanish chroniclers, notably Landa and Cogolludo, and the native traditions preserved in the Popol Vuh and the books of Chilán Balam will probably be easier of interpretation when re-read in the light of Dr. Schultze Jena's detailed account of surviving belief and practice.

The author has put forward no far-reaching theories, but has simply placed a vast material in the most admirable form, at the disposal of anthropological students. From this point of view, his two volumes constitute one of the most notable contributions to American sociology, and also archaeology, produced in recent years. The volumes are admirably illustrated with photographs of native physical types, scenery and archaeological sites. A short bibliography is appended to each volume.

T. A. J.

Exposés de génétique

2: *L'Effet de position et la théorie de l'hérédité*. Par Prof. Th. Dobzhansky. (*Actualités scientifiques et industrielles*, 410.) Pp. 38. (Paris: Hermann et Cie., 1936.) 12 francs.

BEGINNING with a short statement of corpuscular theories of the germ-plasm, the author classifies chromosomal aberrations into changes of (a) the number of chromosomes, (b) the number of genes in a chromosome, (c) the linear order of the genes. The bar-eye gene of *Drosophila* is then discussed on the basis of gene duplication. Other topics considered are (1) the relation between a chromosome break and the dominance of the neighbouring genes, (2) visible mutations appearing at the point of breakage, and (3) reversibility of the position effect. It is concluded that the existence of a position effect is proved. The functioning of a gene is therefore determined not only by its own structure but also by that of neighbouring genes. A gene can therefore be modified by its transfer to a new position, and the position effect can be used in order to investigate the first stages of the action of a gene in development.

What is Osteopathy?

By Drs. Charles Hill and H. A. Clegg. Pp. xix+217+8 plates. (London: J. M. Dent and Sons, Ltd., 1937.) 7s. 6d. net.

THIS is a searching and pitiless exposure of the claims of osteopathy. The first five chapters deal with the life, theories and practice of Andrew Taylor Still (1828-1917), the founder of osteopathy. His inventive power, we are told, far outstripped any scientific discretion he may have possessed, while the evidence that he possessed any at all is scanty. Modern osteopaths, whose theory and practice are examined in the rest of the work, have done nothing to justify their claim for State registration. Their advanced text-books show, it is said, lack of knowledge of the facts of anatomy and physiology as well as a complete absence of scientific evidence in support of their contentions.

The fundamental doctrine of osteopathy, that the predisposing cause of 90 per cent of disease is nothing more or less than a strained joint, is in no department of medicine more obviously false than in that of infectious disease, nor is there any support for such a view in the case of other disorders. While the authors do not deny that osteopathic manipulations may do good in certain conditions which respond to manipulative treatment in the skilled hands of manipulative surgeons, they maintain that no patient should have such treatment until his condition has been correctly diagnosed, and that a correct diagnosis is not likely to be made by one who has not had a thorough medical training.

The Road to Oxiana

By Robert Byron. Pp. ix+341+16 plates. London: Macmillan and Co., Ltd., 1937.) 10s. 6d. net.

SUPERFICIALLY, telephone and motor-car may seem to have transformed travel in inner Asia, but all they have done is to speed it up—in some ways only. Fundamentally it remains the same, especially where the human factor acts as grit in the machinery. Hence Mr. Byron failed to reach the Oxus—the objective of his journey. In this journal of travel in the Middle East, the villain of the piece, though not in the final obstruction, is "Mr. Marjoribanks", a synonym for the ruler of Persia, though perhaps this name ought to be interpreted as a generic term for all the many incongruities, restrictions and uncongenial elements which the author encountered in the 'modernized' life of the country. In Afghanistan and among its people Mr. Byron was much more at home, even though political exigencies were invoked to debar him from the riverine frontier of Turkestan. International policy and the British Foreign Office receive treatment which the author considers their due.

This lively and entertaining record of personal experiences—in Palestine and Syria as well as in Persia and Afghanistan—is varied by excellent appreciative notes on the architectural features of the more important historical monuments. These are illustrated by a number of photographs which are both beautiful and informative.

The Seventeenth International Geological Congress

"Science is called Science just because it recognises no fetishes, and does not fear to raise its hand against everything that is obsolete and dying, and attentively listens to the voice of Experience, of Practice."—STALIN.

THE decision made at Washington, D.C., in 1933, accepting the invitation of the Government of the U.S.S.R. to hold the seventeenth International Geological Congress in Russia, was received with pleasure by geologists all over the world; and, as a consequence, the meetings at Moscow and Leningrad, which began on July 21 last, were well attended from abroad. The preparations were on a scale that has rarely, if ever, been exceeded, and every opportunity was given to foreign geologists to appreciate the resources of the Union, and the work that had been accomplished by Russian research workers.

The general attitude towards science, in Russia, is clearly exemplified in the quotation from Stalin that heads this article—a quotation that was translated into all the official languages of the Congress, and displayed on each side of the rostrum in the general meeting room. But the attitude towards, and intense interest in, geology, in particular, had to be experienced to be believed; and contrasted most strikingly with the general lack of knowledge in Great Britain of what that science is doing, and has done, for the nation. Geology, to the Russian, stands not merely for the means by which the natural mineral resources of his country may be explored, but also for the means by which his mind can be enlarged beyond the possibilities offered by other sciences. It was not surprising, therefore, to learn that there were about eight hundred Russian members of the Congress.

The language difficulties were overcome in a most excellent manner; for the general meeting room—the Moscow State Conservatory—was fitted up with head-phones, so that the delegates could receive a running translation of the speech of the particular delegate at the rostrum in any of the official languages of the Congress. Some difficulties certainly arose, for the interpreters were not all technical experts, but the ease with which the great bulk of the communications could be followed was remarkable. In the several sectional meeting rooms, official interpreters gave similar services, though the results were not usually so effective. Nevertheless, these services made the Congress a memorable one by relieving the strain

of following papers in foreign languages, and so rendering the meeting more interesting and enjoyable.

The programme for the Congress consisted of some ten major topics; and, of these, the opening meeting considered the problems of petroleum and the world resources of this material. A paper by the president, Dr. I. M. Goubkin, on the estimation of the oil resources of the U.S.S.R., opened the discussions. Subsequent papers covered the several suggested modes of origin of petroleum in the oil fields of the world; and estimates of oil resources in many areas were presented. Criticism of the figures given for potential supplies was not wanting, but the consensus of opinion tended to a less pessimistic view of the world situation, though quite recognizing that the resources were being rapidly dissipated. Theories of oil production from vegetable and animal matter by bacterial action, from methane by ionization produced by radioactive elements, from coal and oil shale by destructive distillation due to volcanic action, were all advocated as possible modes of origin of petroleum; but the bulk of the communications centred round the tectonics of the several fields described.

The geology of coalfields introduced fewer speculative topics. Again, however, the geological surveying of fields, and the determination of hidden fields in the U.S.S.R., constituted the main themes of the communications; in addition, coalfields in Japan, French Morocco and other regions were described. Methods of correlation of coal seams, and especially the most recent that depend on the examination of the spores and pollen in the individual coal beds, were illustrated by several papers. A particularly interesting communication discussed the structures of anthracites as shown in polarized light. The method had been first proposed by the Chinese geologist Si.

The mineral resources of the U.S.S.R. were still further delineated in the communications relating to Pre-Cambrian rocks, and ore deposits in other formations. These ranged throughout the whole territory of the State, from the Kola peninsula to farthest Siberia, from the Caucasus to the Arctic. While some of these resources have been known for many years, new deposits have come to light during the past two decades, and some of these were very striking. Of special interest to the microscopist was the discovery, in Siberia, of large crystals of optically clear fluor spar. Some of the crystals were cubes with an edge length of

from 4 to 6 inches. They are the largest crystals of colourless fluor spar which have ever been found.

Historically, the geological formation most closely associated with Russia is the Permian System. It is little wonder that problems relating to these rocks should have constituted a considerable part of the proceedings; and, among the most striking of the exhibits arranged for the Congress was a gallery in the Palaeozoological Institute of the Academy of Sciences, Moscow, containing the mounted skeletons of herbivorous and carnivorous Pareiasaurians from Permian strata. In *Inostrancevia*, the Pareiasaurian equivalent of *Smilodon* (the sabre-toothed tiger from Pleistocene deposits), there is an example of parallel development that could scarcely be bettered in the whole palaeontological record. The teeth of this carnivore attained a length of 10 inches in the specimens on exhibit. This whole exhibit rivals that of the *Smilodon* Gallery in the Museum at Los Angeles, California.

No less striking and fascinating was the exhibit of the Pleistocene mammoth and the woolly rhinoceros in the Zoological Museum at Leningrad. It was common knowledge to geologists that this unique exhibit was to be seen at Leningrad; but it was not known to the majority of the excellent guide-lecturers provided by the Intourist agency at Leningrad. There was some amusing consternation when the suggestions of trips to the Hermitage, the Winter Palace, Peter and Paul Fortress, etc., were emphatically rejected by the visiting geologists, and equally emphatic demands to see 'The Mammoth' were made in every language available to the delegates. The guides were distinctly nonplussed for the moment; but the position was soon straightened out and the pilgrimage to 'The Mammoth' organized.

University departments in geology, in Leningrad and Moscow, were also made available for visits, and among these the Fedorovsky Institute of Economic Mineralogy at Moscow afforded an excellent example of the teaching facilities, and apparatus, available for the Russian mineralogist. The Institute contains probably the most complete and up-to-date range of instruments for mineral research in the world. Prof. Fedorovsky and his assistants demonstrated the methods and technique to parties of those interested. In making mention of this Institute it must not be forgotten that all the other museums were equally generous in affording facilities for the visiting geologists; but it happens that Prof. Fedorovsky was a personal friend of the author of this article, and hence the latter was specially interested in that department. Indeed, it is no exaggeration to say that the preparations made at these several

museums and institutes far exceeded those made for any former International Geological Congress. The preparations were nation-wide, and specimens brought from practically every district of the U.S.S.R.; certainly from every part where specimens of geological interest could be obtained.

Mention must be made of the many social entertainments organized for the Congress. The banquet in the Kremlin, given by the Government, and attended by many of the chief officers of the State, will always remain the central social event of the Congress: but no less memorable were those given by the Academy of Sciences; the Soviet Committees of Moscow and Leningrad; and the Society of Cultural Relations with Foreign Countries. Nor must the numerous banquets organized for the entertainment of the participants on the several excursions be omitted. Wherever these excursions were held, unstinted kindness was lavished on the members of the Congress. Banners of welcome were made ready and displayed; and invitations freely given to visit local places likely to be of interest. A banquet generally terminated the proceedings.

On the excursion to Novaya Zemlya the Soviet Committees of Archangel and Tuloma (near Murmansk) arranged visits and banquets at which the writer was present; even at the wireless stations and settlements in Novaya Zemlya, that far-flung outpost of the U.S.S.R., such entertainments as were possible were arranged.

When one considers the enormous strides that Russian geological science has made during the present regime, it is little wonder if a note of laudation of that regime was evident; and, while political fervour sometimes became prominent, and a little disconcerting to people unaccustomed to such, the reasons for the enthusiasm could easily be understood.

Among the most important of the activities of the International Geological Congress are the excursions. Five were arranged before the Congress and five took place at the close. It was, of course, impossible to attend more than two of these; but for many members only one could be managed in the time available. The writer selected the excursion to Novaya Zemlya, and has had no reason to regret his choice. The party was accommodated on the Soviet steamship *Vologda*; and the navigation around these two islands without adequate charts—for we put into uncharted inlets where places of geological interest occurred—was a tremendous triumph of seamanship on the part of the captain and crew of the vessel. Fortunately, the weather was unusually propitious, and a most ambitious programme completed with practically no alteration, despite the preliminary notice that

the excursion might have to be curtailed. Far from that being the case, it was actually augmented by visits to additional places. The leader, Prof. S. V. Obruchev, was ably assisted by several other members of the Arctic Institute, Leningrad, and by official interpreters. The Lower Palaeozoic rocks of this Arctic province were examined, and collections of the most common rocks and fossils were made. The glaciers of the region furnished opportunities of studying many problems of ice-action; while intrusions of acid and basic igneous magma gave scope to those more interested in petrology.

The other excursions were doubtless as interesting, but the writer can only touch on the one he attended.

In conclusion, a word of congratulation must be accorded to the authors and editors of the twenty-five guide books for the excursions, and

the beautiful geological map of the U.S.S.R. on the scale 1 : 5,000,000. The former were published in Russian, French and English, and represent an amount of organization, preparation and editing never before attempted for a geological congress. The map, also, is an achievement that cannot be too highly praised.

Taken all in all, the Congress will be a memorable one for those who took part in it, and the *Comptes rendus*, and other publications, will show those unable to attend the enormous amount of work that has been done, in recent years, in every branch of geology by our Russian colleagues.

It was agreed at the close of the Congress to accept the invitation to hold the Eighteenth Congress in Great Britain; and already steps have been made by the Geological Society for the meetings to be held in London in 1940. W. T. GORDON.

Planning the Land of Britain

APPARENTLY for the first time in the course of its hundred and six years of existence, no fewer than seven sections of the British Association united in a joint discussion on the last evening of the recent Nottingham meeting. The subject was "Planning the Land of Britain" and the chairman was Lord Trent. Symposium would be a more apt description than discussion, for there was no time for any discussion after the seven sectional representatives had each delivered his contribution. The result, however, was instructive; it became very clear that each of the sciences has a definite contribution to make to the general problem, but that there is a considerable divergence both in point of view and objective—differences which point the need for further discussion.

Dr. L. Dudley Stamp, director of the Land Utilization Survey of Britain, in his opening paper, attempted to stress some of the fundamental considerations underlying planning. In the first place, any planning must start from the present position, for the present utilization of the surface of Britain is the result of two or three thousand years of settlement, of a long-continued process of discovery by trial and error and of the play and interplay of a variety of factors. The isolation and intensive study of those factors must surely be the first requirement, for any planning contrary to the dictates of long-term trends and natural controls must surely end in failure. In the first place, there are the *natural or geographical factors* of position and accessibility, physical build and geological structure, soil and climate, all of

which impose strict limitations on land use. They emphasize the essential contrasts between the predominantly moor-covered highland Britain of the north and west with pastoral, agricultural and industrial Britain of the south and east. Insufficient is known of Britain's soils, but the limited resources of first-class soil are certain. With the improvement of transport and communications, it is easy to supply even the remoter settlements with the needs of everyday life, so that there is no longer any necessity for the semi-subsistence type of agriculture so prevalent in the past—as with the Scottish crofter. Consequently the incidence of the natural factors in determining land use is greater than ever before. In the second place, the *historical factors* often result in a stabilizing of land use—many of the parks, forests and common lands so valued to-day for amenity reasons are legacies from days when the reasons for their creation were entirely different. In the third place, the *economic factors* are clearly the most important in determining changes within the limits permitted by natural factors. A study of a large number of parishes in different parts of Britain over a hundred years or more shows a remarkable stability of land use on the best land (arable farming) and on the poorest land (heathland or woodland), and a maximum change on land of intermediate quality.

The incidence of geological factors in planning is both direct and indirect. The direct influence of coalfields and ore deposits on industry and land use is obvious; so also is the negative influence of

great areas of hard ancient rock, but Prof. P. G. H. Boswell (Section C) was concerned to stress the important indirect influences, especially through water supply. If the geologist is concerned with factors which are omnipresent but static, the zoologist and botanist deal with factors which are essentially both ubiquitous and dynamic. It is quite impossible to preserve 'typical' tracts of Britain by isolating them as national parks. The vegetation which is the chief attraction of our chalk downland or our scrubby heathland is essentially ephemeral—all these seral communities will change rapidly to woodland unless deliberately preserved in their present form. On the other hand, the 'management' of woodland of necessity destroys the decaying timber, which is the home of a characteristic fauna and flora. Each case must be decided on its individual merits, and the detailed knowledge of the scientific worker is needed. There is a real danger in the preservation of small beauty spots in that the concentrated pressure of human population quickly destroys both flora and fauna. Prof. E. J. Salisbury and Dr. Julian Huxley were in obvious accord on these points, though the latter was also concerned with the provision of Nature reserves in remoter areas in which wild life could adapt itself to present or changing vegetation.

We are accustomed to associate the charm of rural England with its old and picturesque cottages, perhaps forgetting that the cottages would lose most of their charm if removed from the setting of the old cottage garden. Although gardens in aggregate only occupy some two per cent of the surface of Britain, their influence on the scenery and indeed on the whole life of the country is out of all proportion to this area. The 'standardization' of gardens may be more fatal than the standardization of rows of houses all alike, since it should be the function of the garden to provide both individuality and variety. Since most houses are on roads, this is the more important in that the traveller sees more of England's gardens than of any other aspect of land use for amenity purposes.

Sir Daniel Hall spoke as the protagonist of a depressed industry and he claimed that his 'depressed area'—the farming lands of Britain—occupied the bulk of the country. He clearly considered the modern trend to be to think too much of recreation and too little of the serious work of the countryside, though the hiker might have an important economic importance to the small farmer by his requests for accommodation and food. As he was leaving the platform, Sir Daniel threw the bomb of the evening amongst the audience when he claimed that the reorganization needed by agriculture could only be accomplished

with the State ownership of land. In a later letter to *The Times* (Sept. 24) he urges that although the farmer may know what best suits his land, it does not follow that he knows what best suits the national interest. The conditions in Fenland are such as to make this the area which, above all others in Britain, should be devoted to fruit and vegetables. Is it to the national interest that a quarter of the land should be, as it is at present, devoted to wheat, simply because the local farmer is encouraged by the wheat quota? Our leading agriculturists are clearly divided on the question of land ownership. Prof. R. G. Stapledon would agree with Sir Daniel, but many doubt whether there are sufficient numbers of experts of their calibre to direct a State-owned Britain. G. M. Young visualizes "Some Board of Experts, all fighting like cats, staffed by tired examinees aspiring to become successful officials".

Unfortunately for Britain, agriculture seems to have few contacts with forestry, nor has the forester been conspicuous in his regard for agriculture. Sir Roy Robinson expressed pride at the achievements of the Forestry Commission—the sole post-War plan to move steadily to its appointed goal. Sir Roy spoke rather as a dictator, and it may be that the widespread opposition to the work of the Commission from landowners, sportsmen and those who seek so conservatively to preserve the countryside as it is at present, is based on a hatred of a relentless prosecution of a most desirable and nationally important objective. But it bodes ill for the success of a national plan for agriculture or indeed for any single demand on the land. Surely it is co-operation which should be the keynote of any land planning.

No family has done more to develop and beautify the local city than has the family of Boot in Nottingham, and it was accordingly of interest to hear Lord Trent say that individual efforts have already done as much as possible, and that the next move is with the State. He was alive to the practical difficulties of planning, just as Prof. J. H. Jones as an economist was concerned to stress the wider and deeper aspects of planning and the difficulties involved. What is the object of planning? We cannot plan without being sure of our objective, and it must be decided whether the object of planning is social, economic or strategic. The planning of industry is identical with the planning of land, and this is a truth which it is hoped the Royal Commission on the Siting of Industry will not overlook. It is surely the duty of the scientific community to maintain a permanent committee amongst themselves and to present a considered, if not unanimous, opinion on all aspects of the land and its future. L. D. S.

A New Conception of Supraconductivity

By F. London, Institut Henri Poincaré, Paris

IN the past few years, physicists have been much engaged by the phenomenon of supraconductivity. It is well known that various metals, when cooled below a certain very low temperature, characteristic of the metal in question, show the strange property of conducting electricity apparently without offering any resistance to the current. This curious phenomenon seems to contradict all our customary conceptions in physics. Particularly striking was the experiment of Kamerlingh Onnes and Tuyn, in which a current was induced in a supraconducting ring of lead and was found to persist there without any measurable decrease for many hours—so long as the low temperature could be maintained. This experiment seems to present a unique case of motion without any friction, whilst we have been accustomed to see in every mechanism an occasion for dissipation of kinetic energy into heat.

1. Attempts have been made to explain this phenomenon by various mechanisms. But in all of them the same type of difficulty is always encountered. As in an ordinary conductor, so in a supraconductor, it seems necessary to imagine an enormous number of different electronic states corresponding to the infinite number of different currents possible in it, different as regards direction and intensity. But on the other hand, it seems very difficult to comprehend why in these states the motion of the electrons should not be damped, that is, why the electronic waves should not be dispersed. One would imagine that in any event the interaction with the ionic lattice would cause transitions between these numerous electronic states favouring the passage to states of less energy and less intensity of current. In a short time the irregularity of the thermal vibrations of the lattice should effect a complete dissipation of the initial current.

This difficulty still appeared aggravated when Bloch adduced a very general argument according to which the most stable state of a mechanism of electrons under rather general conditions cannot show any current if no external field is applied.

It can be said that all who have tried to construct a theoretical picture of a supraconductor have been completely baffled by this dilemma.

The new conception I have developed in different papers, partly in collaboration with H. London¹, differs essentially from the earlier attempts in so far as it exhibits the possibility of representing

all supercurrents realizable in a simply connected supraconductor by even one single electronic state alone; though to be sure, the presence of an external field has been found to be of fundamental importance.

A new experiment has given us the key to this possibility. Meissner and Ochsenfeld² found in 1933, that a supraconductor behaves not only like an ideal conductor, but in addition also like a very strongly diamagnetic metal. According to the Maxwell equations, an ideal conductor would not show any change of magnetic flux in its interior; this signifies that one should find, so to speak, 'frozen in', that magnetic field which was present at the moment when the supraconductivity was established. Meissner's experiment, however, has shown that in a supraconductor the magnetic flux is always equal to zero. It has been observed that those magnetic fields, present before the supraconductivity was established, are pushed out while the temperature is lowered below the transition point (provided the experiment is carried out under 'ideal' conditions; see further below).

According to Meissner's experiment, it looks as though the transition from the non-supraconducting to the supraconducting state in a magnetic field is *reversible*, so far as the magnetic flux can always be considered as equal to zero in any volume element in the supraconducting state *independently of the way* in which the transition temperature has been passed. That is quite different from the case of infinite conductivity. There the transition is not reversible and the supraconductor would show a kind of permanent memory of that magnetic field which was present when supraconductivity was last established. The point of view, that *the transition into the supraconducting state is a reversible phase transformation*, was already suggested by Rutgers and Gorter³, who, starting from this assumption of reversibility, derived certain thermodynamical relations between specific heat, magnetocaloric effect, etc., relations which have been verified in the meantime by many experimenters.

2. This state of affairs suggested an interpretation of supraconductivity which is entirely different from that which considers this phenomenon as a limiting case of ordinary conductivity. Though it is not possible to consider the diamagnetic phenomenon as a consequence of the infinite conductivity, the converse can to a certain extent be done.

A diamagnetic atom, as is well known, exhibits the possibility of permanent currents flowing in a system which is in its most stable state. These currents, indeed, do not appear except in the presence of a magnetic field, and that is precisely the reason why this mechanism is not covered by the theorem of Bloch mentioned above; for Bloch's theorem deals only with systems with no external field.

Let us for a moment consider the behaviour of a diamagnetic atom in a magnetic field. We may describe such an atom by the following properties:

(a) Its lowest state is not degenerate and belongs to the discontinuous spectrum. Its wave function is real.

(b) In a weak magnetic field h , the wave function ψ does not experience stronger perturbations than those proportional to the square of h or still higher powers of h :

$$\psi = \psi_0 + h^2 \psi_1; \quad (1)$$

where ψ_0 is the wave function for $h = 0$.

In the (non-relativistic) wave mechanics, the density of current j of an electron in the state ψ is known to be given by the formula:

$$j = \frac{he}{4\pi im} (\psi^* \text{grad } \psi - \psi \text{grad } \psi^*) - \frac{e^2}{mc} \psi \psi^* \mathbf{A} \quad (2)$$

where h , m , e , c are the well-known universal constants, ψ^* is the conjugate complex value of ψ and $\mathbf{A}$ is the vector potential of the magnetic field h ($h = \text{curl } \mathbf{A}$).

Substituting into this expression the above ψ of the diamagnetic atom, one obviously obtains as the greatest term, the only one proportional to the field strength:

$$j = - \frac{e^2}{mc} \psi_0^2 \mathbf{A} + \dots \quad (3)$$

All the other terms are of the order h^2 or still smaller. Calculating the moment of this current, one obtains the well-known expression for the induced diamagnetic moment of the atom.

It is perhaps of some interest to discuss in more detail how the diamagnetic atom succeeds in representing an *infinite number of currents* by one *single state*.

In a magnetic field the total momentum p of an electron is not simply proportional to the velocity v ; it is rather

$$p = mv + \frac{e}{c} \mathbf{A} \quad (4)$$

This formula can be considered as the supplement to the well-known analogous resolution of the energy into 'kinetic' plus 'potential' energy, and accordingly the two terms mv and $\frac{e}{c} \mathbf{A}$ are sometimes distinguished as 'kinetic' and 'potential' momentum.

The formula (2) for the current is obviously based on the corresponding resolution of the velocity v equivalent to (4):

$$v = \frac{1}{m} p - \frac{e}{mc} \mathbf{A} \quad (4')$$

For the term $(h/4\pi i) (\psi^* \text{grad } \psi - \psi \text{grad } \psi^*)$ in (2) represents the local density of the total momentum p in the state ψ . (This can easily be verified by putting, for example, a plane wave $e^{2\pi i x/\lambda}$ into this term.) It is a somewhat strange but quite characteristic feature of the wave-mechanical description that the wave-length of the de Broglie waves does correspond to the *total momentum* ($p = h/\lambda$) and *not to the kinetic momentum*, whereas the latter, being proportional to v , is attached to the current. (Correspondingly the frequency is known to be attached to the total energy ($E = h\nu$) and not to the kinetic energy.)

Now, owing to equation (1), in a diamagnetic atom the term $(h/4\pi i) (\psi^* \text{grad } \psi - \psi \text{grad } \psi^*)$ representing the mean total momentum p remains everywhere practically zero, even in a magnetic field. In this case the currents occurring are, so to speak, a kind of image of the actual magnetic field. The local kinetic momentum, that is, the local current, given by (3), is throughout equal but opposite to the local potential momentum, represented by the vector potential of the magnetic field, so that the sum of both, p , is everywhere zero. In such a manner a diamagnetic atom in its one lowest state can show an infinite variety of different currents corresponding to the infinite variety of orientations and intensities of the applied magnetic fields, whereas its wave function does not show any appreciable reaction.

This mechanism of conduction is entirely different from that considered in the customary theories of conductivity: the transport of electricity is *not* based, as usually, on *progressive waves* (or progressive wave packets), *but on stationary waves*. By these a transport of electricity can only be effected in the *presence of a magnetic field* and this is precisely our assertion as to the nature of the supracurrents.

3. Let us now assume that in a simply connected supraconducting metal there may be one or several discrete electronic states of the same properties (a) and (b) below the continuum of ordinary (Bloch-) states. Since in all these states by a given magnetic field practically the same current is evoked, the transitions between these states caused by the interaction with the lattice vibrations will effect no dissipation of the diamagnetic currents. This is exactly the mechanism by which the interaction with the nuclear vibrations in a diamagnetic molecule is prevented from effecting any dissipation of the diamagnetic currents evoked by an external magnetic field.

Thus for a supraconducting electron also we will suppose the same equation (3) to be valid:

$$\mathbf{j} = -\frac{e^2}{mc}\psi_s^2\mathbf{A};$$

where ψ_s^2 signifies the probability of finding this electron, which we will suppose to be practically constant throughout the metal. Summing over all electrons, we therefore obtain for the density of the total current:

$$\mathbf{J} = -\frac{e^2n}{mc}\mathbf{A} = -\frac{1}{\Lambda c}\mathbf{A} \quad (5)$$

where n signifies the number of supraconducting electrons per cm.³. $\Lambda = m/ne^2$ is a constant of the dimensions [sec.²] characteristic of the supraconductor in question. As $n < 10^{22}$, one obtains $\Lambda \geq 3.2 \times 10^{-22}$ sec.².

The vector potential not being uniquely defined has yet to be normalized in a definite way in order to obtain in (5) an unambiguous statement. We can, however, get rid of this ambiguity by forming the curl of (5) and obtain

$$\Lambda c \cdot \text{curl } \mathbf{J} = -\mathbf{h} \quad (6)$$

This is the fundamental macroscopic connexion between magnetic field $\mathbf{h}$ and current density $\mathbf{J}$ that we propose for the supraconducting state.

From our observations apropos of the diamagnetic atom, we may infer that in our model the notorious difficulties discussed above will not appear. Compared with the former conception of infinite conductivity the assumptions (a) and (b) certainly signify an appreciable *reduction* of the mechanism which remains to be explained by the theory of electrons. On the other hand, (a) and (b) form, of course, in no way a necessary basis of (6), and it is quite possible that the future development of the molecular theory will replace them by a still more reduced basis⁴.

4. In the following we shall discuss the *macroscopic description* furnished by (6). The currents which are admitted by this equation are very far from being identical with those which would correspond to an infinite conductivity. *The variety of possible currents is considerably more restricted* according to our interpretation, which admits *only currents, which are correlated in a very special manner with a magnetic field*. But it can be shown that it is really possible by just this restricted ensemble of currents to describe all the supracurrents which are actually observed.

Applying the Maxwell equation

$$c \cdot \text{curl } \mathbf{h} = \mathbf{J}, \quad (7)$$

(neglecting here the displacement current) we can eliminate $\mathbf{J}$ in (6) and (7) and get

$$c^2 \Delta \text{curl } \text{curl } \mathbf{h} = -\mathbf{h};$$

or since $\text{div } \mathbf{h} = 0$

$$c^2 \Delta \nabla^2 \mathbf{h} = \mathbf{h} \quad (8)$$

This equation indicates that the magnetic field decreases exponentially from the surface to the interior of the supraconductor, in this way representing the Meissner effect. As in a diamagnetic atom, the induced currents behave like a screen; their magnetic field tends to diminish the original field. In a distance of the order of magnitude $> c\sqrt{\Lambda} (> 10^{-4}$ cm.) the field can be considered as practically zero.

In Meissner's experiment, it is obviously the applied external magnetic field which evokes the supracurrent as soon as the supraconducting state is established. In the case of the permanent current in a ring (and also in the case of an open wire which is fed by normal conducting leads), the magnetic field which *maintains the current* proves to be *identical* with that which is *produced by the current* itself. The most stable state of a ring has no current, unless an external magnetic field is applied. To be sure, the states in which the ring possesses a permanent flux through its central hole, are not states of lowest energy but are *metastable under macroscopical conditions*: only by a *finite* variation of the macroscopic parameters of the system (for example, by passing the transition temperature or by cutting the ring open) can the ring be brought into the absolutely stable state which contains no flux.

To complete this theory it is necessary to add to (6) a further statement as to the behaviour of the electric field. In this regard the magnetic equation (6) as well as experience do not exclude a certain indeterminateness, and an experiment had, therefore, to be arranged in order to elucidate this point⁵. We cannot enter here into a detailed discussion of this question, and want only to state that as a result of this experiment the relation

$$\Delta \dot{\mathbf{J}} = \mathbf{e} \quad (9)$$

($\mathbf{e}$ being the electric field strength) seems now to be the most simple formulation of this supplementary electric equation. The electric fields possible according to (9) and (6) are reduced to just those which are inseparably attached by induction to the magnetic field. The equation (9) simply states that there are no other currents in the supraconductor than those which, according to (6), are evoked and maintained by the magnetic field.

It might be emphasized that our conception differs essentially from a description which has sometimes been given, according to which supraconductivity should be characterized by the particular value $\mu = 0$ of the magnetic permeability. Though for simply connected isolated supraconductors both formulations give macroscopically

identical results, they prove entirely different if one has to deal with superconducting rings.

The essential characteristic of our theory can be seen in the following: The same relation (6), between current and magnetic field, which represents the Meissner effect and which for simply connected superconductors is practically identical with the description $\mu = 0$, is able, moreover, to describe the distribution of the permanent currents in superconducting rings. The magnetic field of these rings, having a curl, requires, according to Maxwell's theory, the explicit introduction of the

macroscopic current. It cannot, of course, be described by a particular value of the magnetic permeability only.

¹ London, F. and H., *Physics*, 2, 341 (1935). London, F., *Proc. Roy. Soc., A*, 133, 24 (1935). Comprehensive report: "Une conception nouvelle de la supra-conductibilité", *Actualités scientifiques et industrielles* No. 458 (Hermann et Cie., Paris, 1937).

² Meissner, W., and Ochsenfeld, R., *Naturwissenschaften*, 21, 787 (1933); Meissner, W., and Heldenreich, T., *Phys. Z.*, 37, 449 (1936).

³ Appendix to Ehrenfest, P., *Lectures Comm. Suppl.*, 756 (1933). Gorter, G. J., *Arch. Mus. Taylor*, 7, 878 (1933).

⁴ London, F., *O.R.*, 205, 28 (1937).

⁵ London, H., *Proc. Roy. Soc., A*, 155, 103 (1936). See also v. Lame, M., London, F. and H., *Phys. Z.*, 36, 359 (1935). Schrodinger, E., *NATURE*, 137, 824 (1936).

[To be continued.]

Obituary Notices

Dr. J. R. Airey

DR. JOHN ROBINSON AIREY died in his seventieth year at his home in Newtown, Montgomeryshire, on September 16, after an illness lasting more than six months. He was a native of Leeds, where he received his early education at the Blenheim Council School and the Central High School. After serving as an assistant in the science department of the latter he was, from 1896 until 1903, a master at the Porth County School, Glamorganshire.

Airey's first degree was a London B.Sc. in 1894. In 1903 he interrupted his teaching work for three years, and went up to St. John's College, Cambridge, as a foundation scholar; he took first-class honours in both parts of the Natural Science Tripos, and was awarded the Wright Hocking and Hughes prizes. From 1906 until 1912 he was principal of Morley Secondary School, and from then until 1918 principal of the West Ham Technical Institute. In that year he became principal of the City of Leeds Training College, where he was held in very high esteem by all with whom he came into contact. On his retirement in 1933 he was presented by his old students with his portrait in oils, which he gave to the College. This was accompanied by an illuminated letter, from which may be quoted "You will live in our memories as a principal and a friend whose words were few and whose happy and kindly disposition shone out so brightly that even your reproofs were tinged with humour". Another friend described him as "a varray parfit gentil knight".

Airey became a D.Sc. of London in 1915, and in 1926 Cambridge conferred on him its coveted Sc.D. He will be best remembered in scientific circles for his work as a mathematician and computer, particularly in connexion with Bessel functions, in which he was deeply interested for thirty years. He became a member of the British Association Mathematical Tables Committee in 1911 and continued to serve uninterruptedly until his death; from 1918 until 1929 he held the office of secretary. His first published tables appeared in the report of this committee for 1911, and were of the so-called Neumann functions, which are related to the functions usually known as

Y functions or Bessel functions of the second kind; these tables were extended in 1913, 1914 and 1915.

The need for extensive tables of sines and cosines in radian measure to facilitate the rapid calculation of transcendental functions from their asymptotic expansions led Airey to prepare such tables. The first, in 1916, gave these functions to 11 decimals at interval 0.001 throughout the quadrant. 15-figure tables at varying intervals up to $x = 100$ appeared in the Reports for 1916, 1923, 1924 and 1928. These tables were reprinted, with some extensions, in volume 1 of the "British Association Mathematical Tables" in 1931, and are now widely used and appreciated by engineers and mathematical physicists. Since their publication Airey has prepared extensive manuscript tables to 13 decimals at interval 0.0001, but these have not yet been published.

It is not possible to enumerate all the tables computed by Airey of functions related to Bessel functions; a list of them occupies a page in the 1929 Report. It should, however, be mentioned that he made, in 1917, the first extensive calculations of what he called the Lommel-Weber function. Owing to war conditions they were not published until 1924, although mentioned in the reports of the two previous years; meanwhile similar figures appeared in Watson's "Theory of Bessel Functions" under the name of Struve function.

In 1918 Webb and Airey directed attention, in a paper in the *Philosophical Magazine*, to the importance of the confluent hypergeometric functions in the solution of a wide range of differential equations of the second order. This was followed, in the British Association Reports for 1926 and 1927, by tables of these functions for various values of the three arguments on which they depend.

The second volume of the "British Association Mathematical Tables", giving solutions of Emden's equation, is based entirely on methods suggested by Airey. He was, in fact, a master of the art of getting numerical solutions of equations that would not yield to formal treatment. In particular, he was conspicuously successful in dealing with asymptotic series, where the common practice is to compute to

the least term, and neglect the divergent part. He had the happy knack of discovering the form of 'converging factors', which, when multiplied by the least term, gave the effect of the divergent terms; in this way he was usually able to double the number of decimals that could otherwise be obtained.

Another phase of Airey's activity was his association with the production of the *Philosophical Magazine*, which goes back many years. In 1933 his name first appeared on the journal as a joint editor, and from that date onwards he read and passed for press every article. Although not a frequent contributor in recent years, his last task was the reading and correction of an article by himself, which will appear in a future number.

Airey was a fellow of the Royal Astronomical Society, the Physical Society and the Edinburgh Mathematical Society. He will be remembered as an inspiring colleague, and a friend who was always generous with his help. He is survived by a widow and a daughter.

L. J. COMBES.

Mr. W. B. Ferguson, K.C.

WILLIAM BATES FERGUSON, who died on Thursday, October 7, in his eighty-fifth year, was educated at Manchester Grammar School and Merton College, Oxford, where in 1874 he graduated with first-class honours in natural science. At this time it was apparently his intention to enter the medical profession, but after another year or two engaged in study and lecturing, during which he became one of the original fellows of the newly founded Institute of Chemistry, he qualified for the Bar, to which he was called in 1882. He practised for some eighteen years and took silk in 1900, but then on urgent medical advice had to give up his profession and retire for several years to Arosa in Switzerland.

Ferguson was already keenly interested in photography, and having become a member of the Royal Photographic Society in 1895, was elected a fellow in 1900, in which year he published a paper on toning prints and slides with copper compounds. While at Arosa, in collaboration with B. F. Howard, he studied the influence of temperature on the rate of development of dry plates and devised his time-temperature system of compensating therefor, which has proved of permanent value. He was a close student of Hurter and Driffeld's epoch-making researches, and the design of photometers for the measurement of photographic densities became one of his hobbies. His outstanding contribution to photographic science was undoubtedly the Hurter and Driffeld memorial volume, in which he not only collected together in conveniently accessible form all their important papers, but also gave us the results of a painstaking study of their apparatus, laboratory notebooks and correspondence, a labour of love which occupied him for fully two years.

Ferguson's striking figure and charm of manner will not soon be forgotten by members of the Royal Photographic Society, and many are indebted to him for his unfailing interest and kindly encouragement in their work. Although repeatedly invited to become

its president, his precarious health always compelled him to decline, but on the Council and in numerous committees he served the best interests of the Society for many years. He was awarded the Society's honorary fellowship and the Progress Medal in 1914, the Hurter and Driffeld Memorial Medal in 1918 and the Davanne Medal of the Société Française de Photographie in 1925, in recognition of his scientific work, and was throughout its existence a vice-president of the British Photographic Research Association. All who knew him will mourn the loss of a good friend and an outstanding personality, and will deeply sympathize with his wife and family in their sorrow.

F. F. R.

Dr. Carl Spengler

By the death on September 16 of Dr. Carl Spengler in his seventy-seventh year, one of the pioneers of tuberculosis research and treatment has passed away. He lived and died at Davos, and was one of those who made Davos the first, and for a time the chief, centre for the Alpine treatment of pulmonary tuberculosis.

Carl Spengler studied medicine at Heidelberg and Zurich, afterwards worked at bacteriology under Prof. von Stilling and de Bary, and from 1886 until 1889 was assistant physician in the University of Strassburg. He then returned to Davos in order to specialize on tuberculosis, and his work attracted the attention of Robert Koch, with whom he collaborated for a time, originating the preparation of tuberculin from the bovine type of bacillus, and devising the method of administering tuberculin now in general use. He also devised a special technique for demonstrating the tubercle bacillus, which still remains one of the best of the staining methods, and described the presence in tuberculous materials of spheroidal bodies derived from the tubercle bacillus, which he termed 'splitter' bodies, and the appearance of which he regarded as being of favourable import as indicating disintegration of the tubercle bacilli.

In addition to developing the climatic and open-air treatment of tuberculosis, Spengler also sought to discover an agent which would exert a curative action upon tuberculosis by the possession of lytic and antitoxic properties towards the tubercle bacillus. This he claimed to have done, and evolved his I.K. (= *Immun Körper*) treatment for the disease. He believed that the red blood corpuscles (and not the serum) of a specially immunized animal carry the bulk of the immunizing substances, and devised his I.K. remedy for treatment, which consists essentially of a solution of the anti-tuberculous immunizing bodies derived from the red blood corpuscles of a treated animal. He also applied the same methods in the treatment of other diseases, and during his last years devoted much time to research on cancer.

R. T. HAWLERT.

We regret to announce the death of the Right Hon. Sir Herbert Maxwell, Bt., K.T., F.R.S., chairman of the Royal Commission on Ancient Monuments (Scotland) in 1908-34, on October 30, aged ninety-two years.

News and Views

Prof. A. von Szent-Györgyi: Nobel Prize for Medicine

It is announced by the Stockholm correspondent of *The Times* that the Nobel Prize for Medicine for 1937 has been awarded to Prof. Albert von Szent-Györgyi, of the University of Szeged, in Hungary, for his work on vitamin C. More than fifteen years ago, experiments carried out by Szent-Györgyi on the adrenalectomized animal suggested to him that the adrenal cortex is in some way involved in biological oxidation. A detailed study of different animal, vegetable and synthetic oxidizing systems was made, but no connexion could be found between these and the function of the adrenal cortex. However, nine years ago, evidence was obtained that the cortex is in some way connected with the peroxidase system and at the same time a reducing substance, considered to be a 'hexuronic acid', was isolated from it. The same acid was also found in plants and shown to be an essential part of the 'reducing factor' of plant juices, being apparently connected with the function of the peroxidase system. Since the 'reducing factor' is found in fruit juices which contain vitamin C and cure both human and experimental scurvy, the antiscorbutic potency of the 'hexuronic acid' was investigated,

HOWEVER, it was not until four years later that Svirbely and Szent-Györgyi were convinced that the potency of this acid was really due to the acid itself and not to its contamination by some more potent substance. Success was dependent on the possibility of obtaining large quantities of the acid, and the authors were finally successful when they discovered that paprika, the Hungarian red pepper, is an unusually rich source. Meanwhile, investigation in various laboratories of the chemical nature of 'hexuronic acid' had necessitated a modification of the structural formula originally proposed and Szent-Györgyi and Haworth (*NATURE*, 131, 24; 1933) suggested the name "ascorbic acid", by which vitamin C is now generally known. It was not long after Szent-Györgyi's isolation of ascorbic acid from natural sources before the vitamin was prepared by chemical synthesis, and the synthetic vitamin is now employed in medicine when large doses are required. Although Szent-Györgyi's brilliant research may have closed a chapter in vitamin chemistry, it has nevertheless opened one in the treatment of disease.

Representation and the Australian Aborigines

To those whose vocation it is to consider the Australian aboriginal mainly, if not exclusively, in a context in which he appears as the most primitive, physically and culturally, among existing peoples, there is something incongruous in the report from Canberra (*The Times*, Oct. 27) that the aborigines have petitioned the King, asking His Majesty, through the Australian Government, to empower them to

propose one of their own people, or a sympathetic white, to represent them in the Federal Parliament. The purpose of the petition, it is stated, is to prevent their extinction. It goes on to point out that the injunction laid on the first settlers in Australia, that the aborigines should be adequately cared for, has not been obeyed, since aborigines' lands have been expropriated and legal status has been denied them. This is the first occasion in Australian history on which such action has been taken by the aborigines; but as the eighteen hundred and fourteen signatories to the petition, drawn from all parts of Australia, are chiefly from mission stations, the circumstances which have determined their mode of action are not beyond conjecture. The petition has been forwarded by Mr. Lyons, as Prime Minister, to Lord Gowrie, the Governor-General, for submission to the King.

WHATEVER may be its ultimate fate, the fact of the submission of the petition is significant. It is one among a number of indications of the profound cultural changes which are taking place among even the least advanced races under Imperial administration. It points to the fact that neither segregation, the provision of reservations, nor even 'indirect rule' are to be regarded as the final solution of the problems which arise in modern conditions out of even the regulated cultural contacts of white and backward civilizations. Cultural change, it seems, is inevitable; but in recent discussion of the colonial question, it appears to be overlooked that under democratic institutions the growth of a native opinion cannot be ignored, and the crux of the colonial problem is not ownership, but the will, as well as the competence, to guide native development in the light of detached and scientific study along lines beneficial to the native himself, as well as to the larger world in which he will have to find his level some day when he emerges from tutelage.

The Progress of Engineering

IN his presidential address to the Institution of Civil Engineers on November 2, Mr. Bryan Donkin pointed out that it is nearly thirty years ago since Siemens and Kennedy, who preceded him in the chair and who were like himself connected with both the mechanical and electrical branches of engineering, described the latest advances which had then been made in the new industry. The intervening gap he filled up most satisfactorily. In an essay on applied science written in 1810, Shelley said of electricity, "What a mighty instrument it would be in the hands of him who knew how to wield it." Shelley referred to the aerial mariner who could swim in the air with bladders and said that such ingenuity was not to be condemned. "Why," he said, "have we not dispatched intrepid aeronauts to cross Africa in every direction to survey the whole peninsula in a few

weeks?" It is by these means "that we could advance civilization, emancipate every slave and improve generally the welfare of mankind." Now most of the things Shelley thought of have been done, and mankind has benefited.

MAN has become a more efficient unit, he performs more work in a given time, he lives longer, he has greater comforts, but with all these advantages, it is a misfortune that the necessity still arises for some to spend their energies and the wealth of their country in fruitless endeavours to kill, or to be ready to kill, their enemy in less time and at less cost than is possible for their adversaries. According to the best authority, it was shown in 1936, by statistics of the cost of various domestic commodities throughout Europe, ranging from electricity to coal and including butter, bread, milk, meat, potatoes and sugar, that the fall in the price of electricity since 1914 was greater than that of any of the others. In addition, the price of electricity in Great Britain had fallen more than in any other country. It is practically certain that it will fall still further. In conclusion, Mr. Donkin quoted with approval Lord Weir, who said that millions of pounds should be spent in research in the political sphere for the founding of a thinking department for the investigation and analysis of human qualities. It should explore the possibility of healing and softening racial bitterness and ultimately demonstrate to the world the utter inability of war to solve political problems.

Co-operation between the Engineering Professions

At the beginning of his presidential address to the Institution of Electrical Engineers delivered on October 21, Sir George Lee re-echoed Sir Alexander Gibb's suggestion, given in his address to the Institution of Civil Engineers last year, for closer co-operation and co-ordination between the various engineering institutions. The engineering industry is now so large that amalgamation between the various institutions, even if desirable, would be practically impossible. But he made two suggestions of directions in which co-operation should be easy and an advantage to industry. The first was that facilities might be given to members of one institution to attend meetings of other institutions, to hold joint meetings on subjects of common interest and to give special library facilities to all. The second was that the full implications of social science can best be handled from the engineering side by the combined efforts of all the engineering professions. To an increasing extent the lives of our people are bound up with engineering development, and the economics of our welfare are dependent to a large extent upon the rate of this development. The closer association and meeting of people who are interested in different phases of what is actually the same subject would facilitate the recognition of common interests and ideas.

SIR GEORGE then passed on to give an interesting account of developments in some of the activities of the Post Office. He pointed out the success of the

new telephone tariffs. The shilling night rate has been a very successful psychological touch which succeeded beyond the wildest expectations. He laid stress on the difficulties of development forecasting. If a successful forecast is made, then the capital expenditure can be reduced to a minimum. When the sixpenny telegram was introduced in 1935, there was an immediate increase of 34 per cent over the corresponding period for the preceding year. The standardization of teleprinter working has paved the way for the development of a switched telegraph system utilizing the familiar methods of automatic telephony. Probably it will soon be possible for any teleprinter office in the inland service to obtain instant communication with any other teleprinter office simply by dialling.

Nuffield College, Oxford

MORE information relating to the proposed college for research in social studies, to be called Nuffield College (see NATURE of October 23, p. 697), is now available. The erection and equipment of the College and the laying out of its grounds will be in the hands of the governing body of the University, the Hebdomadal Council. It shall from time to time appoint the warden, the fellows and other officers, and generally take charge. It is proposed to have maxima of twelve official fellows, eight faculty fellows, twenty visiting fellows, and forty students. Women will be eligible for fellowships and studentships. The official fellows will be whole-time research workers, the faculty fellows teaching members of other colleges who do work on social studies, and the visiting fellows the possibly non-academic persons from outside. The students will be at least in their third term of residence at the University and working for research degrees. All classes of fellows (but not women fellows) will be entitled to rooms and dinner in college and students may also have rooms there. The visiting fellows and the students will receive honoraria or emoluments of the order of fifty pounds per annum. Lord Nuffield will be the first honorary fellow.

Comets and Problems of Cosmogony

THE presidential address at the British Astronomical Association was delivered on October 27 by the Rev. Dr. M. Davidson. He discussed comets, especially in connexion with the light that they throw on problems of cosmogony. Considering that comets move in orbits of such a diverse nature, direct and retrograde orbits being nearly equal in number, taking comets on the whole, he showed that there are difficulties in reconciling this fact with the tidal theory of the origin of the solar system. He referred to the families of comets which are associated with the major planets, stating that it is quite impossible to explain these on the capture theory. There is, he considers, some basis for the view that they were expelled by the planets, though there are certain objections here also. Various theories for the origin of both the short-period and long-period comets were dealt with in turn; but, Dr. Davidson

pointed out, none of these can be considered satisfactory. Bobrovinkoff's conjecture that the sun captured comets when it was passing through diffuse clouds of obscuring matter less than a million years ago would appear to be mere speculation, and great difficulties arise when we inquire how bodies of such diverse sizes as are found in the nuclei of comets should appear in diffuse clouds of obscuring matter. The whole subject is full of difficulties, and Dr. Davidson contented himself with expressing the hope that posterity would be able to solve the problem. At the close of his address, he presented the Walter Goodacre Gold Medal and Gift to Dr. A. C. D. Crommelin, whom the Council selected this year for this award, in consideration of the very valuable work that he has done for the Association, more especially in connexion with comets and minor planets, on which he is a recognized authority.

Easton Park Nature Sanctuary

EASTON PARK, Dunmow, Essex, which Frances, Countess of Warwick, has recently willed under terms to the Essex County Council to assure its future as a Nature reserve, covers a thousand acres of mixed wood and parkland, and has long been preserved as a wild-life sanctuary, with no shooting and only the rabbits killed. Although a little short of water except for the dewponds, the estate is rich in wild-life: there are considerable numbers of jackdaws, green and spotted woodpeckers, goldfinches and long-tailed tits; goldcrests, hawfinches, kestrels, the three common owls, nuthatches and many jays nest in the woods. In a recent autumn study of the bird sanctuaries there, by invitation of Lady Warwick, Mr. Eric Hardy noted fifty species of bird, including a roosting flock of 195 jackdaws. There are a few red squirrels in the park, but no grey squirrels and no nesting carrion-crows. Wild pheasants and partridge are numerous, and there are two large duck ponds where Lady Warwick intends to introduce ornamental waterfowl. A large four-acre wood around Stone Hall on the south side of the estate is permanently fenced and padlocked and kept as a specially secluded sanctuary for woodland nesters.

In the grounds of Easton Lodge, Lady Warwick has had erected a number of large aviaries, and converted old conservatories to heated aviaries, totalling eight aviaries in all, the largest, as high as the big aviary at the London Zoo, enclosing a full-grown yew tree. The collection comprises some 17 species and about four hundred specimens, chiefly of foreign finches, and is also used as a 'flying school' for injured or rescued British birds before their release. The aviaries are in the charge of Mr. Gilbert, formerly a keeper of aviaries under Mr. D. Seth-Smith at the London Zoo. The park also contains large herds of red and fallow deer, a herd of Highland cattle, some 700 Shetland sheep, including four-horned rams, a number of Shetland ponies, and some very outstanding trees, including some of the country's best specimens of cedar, wych-elm, oak, maiden-hair, palm and *Ailanthus* or tree of heaven.

Electron Diffraction and Surface Structure

THE thirty-ninth Bedson Lecture was delivered on October 25 in King's College, Newcastle-on-Tyne, by Prof. G. I. Finch, on "Electron Diffraction and Surface Structure". Prof. Finch stated that patterns are obtained on a photographic plate placed in the path of an electron stream which has been allowed to graze the surface of a solid body, and from these diffraction patterns an accurate indication of the surface structure is obtained. The diffraction patterns tend more and more towards well-defined rings with decreasing crystal size and more random orientation, until eventually an effect similar to the Debye-Scherrer pattern is obtained. Experiments with thin films of nickel deposited on a copper surface show that the nickel crystals follow, up to a certain thickness, the orientation and size of the original copper crystals. As the thickness of the nickel film increases to about 30,000 Å., the crystals orient themselves in directions independent of the original copper crystals, although ordinary microscopic examination indicates a continuance of the original orientation. Electron diffraction experiments have also been used for determining the chemical composition of thin surface films, where ordinary chemical analysis has failed; for example, the composition of the blue film on tempered steel razor-blades was successfully determined in this manner. Sir George Beilby's theory of surface liquefaction of solids during polishing has received experimental proof from electron diffraction experiments on polished surfaces, and extremely important work is being carried out in this field in connexion with the 'running-in' of machinery.

Pottery in the Palaeolithic Period

FURTHER evidence on the disputed question of the occurrence of pottery in the later phases of the palaeolithic period was brought forward by Mr. J. P. T. Burchell at a meeting of the Society of Antiquaries held on October 28. Pottery has now been found by him on several sites in the Thames Valley in circumstances which, he maintains, warrant a dating in Upper Palaeolithic times. At a site in the Bean Valley, Kent, which he has excavated recently, pottery occurs between the fourth and the fifth of a series of seven separate deposits of windborne loams. Of these deposits the lowest and oldest is linked with the glacial deposit on which it lies. The first four deposits in the series contain no sign of man, but with the pottery between the fourth and fifth deposits were bones and implements. It has been suggested that the pottery belongs to the bronze age, but Mr. Burchell maintains that the absence of any evidence of a mesolithic culture in the lower beds precludes that view. He relies further on the evidence of the occurrence of the extinct shell *Helicella striata* in beds 2-4. This shell has not been recognized as occurring after the Upper Palaeolithic period. Collateral evidence which possibly may appear more convincing was obtained at Springhead, in the Ebbsfleet Valley, Kent. Here implements similar to those found in the Bean Valley, as well as

those found at Ipswich, with the pottery for which Mr. Reid Moir claims a palæolithic age, were found in an unworn condition in a gravel bed underlying alluvium and peat and resting on a glacial bed. On top of the gravel occurred a large number of scrapers of a type not hitherto recognized and showing marked eolithic characters. These were striated, presumably by floating ice or the movements of semi-frozen material, indicating that the implements, and therefore, presumably, the pottery, dated from before the last glacial manifestation; in other words, that both pottery and implements belonged to Upper Palæolithic times.

Meteorite Craters

THE crater-lake of Kaalijärvi, one of the group of craters on the Island of Oesel off the coast of Estonia, has been described on several occasions since 1827, and many suggestions have been made as to its mode of origin. In 1927 and 1929 Mr. I. Reinvald, Inspector of Mines in Estonia, made a detailed survey of the craters with borings and trenches, and he was himself convinced of their meteoritic origin, although he was then unable to find any traces of meteorites at the locality. With remarkable persistence he has again returned to the work of excavation, and in July last he was rewarded by finding in the smaller craters, Nos. 2 and 5, thirty small rusted fragments of nickel-iron, which on a polished and etched surface show a characteristic though rather unusual type of structure. These remnants of the Kaalijärvi meteorite finally settle the question of the meteoritic origin of these craters.

ANOTHER meteorite crater has been discovered by Dr. C. T. Madigan, lecturer in geology at the University of Adelaide, during his recent expedition in Central Australia. This was found on the Box Hole station by Plenty River, which is about 200 miles north-east of the famous Henbury craters. It has the form of a shallow basin measuring 200 yards across the rim. During the brief visit no meteoric iron was found on the spot. Another noteworthy discovery made by Dr. Madigan during this expedition is a large meteorite of the rarer siderolite (stony-iron) type, which was seen on the Huckitta station near the Hart Range, about fifty miles from the crater and with no relation to it. It measures 4 ft. 5 in. long and 20 in. high, and is estimated to weigh 2-3 tons. This is considerably larger than any stony-iron meteorite previously recorded, including the original pallasite (Pallas iron) of about 700 kgm. found in 1749 in the Krasnoyarsk district in Siberia.

Distribution of Raw Materials

AN important aspect of the problem of access to raw materials is the consideration of their position with regard to export. This, among other bearings of the question, is discussed by Prof. I. Högbom, in the report of the League of Nations Committee for the Study of the Problem of Raw Materials (Geneva: League of Nations. London: G. Allen and Unwin, Ltd., 1937. 2s.). Prof. Högbom points

out that for certain minerals, the bulk of which is great in comparison to their value, anything more than a relatively short distance from the sea is an almost insuperable bar to exploitation. The same is true of the cheaper and bulkier vegetable products. Thus for many forms of raw material the potential production of the great colonial areas of the interior of Africa and of certain sovereign States is not commercially accessible. Transport cost and not occurrence is the decisive factor in availability. Thus coal and iron ore, if mining for local ore is left out of account, can be economically produced only in Europe, North America, certain parts of the Far East and elsewhere only in a coastal strip some sixty miles in width. The same applies to phosphates. Mineral oil is profitably exportable within about a hundred and fifty miles from the coast. More valuable ores such as tin, copper, manganese and chromium ores can be mined over a much wider area. Prof. Högbom has illustrated these conclusions in a map incorporated in the report.

The Empire's Mineral Wealth

THE leading article in the September issue of *Sands, Clays and Minerals* develops the theory that the Empire can be made in Dr. Johnson's words "rich beyond the dreams of avarice" by economic development of known mineral resources and by systematic exploration of every country within the Empire for hitherto undiscovered deposits. It is no longer practicable to await accidental discoveries of valuable mineral resources: they must be looked for scientifically. Admittedly an exhaustive Imperial mineral survey is a Herculean task, but certain suggestions are made which should go far towards this ultimate aim. It is too great a task for any private concern or individual, or indeed for any Government. It must be undertaken corporately by geologists, metallurgists, economists, Government officials, and others equipped for different phases of the investigation, all of whom must take a share of executive authority. Aerial survey is the means by which information can be obtained on the resources of every country, but this should be conducted on a more scientific basis than hitherto. Present-day mining and metallurgical technique should at the same time be scrutinized and improved wherever possible on the advice of experts. Moreover, ancillary investigations of transport systems, market conditions, currency, tariffs, banking and finance in general, should be undertaken in order to provide a central body with all the information necessary to co-ordinate survey results. Finally, the technical education of the coming generation of geologists, chemists, mineralogists and industrialists, and of the mature worker in these fields should be broadened to give an imperial view-point of mineral resources rather than a restricted outlook on one part only.

British Museum (Bloomsbury): Recent Acquisitions

RECENT accessions to the collections of the British Museum (Bloomsbury) reported at the October meeting of the Trustees include a number of ethnographical

and archaeological objects of exceptional interest. Among these is a war-drum presented by H.M. the King, which was captured from the Khalifa at Khartum in 1898 and given to Queen Victoria by Lord Kitchener. It is of the split-gong type, is made of wood, and is some seven feet long. It is shaped like an animal with a horned head at one end, and is carved with geometrical ornament in relief on the sides. A ceremonial staff from Ashanti, formerly the property of Nana Kobina Amponsah II, Ohene of Busumtwi Stool, has a gold top surmounted by a bird pecking two skulls. Sir Aurel Stein has now decided that the objects allotted to him by the Persian Government from the finds of his journeys of archaeological exploration in Iran should be sent to the British Museum, and the pottery and sherds from his third journey in 1934, on which he traversed the modern province of Fars in south-west Persia, have now been received. They date from well before 3000 B.C. and are of importance as showing affinities with such early sites as Susa and El Obeid in Irak.

THE Department of Oriental Antiquities has received an accession of exceptional importance in the form of five sculptured stone heads from the Buddhist cave temples of T'ien Lung Shan, near Taiyuanfu in Shansi, dating from the sixth to the tenth centuries A.D. They represent a highly developed phase of Chinese religious sculpture, of which very few examples are to be found in British collections. They were given through the British Ambassador in Tokyo by Mr. Kaohiro Nezu as a token of friendship to the British nation. Among the British antiquities is a large Roman pottery basin, about seventeen inches in diameter, with figures of horsemen and floral design, which appear upside down. It was found by Colonel and Mrs. A. Ogilvie, by whom it is presented, inside a larger vessel in a kiln at Linwood in the New Forest. It dates from the third century A.D.

Fruit-Cooling Plant at Cape Town

IN *Electrical Industries* of August 11 a description is given of the largest pre-cooling plant in the world, dealing with the fruit exported from Cape Town docks. This installation, which was completed twelve years ago, has made it easy to ensure the low-temperature preservation of fruit as soon as possible after picking. It ensures also that the temperature of the fruit when loaded is comparable with that maintained in the ship's storage chambers on the voyage. Thanks to the Government policy of insisting on high standards and of providing research and educational facilities for fruit growers, the plant is now working at its full capacity and more accommodation is urgently needed. To meet this need, large pre-cooling chambers were projected, and when the entire scheme is completed next year they will have a capacity of 6,000 (shipping) tons. When the fruit trains reach the store from the country, they are shunted into the 'air-lock', a large asphalt-floored shed 74 feet wide by 900 feet long. The fruit is examined and tested there by the Government in-

spectors, and that which does not reach export standard is rejected. The standard fruit is then transferred by battery vehicles to the ship's side and by crane to the hold. The ammonia method being economically impracticable, the underground storage chambers are cooled by brine circulated through coils. At a considerably lower level is the large engine room containing electric transformers and ammonia compressors. An automatic recorder keeps a visible record of the temperature in every cooling chamber taken every eight minutes. The engine room is provided with an emergency lighting battery plant.

New "North-West Passage"

A BULLETIN from the office of the High Commissioner for Canada announces the receipt of a radio-telegram from the S.S. *Nascopie*, a vessel now under charter to the Canadian Government for the 1937 Arctic Expedition, in which it is stated that the vessel has effected the first crossing of Bellot Strait, forming a second North-West Passage across the Canadian Arctic. The strait separates Somerset Island from the Boothia Peninsula, the northern tip of Canadian mainland. The original "North-West Passage", the discovery of which was for many years the dream of Arctic navigators, as a short route from Europe to Asia, runs farther north than the Bellot route. So early as 1585, John Davis set sail to locate this passage, but it was not until 1903-7 that Captain Roald Amundsen made the voyage along Lancaster Sound, Barrow Strait and Peel Sound which defined the route. The Bellot route, a shorter and possibly better passage, has engaged the attention of Arctic explorers since 1858, when Captain Thomas McClintock, searching for the lost Franklin expedition, endeavoured to make his way through. The attempt, unfortunately, was futile, and other later attempts were equally unsuccessful. The Strait was discovered by Captain W. Kennedy in 1852, when he crossed it by dog-team. The appearance of the waterway is that of a Greenland fjord. It is about twenty miles long and barely a mile wide at its narrowest part. The shores are of granite formation of bold and lofty elevation, with a fair sprinkling of Arctic vegetation. Some of the hill ranges attain heights of 1,500-1,600 feet.

Symbols for Thermodynamical Quantities

THE report of a joint committee of the Chemical Society, Faraday Society and Physical Society on symbols for thermodynamical and physico-chemical quantities and conventions relating to their use has been published. It contains symbols for use in thermodynamics and physical chemistry, with explanatory matter. The objects of the joint committee, it is stated, were to correlate the views of chemists and physicists with regard to the use of symbols for thermodynamic quantities and to deal similarly with symbols for other quantities which are of interest to both chemists and physicists. The committee was very representative, and the report, which is a document of sixteen pages, is of considerable interest. The symbols and conventions of the report have

been adopted as recommended practice by the three societies responsible for it and by *British Chemical Abstracts*. Copies of the report may be obtained by non-members at 6d. per copy or 7s. 6d. per 25 copies, post paid, from the Assistant Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1.

Biological Station in Memory of Pavlov

THE biological station being built at Pavlovo (formerly Kottushi) in memory of the late Prof. I. P. Pavlov is almost completed (Soviet Union Year Book Press Service). The department of evolutionary physiology of the Leningrad Branch of the All-Union Institute of Experimental Medicine is being transferred to Pavlovo, where it will be housed in a newly built laboratory, equipped with the most up-to-date appliances for research, and under the directorship of L. A. Orbeli. The reconstruction of Pavlov's own laboratory is now finished, as are also the new kennels and stables and administrative offices.

Richard Watson (1737-1816)

IN an article on the bicentenary of Richard Watson, professor of chemistry at Cambridge and afterwards Bishop of Llandaff, Prof. J. R. Partington (*Chemistry and Industry*, 56, 819; 1937) directs attention to his important experimental work, particularly on the freezing points of solutions of salts, and to the valuable information on contemporary chemical industries contained in Watson's "Chemical Essays". He gives reasons for concluding that some of the unfavourable criticisms of Watson are unjustified. Although Watson was ignorant of chemistry on his appointment to the professorship, he quickly made himself proficient in the subject and carried out original work of considerable merit, whilst his knowledge of pure and applied chemistry was certainly very extensive. Mr. J. P. de Castro (*ibid.*, p. 846) also directs attention to a portrait of Watson apparently engaged in lecturing on chemistry.

Science, Invention and Society

IN a paper entitled "Science, Invention and Society" at the second Congress on Industrial Physics, Pittsburgh, U.S.A., on May 22 (*J. Applied Physics*, 8, 449; 1937), W. Kaempffert, reviewing some of the technical aspects of society as well as the economic aspects of mass production, stresses the need for government to rely not on politicians but on experts. More organization and control are required. Social invention must become as systematic and as well organized as mechanical invention and scientific discovery if it is to keep pace with the laboratory. We can no longer make the utmost use of scientific and mechanical innovations without social adjustments and social invention. We do not yet know what form of government will be evolved to meet the social needs which have come with science and the machine. At present the tendency appears to be towards a collectivism in which private profit will be severely limited or abolished entirely. This in itself demands more expert control, and whatever form future democratic government may take, it

must be a government by technicians or experts. If democracy itself is to survive the increasing strain to which machine methods and scientific progress subject it, its own character must inevitably be immensely changed from that of eighteenth century egalitarianism.

Eighth International Conference of Genetics

WE are informed by Prof. O. L. Mohr, of Oslo, chairman of the International Committee of Genetics Congresses, that the question as to the place for the next International Congress of Genetics has now been considered and voted upon by the International Committee, which has by a large majority resolved to invite the British geneticists to arrange the next congress in Great Britain in 1939. The committee of the British Genetical Society has passed a resolution welcoming the invitation. British geneticists will shortly appoint an organization committee, after which further information concerning the date and place of the congress will be published.

Announcements

IT will be remembered that the late Lord Rutherford had consented to preside over the jubilee meeting of the Indian Science Congress Association to be held in Calcutta next January, which will be attended by a representative British scientific delegation organized by the British Association (see *NATURE*, October 9, p. 609). We are glad to announce that Sir James Jeans has consented to fill the vacancy caused by the lamented death of Lord Rutherford.

THE Society of Glass Technology will hold its twenty-first anniversary meeting on November 9-10, under the presidency of Prof. W. E. S. Turner, at Sheffield, where the inaugural meeting was held in 1916. On November 9, the Society will attend the laying of the foundation block for the new building at Elmfield for the University Department of Glass Technology, towards which the Society has already raised more than £1,500. The Wood Memorial Library will also be opened at Elmfield by Sir Frank Heath on the same day.

DR. H. LOWERY, principal of the North-Western Polytechnic, London, and honorary secretary of the London and Home Counties Branch of the Institute of Physics, has been appointed principal of the new South-West Essex Technical College at Walthamstow as from April 1938.

WE have received from British Drug Houses, Ltd., a priced catalogue of B.D.H. laboratory chemicals. This is a volume of more than two hundred pages, with thumb indexes, and includes indicators, reagents, microscopical stains, minerals and laboratory sundries. It is very gratifying to note what a wide range of chemicals of high quality of British manufacture are now available. The items include both inorganic and organic chemicals, and the prices are quoted for quantities based on the metric system. The address of the firm is Graham Street, City Road, London, N.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 811.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Development of the Spark Discharge

SOME time ago, one of us¹ photographed the long electric spark with a rotating camera and showed that a preliminary discharge occurred prior to the

the former experiments under a variety of physical conditions and have now shown that the pre-discharge traverses the whole of the inter-electrode gap, and only after it reaches the opposite electrode

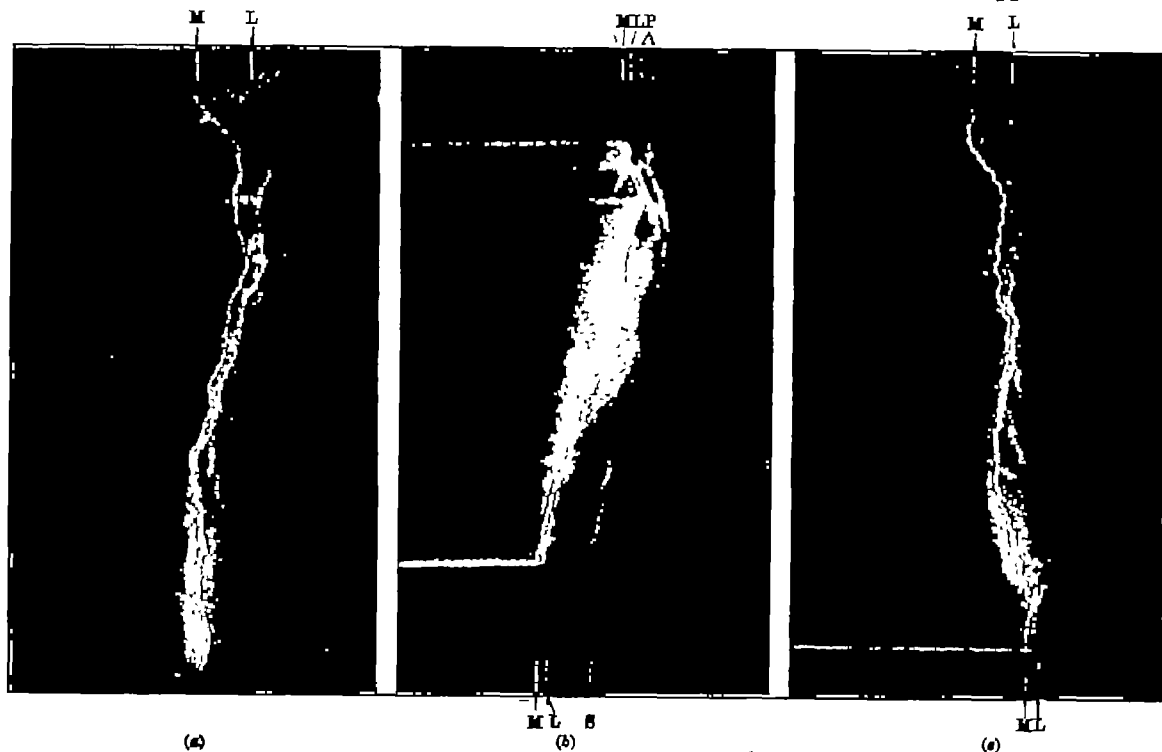


Fig. 1.

- (a) LEADER (L) AND MAIN (M) STROKE FROM POSITIVE HIGH-VOLTAGE POINT TO EARTHED PLANE.
 (b) LEADER (L) AND MAIN (M) STROKE FROM NEGATIVE HIGH-VOLTAGE POINT AND FROM EARTHED PLANE.
 P = TWO PREDISCHARGES AT THE CATHODE. S = INDEPENDENT STREAMER DISCHARGE RISING FROM THE PLANE ANODE.
 (c) LEADER (L) AND MAIN (M) STROKE FROM POSITIVE HIGH-VOLTAGE POINT AND FROM POINTED PROJECTION ON THE EARTHED PLANE.

main spark, just as in the case of the lightning discharge studied by Prof. B. F. J. Schonland and others. The original photographs of the spark between a pointed high-voltage electrode and a plane earthed electrode showed the course of this 'leader' discharge for about 20 per cent of the inter-electrode spacing the luminosity diminishing with increasing distance from the high-voltage electrode. The time interval between the leader and the main stroke corresponded to the time-to-sparkover as recorded on the oscillograph. Leader strokes preceded positive and negative discharges.

We have recently had an opportunity of extending

does the main spark develop. Thus the pre-discharge is a 'leader-stroke' exactly analogous to the leader stroke of the lightning flash. Fig. 1a shows such a discharge at 600 kv. between a positive point electrode and an earthed plane; the time-interval between the leader and the return flash is 72 micro-seconds. The main stroke develops at a much higher speed than the leader stroke, so that it is possible to quote the average speed of development of the leader with fair accuracy. For a succession of sparks at this voltage its average speed was 1.9×10^8 cm./sec., but we have found that the speed increases as the leader approaches the opposite electrode.

When the high-voltage point is of negative polarity, the spark presents a rather different appearance. In addition to the leader from the high-voltage point, a leader also precedes the main stroke at the earthed plane, and the two leaders develop towards one another, meeting at mid-gap as in Fig. 1 *b* for a 900 kv. spark. This type of leader has not hitherto been observed in the lightning flash, but its appearance is not surprising, as upward directed streamers are often observed developing from a plane electrode in a negative field. The time interval between the negative leader and the main stroke at the cathode is generally greater than between the positive leader and the main stroke at the anode. The velocity of the negative leader in Fig. 1 *b* is 2.4×10^8 cm./sec. and that of the positive leader is 4.4×10^8 cm./sec. Generally one or more discharges develop from the cathode but fail to bridge the inter-electrode gap; however, they ionize a path which the final leader stroke takes. Two such pre-discharges can be observed in Fig. 1 *b* at the cathode.

If a pointed electrode projects out of the earthed plane for a fraction of the inter-electrode gap, a leader stroke develops from this point upwards irrespective of the applied polarity. Such a double leader is shown in Fig. 1 *c* for a positive high-voltage point electrode; the point at the cathode projects 4 in., and the gap is 40 in. In Figs. 1 *b* and *c* it will be seen that the leader stroke developing upwards from the earthed electrode is also branched upwards, and we have now definitely established that the direction of branching indicates the direction of propagation of the leader stroke, since the leader stroke is initially responsible for all branching. These results should suggest therefore that Boys camera photographs of upward branched lightning strokes will show upward propagation of the leader stroke.

Experiments at pressures down to one tenth atmospheric pressure substantiate the above and indicate that the time intervals between the leader and the main stroke increase rapidly with diminishing pressure.

We desire to thank Dr. A. P. M. Fleming for permission to publish this note.

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¹Allibone and Schonland, *NATURE*, 124, 736 (1934).

Splitting of the Haemocyanin Molecule by Ultra-sonic Waves

EMULSIONS and colloidal solutions may be produced by means of ultra-sonic waves^{1,2}. Compounds such as starch and gelatine are depolymerized^{3,4}. It seemed, therefore, of interest to study the action of sonic waves on high-molecular proteins such as the haemocyanins, the molecules of which are of 'colloidal' size. In the investigation I used haemocyanin from *Helix pomatia*, which has a molecular weight of 6,740,000, a sedimentation constant of 99×10^{-13} and which, upon change of the pH, gives three dissociation fragments with the sedimentation constants 62, 16 and 12×10^{-13} respectively (correspond-

ing to $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{8}$ molecules). These fragments may reversibly recombine to form the original molecule^{5,6,7}.

Dilute solutions of the haemocyanin (0.1–0.4 per cent) were treated by sonic waves with a frequency of 250,000 per sec. and the effects were studied by means of the ultra-centrifuge. The solution of the protein was centrifuged before and after the treatment, and it was found that the sound-waves had partly split the haemocyanin. The fragments obtained were uniform (monodispers) and were equal to $\frac{1}{2}$ and $\frac{1}{4}$ of the molecule, that is, in size corresponding to the fragments which are obtained by changing the pH. A solution of pH 6.2 containing only the original molecule gave after treatment 20 per cent of half molecules. A solution of pH 7.2 containing 64 per cent of the original molecule and 36 per cent half molecules gave 35 per cent original molecules, 44 per cent half molecules and 21 per cent eighth molecules. Usually the one-eighth molecule is obtained only when the pH reaches 8.0. The total concentration of the different kinds of soluble molecules was in most cases the same in the treated and in the non-treated solutions. In a few cases, however, when the initial solution was not clear due to precipitated haemocyanin, a larger total concentration of soluble molecules occurs in the treated solution. In these cases the sound-waves may have brought a part of the precipitate into solution.

The action of the sound-waves was accompanied by a rise in temperature to about 40° C. Heat treatment alone at 50° C. of a solution with whole and half molecules did not, however, change the relative percentage of the two molecules. By heating to 60° C. non-uniform compounds of association were obtained.

The fragments, $\frac{1}{2}$ and $\frac{1}{4}$ molecules, formed by action of the ultra-sonic waves, do not, upon a change of pH from 7.2 to 6.2, show any tendency to recombine to the original molecule. Apparently there is a difference between the haemocyanin molecule in the native state and that treated with sonic waves.

During the sonic treatment amino-acids or similar low-molecular compounds may have been split from the molecule. Since in some cases small amounts of such foreign substances are known to cause dissociation of proteins^{8,9}, this might be a possible explanation of the splitting of the haemocyanin molecule to halves and eighths. Therefore the treated solution was dialysed before centrifuging, but the same results were obtained.

The electrophoretic properties were not changed by the treatment.

Details concerning the apparatus and results will be published elsewhere.

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¹Wood, B. W., and Loomis, A. L., *Phil. Mag.*, (7), 4, 417 (1927).

²Fremdling, H., Solner, K., and Rogowski, F., *Kolloidchem. Beih.*, 27, 233 (1933).

³Szent-Gyorgyi, A., *NATURE*, 121, 278 (1933).

⁴Szalay, A., *Ex. page. Chem.*, A, 104, 234 (1933).

⁵Svedberg, T., *NATURE*, 120, 1051 (1937).

⁶Svedberg, T., and Hedenius, A., *Biol. Bull.*, 66, 191 (1934).

⁷Brinkman-Quassel, L.-B., and Svedberg, T., *Biol. Bull.*, 71, 498 (1936).

⁸Lundgren, H. P., unpublished.

Action of Iodoacetate on Dehydrogenases and Alcoholic Fermentation

It is well known that iodoacetate produces a complete inhibition of alcoholic fermentation in yeast and of lactic acid formation in muscle even in very dilute concentrations ($M/3000$ or less). Up to the present, however, its mode of action and the precise point at which it attacks the catalytic systems are unknown, for none of the enzymes which has been tested is inhibited by such low concentrations. In high concentrations ($> M/20$) iodoacetate is a general enzyme poison and inhibits almost every enzyme tested. In moderate concentrations ($M/100$), it has no action on most enzymes and has hitherto only been shown to inhibit aldehyde mutase¹ and glyoxalase (the latter by an action not on the enzyme but on its coenzyme glutathione). These systems, however, are not inhibited by $M/3000$ iodoacetate, so that we must seek elsewhere for an explanation of its action on fermentation and glycolysis.

A systematic study of the action of iodoacetate on the dehydrogenases has not previously been made, but the results of such a survey are summarized in the accompanying table. It will be seen that while several of the dehydrogenases show a partial inhibition by $M/100$ iodoacetate, they are, with one exception, unaffected by a concentration of $M/3000$. The alcohol dehydrogenase stands out in a remarkable way as being the only dehydrogenase, and indeed the only enzyme, to be inhibited by this concentration. The inhibition becomes complete on slightly longer incubation.

Dehydrogenase	Source	% inhibition after 10 min. incubation with iodoacetate	
		$M/3000$	$M/100$
Lactic	Yeast	0	7
Alcohol	"	92	100
Triosephosphate (Hexosediphosphate)	"	5	95
α -Glycerophosphate	"	3	60
Lactic	Muscle	0	62
α -Glycerophosphate	"	0	42
Succinic	"	0	11
Fumaric	"	0	3
Malic	"	0	0
Xanthine	Milk	0	0
Aldehyde	"	0	5
Aldehyde mutase	Liver	0	95

The enzymes were prepared and tested with methylene blue at 38° and pH 7.4 essentially as described by Leloir and Dixon². Before testing, the enzymes were incubated at 38° for 10 minutes with the above concentrations of iodoacetate in the absence of substrates and co-enzymes. Owing to dilution on adding these, the iodoacetate concentrations during the actual tests were reduced to one half. The controls without iodoacetate were always incubated similarly before testing.

That the iodoacetate acts on the dehydrogenase (that is, Warburg's 'specific protein'; Euler's 'apodehydrogenase') itself, rather than on the coenzyme or on any enzyme-coenzyme complex, is clearly shown by the following experiment, which is made possible by the fact that the inhibition is not instantaneous but is set up by a time-reaction.

Thunberg tubes with hollow stoppers were used, so that either the enzyme or the coenzyme could be exposed to the iodoacetate during the preliminary incubation period. The reagents were distributed as follows:

In tube	In stopper
2 c.c. enzyme in phosphate	1 c.c. M alcohol
1 c.c. $M/3000$ methylene blue	0.2 c.c. coenzyme
	1.5 c.c. phosphate, pH 7.4
	(0.3 c.c. $M/50$ iodoacetate)

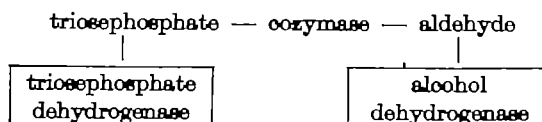
The tubes were evacuated and incubated for 20 minutes at 38° before mixing.

	Reduction time at 38°
Tube 1 No iodoacetate	3 m. 0 s.
Tube 2 Iodoacetate in tube	"
Tube 3 Iodoacetate in stopper	3 m. 55 s.

(Controls without coenzyme or alcohol were negative.)

It will be seen that tubes 2 and 3 contained the same reagents, but these were differently distributed during the initial incubation. When the iodoacetate and enzyme were incubated together, complete inhibition resulted, but incubation of the coenzyme with iodoacetate had little effect. Another tube, as tube 2 but with the alcohol and methylene blue interchanged, gave almost as much inhibition, showing that the enzyme was not appreciably protected by the presence of its substrate.

The specific poisoning of the alcohol dehydrogenase by small concentrations of iodoacetate provides a possible explanation for the inhibition of alcoholic fermentation in yeast. This dehydrogenase (= the 'aldehyde reductase' of Warburg) is a reversible system, catalysing the reduction of aldehyde to alcohol as well as the oxidation of alcohol. According to v. Euler³, it plays an essential part in the main processes of fermentation, namely, the oxido-reduction reaction between triosephosphate and acetaldehyde, which we may represent as follows:



The aldehyde, activated by the alcohol dehydrogenase, is reduced to alcohol by activated triosephosphate, coenzyme acting as a hydrogen carrier. If then the alcohol dehydrogenase is inhibited, this can no longer occur. Thus at any rate one point of attack of iodoacetate on the fermentation system has been found.

While this effect may be adequate to account for the inhibition of alcoholic fermentation, it is still possible that the iodoacetate acts also at some other point in the yeast system. In the glycolytic system of muscle, the lactic dehydrogenase, which occupies a position corresponding to the alcohol dehydrogenase in yeast, is completely resistant to dilute iodoacetate. These results, therefore, cannot account for the inhibition in muscle; the iodoacetate acts elsewhere in the muscle system and hence possibly in the yeast system also, in addition to the action described above. It is believed by many that iodoacetate acts on the initial stages of glucose fermentation by inhibiting the phosphorylating mechanism, for in yeast (unlike muscle) no glucose disappears and no intermediate products are found in presence of iodoacetate. But this is to be expected if we assume that the energy required for the phosphorylation is derived from the oxido-reduction, for inhibition of the latter process will obviously produce an indirect inhibition of the phosphorylation also.

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Oct. 5.

¹ Dixon and Lutwak-Mann, *Biochem. J.*, **31**, 1347 (1937).

² Leloir and Dixon, *Enzymologia*, **2**, 81 (1937).

³ v. Euler, Adler and Hellstrom, *Hoppe-Seyler's Z.*, **241**, 239 (1936).

Reaction between Proteins and Metaphosphoric Acid

In connexion with a publication by R. K. Schofield¹, we have prepared and analysed precipitates obtained from pure proteins with metaphosphoric acid.

1 c.c. of either egg albumen or clupein sulphate solution was mixed with 0.5 c.c. or 1 c.c. respectively 0.1 % metaphosphoric acid, centrifuged and washed with distilled water. When the washings were found free from proteins and metaphosphoric acid the precipitates were dissolved in concentrated sulphuric acid and analysed. (Content of precipitates of P and N in the table are mgm.)

Protein	Solution					Precipitate		
	Total N	Amino N		Total N/Amino N		Total N	Bound P	Ratio of total N to amino N calc. from bound P
		van Slyke	titr.*	van Slyke	titr.*			
Ovalbumin 1.8 per cent	3.1	0.22	0.25	14.0	12.5	2.99	0.49	13.2
						2.90	0.48	13.6
						2.90	0.46	13.9
						2.89	0.46	13.9
Clupein 1 per cent	2.18	Pos. charged amino N calculated		Ratio of total N to pos. charged amino N		2.18	1.06	4.55
		(3)	(4)	(3)	(4)			
		0.475*	0.478*	4.5*	4.55*			
		0.499	0.506	4.4	4.3			
						2.16	1.06	4.55
						2.14	1.02	4.70
						2.15	1.02	4.70

* Calculated for arginine.

The table shows a good agreement between the amount of phosphorus bound and the number of the free amino groups in the egg albumen and the number of positively charged amino groups (guanido groups of the arginin radicals) in the clupein.

We intend to publish a full report of this work later, but we mention these results because according to some workers² the products obtained with precipitants of this kind should have no fixed composition, whereas other investigators³ suppose them to be true salts.

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¹ Schofield, R. K., *Trans. Farad. Soc.*, (1) 21, 164 (1925).

² Linderstrom-Lang, K., *Compt. rend. Lab. Carlsberg*, 17, 4 (1925).

³ Waldschmidt-Leitz, H., Ziegler, F., Schaffner, A., and Weil, L., *Hoppe Seyler's Z.*, 197, 219 (1931).

⁴ Linderstrom-Lang, K., and Rasmussen, E., *Compt. rend. Lab. Carlsberg*, 20, 10 (1925).

⁵ Dillere, W. L., and Mims, B., *Compt. rend. Soc. Biol.*, 26, 1040 (1927).

⁶ Meyer, K., Palmer, W. Y., and Smyth, H. M., *J. Biol. Chem.*, 119, 501 (1937).

Action of Auxin on Protoplasmic Streaming

STUDIES on the mechanism by which auxin exerts its growth-promoting action on plant cells have indicated that, although ultimately detectable on the cell-wall, the effect is exerted in the first instance on the protoplasm. The results of Bonner¹ established a close connexion between growth and respiration, although pure auxin was not found, either by him or by van Hulsen², to increase respiration appreciably.

In an attempt to analyse the initial stages of auxin action, we have studied protoplasmic streaming in the epidermal cells of *Avena* coleoptiles. The streaming rate, as was shown by Bottelier³, is dependent upon oxygen supply. Low concentrations of indole-3-acetic acid, from 0.003 to 0.02 mgm. per litre, accelerate the streaming. Coumaryl-acetic and allocinnamic acids, which also possess growth-promoting activity, have a similar effect. The acceleration is ordinarily transient, lasting only about 30 minutes, but if after a lapse of a further 30 minutes auxin is again added, a second acceleration similar to the first is obtained.

When, however, fructose is added with the auxin, the acceleration is maintained for at least two hours. The limiting factor is, therefore, the carbohydrate supply.

The effect of higher concentrations of auxin depends upon the oxygen supply. In 5 cm. coleoptiles, if ample oxygen is available, all auxin concentrations up to 5 mgm. per litre cause about the same acceleration. If oxygen is more nearly limiting, the auxin causes a retardation of streaming. This retardation is removed by oxygen, but is increased

by dinitrophenol. We therefore conclude that auxin accelerates a respiratory process which controls streaming, and of which carbohydrate is the substrate. Auxin must also accelerate another respiratory process which, by consuming the available oxygen, makes the first process oxygen-deficient and hence retards the streaming. Both processes together probably make up only a small part of the total respiration of the coleoptile.

In younger (3 cm.) coleoptiles, the respiration rate is greater and consequently the streaming soon slows down in presence of insufficient oxygen. If auxin, 0.01 mgm. per litre or above, be added, the retardation is more rapid. On the other hand, if histidine, 6×10^{-4} molar, be added, this retardation is delayed. Since histidine alone does not accelerate streaming, it follows that histidine decreases the consumption of oxygen by those processes which do not control streaming. This may explain the well-known experiments of Fitting on *Vallisneria* leaves, in which the streaming, after stoppage, is retarded by dilute histidine solutions.

The respiration of the coleoptile must therefore be regarded as comprising at least three processes:

- (1) A reaction oxidizing sugar, which controls the rate of streaming and of growth; accelerated by auxin, not affected by histidine or dinitrophenol.
- (2) A reaction oxidizing sugar, which does not affect the rate of streaming; accelerated by auxin.
- (3) Other oxidative reactions, which do not affect streaming or growth; insensitive to auxin, accelerated by dinitrophenol, inhibited by histidine. These reactions account for the larger part of the observed oxygen consumption.

On this view the rates of streaming and of growth are controlled by the same process, and thus the

effect of auxin on streaming is probably one of the first stages of its effect on growth. This agrees with the rapidity of its action, the acceleration of streaming beginning within two minutes of auxin application. Correspondingly, those concentrations of auxin which affect streaming in coleoptiles with ample oxygen supply, show close agreement with the concentrations which affect growth in measurements made over the same short period. Thus the effects of auxin on streaming, and presumably also on growth, arise from the acceleration of a respiratory reaction.

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¹ Bonner, J., *J. Gen. Physiol.*, **20**, 1 (1935).

² van Hulzen, G. J., *Dissertation*, Utrecht (1935).

³ Böttcher, H. P., *Rev. trav. bot. néerl.*, **22**, 287 (1925).

Photoperiodic After-Effect

SEVERAL workers, notably Elghis, Rasumov and Dolgušin, claim to have demonstrated a photoperiodic after-effect with short-day plants, that is, an acceleration of flowering in such plants exposed to short days during the early stages of growth and afterwards grown in long days. This work has been done mainly on cereals and fodder plants, and so far as we are aware the existence of such an after-effect has not been demonstrated with any ornamental flowering plants.

Experiments have been in progress for some time in this department with a Mexican short-day plant, *Tithonia speciosa*. During this year the existence of a photoperiodic after-effect has been demonstrated. Seeds were sown in a glasshouse on April 19, and some of the seedlings covered with black shades from 5.0 p.m. to 7.0 a.m. daily (10-hour day), from germination. Sixteen plants received five weeks of short-day treatment and a similar number seven weeks. A further sixteen plants received the normal day length of fourteen to sixteen hours. All plants were planted in the open (in four randomized plots) on June 9. The first flowers of the seven-week treatment plants opened on June 21. The mean number of days from sowing to opening of the first and second flowers respectively for each treatment were as follows:

	Untreated	Five-week treatment	Seven-week treatment
No. of days to first flower	127	80	71
No. of days to second flower	136	97	83

This acceleration in flowering date was accompanied by a change in the entire habit of the plants. The control plants grew to the normal height of more than six feet with a thick, straight, main axis and lateral branches bearing very large leaves, deeply lobed. The plants receiving the longer short-day treatment were, in contrast, much less in height (about 2-2½ feet) freely branched, with in many cases no well-developed main axis and with unlobed leaves about a third of the normal size. The plants of the remaining treatment were intermediate in character.

The early-flowering habit of the treated plants was maintained throughout the season. The total number

of flowers produced by the sixteen plants of each series up to September 21 was as follows:

	Untreated	Five-week treatment	Seven-week treatment
Total no. of flowers (16 plants) ..	231	616	855

Further experiments will be carried out to determine the minimum exposure to short-day necessary to produce an effect, the maximum day-length, relation to temperature, etc.

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Flaked Flints from the Bone Beds of Bethlehem

OWING to absence abroad, I have not been able to write sooner on the subject of the very interesting article on "The Bone-Bearing Beds of Bethlehem" in *NATURE* of September 4.

I visited the Bethlehem site several times while Miss Bate and Miss Gardner were working on it in the spring of 1935, and was able to see the geological conditions described by Miss Gardner so far as they were then exposed. In July of this year I visited the Wellcome Museum with Miss Caton-Thompson in order to examine the flints which are thought to be artefacts, and came to the conclusion that none of them showed any flaking that could not be explained by the action of the mechanical forces to which they had admittedly been subjected. In contrast with the sub-Crag industry, there is an absence of flakes showing anything that could truly be described as a bulb of percussion, and the edge-trimming, which has rightly been compared with that of the Harrisonian eoliths, is of the vertical type well known as an effect of flaking by pressure in the soil.

A few weeks after I had seen the flints, Miss Gardner and I were able, by kind permission of Mr. Starkey, to show the whole collection to the Abbé Breuil, who was passing through London. He examined the flints and studied Miss Gardner's sections at some length, and his final opinion was that none of the specimens showed any flaking that could not be explained by the condition of the deposit in which they were found. He compared the Bethlehem site with that of Saint-Prest, near Chartres, where a hollow in the chalk had been filled up with an *argile à silex* yielding remains of *Elephas meridionalis*. The associated flints, which he said closely resembled those from Bethlehem, had at one time been claimed as artefacts by the Abbé Bourgeois and others, but were now generally admitted to be flaked by mechanical action.

Miss Caton-Thompson has herself stated and discussed so clearly the case for and against the human origin of the Bethlehem flints that further comment is scarcely necessary. I differ from her only in her final conclusion that these specimens are "less easy reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man. . . ."

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Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures"

(1) Since writing my first note¹ I have come across a passage in meteorite literature which, I think, definitely establishes the view that the high figure usually quoted for the number of Pultusk stones was based on a reasonable estimate and was not due to a misreading of a Warsaw publication, as suggested by Dr. Stenz². Daubrée³ mentions this very publication, and refutes energetically the low figures therein given as being "bien loin de la réalité". He knows already (August 1868) of more than 3,000 stones actually found, and emphasizes the exceptionally unfavourable circumstances for their collection. So, evidently, it was not ignorance of the statement made by the Haute École de Varsovie, but opposition to it, based on more extended knowledge which induced French, Austrian and German authorities to adopt the high value for the total number of the stones.

Dr. L. J. Spencer's contribution⁴ to the question contains interesting details about the transfer of Pultusk stones from the Krantz collection to that of the British Museum. He is right in saying that I over-estimated the proportion of small stones originally present in the former. While the expression used by vom Rath is ambiguous, fortunately it happens that in a paper by Buchner⁵ definite figures are given concerning the unsorted material which had been collected for Dr. Krantz. The average weight of Krantz's 2,012 stones was 61.2 gm. His collectors seem to have paid somewhat more attention to the small stones than did those of Daubrée—who had 942 stones of an average weight of 67.5 gm.—but even in Krantz's material the small stones were certainly not represented in the same proportion as in the original shower, because of the difficulty, or impossibility, of finding them. For other reasons as Dr. Spencer puts it, because "the best museums strive to acquire the best specimens") there is a further shift towards the big stones in most of the museum collections. In the British Museum the average weight of the Pultusk stones is as high as 252 gm.

A characteristic feature of the Pultusk shower was the high proportion of small stones. None were collected of less than 1 gm., but the reports mention black 'dust', and we know that in meteorite showers of this type the stones between 0.1 gm. and 1 gm. may outnumber all those between 1 gm. and 10 gm. Statements as to the supposed total number of stones should be accompanied by an indication as to the supposed average weight; to speak of 100,000 Pultusk stones may be misleading if the reader, or visitor, visualizes the average composition of certain museum collections. The weight of the total shower was perhaps only a small multiple of the 200 kgm. recovered, while 100,000 stones of the British Museum quality would make a total weight of more than 25,000 kgm.

(2) As to the spelling of "Widmanstätten figures", the issue now simply is whether we want to adopt the form of the name used by other members of the family, or the one chosen by the man himself. Dr. Spencer prefers the former alternative; those who share his opinion should speak of Beekh-Widmanstätten figures, or simply Beekh figures, for Beekh is the real family name. The discoverer of the strobiliform figures, however, had dropped the Beekh entirely, called himself Widmanstätten, and was officially and privately known under this name.

Since Dr. Spencer does not appear to dispute this fact, I do not think it necessary to quote more of the historic material from the Austrian archives than was given in my first note; but I should like here to express my thanks for all the trouble they have taken in making, or answering, inquiries, to Dr. H. A. Beekh-Widmanstätten, and Prof. H. Benndorf, A. Lecher, S. Meyer and P. Puntschart. I am especially indebted to Prof. S. Meyer for collecting and forwarding the material to me.

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Oct. 9.

¹ NATURE, 140, 504 (1937).

² Stenz, H., NATURE, 140, 118 (1937).

³ Daubrée, A., *Compt. rend.*, 67, 360 (1868).

⁴ Spencer, L. J., NATURE, 140, 589 (1937).

⁵ Buchner, O., *Poggendorff's Annalen*, 190, 589 (1869).

The Sign and Symbol of Heat of Reaction

THE recent report of the Joint Committee of the Chemical, Faraday, and Physical Societies on Symbols for Thermodynamical and Physico-Chemical Quantities may be taken as an occasion for some remarks on the sign and symbol of heat of reaction and allied quantities. As is familiar, the heat of a reaction may be defined as the heat generated or lost by the system, when unit mass of reactants passes into resultants, the unit of mass being the number of grams represented by the sum of the molecular weights multiplied by their respective coefficients on either side of the chemical equation.

Confining ourselves for present purposes to constant pressure conditions, and representing the enthalpy of the system by H , the mass of resultants in the above units by m , the heat of reaction is expressed by $-\partial H/\partial m$. If the process considered is that of solution, the same expression holds, the unit in which m is expressed being either the gram or the mol according to convenience. In contrast to these 'chemical' cases, we have the 'physical' cases of fusion and evaporation. In fusion, the solid is the reactant, the liquid the resultant, but here the heat of fusion is defined as the heat taken up by the system, and is expressed by $+\partial H/\partial m$, a similar expression holding for heat of evaporation.

These facts illustrate a fundamentally different outlook on the part of the physicist and the chemist. Considering the matter thermodynamically, the universe, regarded as an insulated system, is divided into two portions, the 'system considered', and the 'surroundings', which obviously include the observer. All changes of total energy and all reversible changes of available energy in these two portions are equal but of opposite sign. The physicist concentrates his attention on the former, the chemist tends to concentrate his on the latter portion. This has in the past gone beyond the instances considered, and some physical chemists of unassailable position have used ordinary thermodynamical symbols to express the negative values of the quantities usually associated with them.

With the view no doubt of counteracting the confusion thus created, the Bunsen Gesellschaft some years ago recommended that whereas quantities entering a system should be indicated by ordinary symbols, the quantities leaving the system should be indicated by the same symbols with a minus sign or bar drawn through them. I

should have liked to extend this recommendation, and to express the negative values of most thermodynamical functions where suitable by their signs with a bar drawn through them.

This leads us to the recently issued report. Although slightly diffident in view of its general excellence, and the distinguished names attached to it, I am yet impelled to enter a protest against a group of condemnations or bans contained in it on page 6. They are as follow: (1) The ban on the use of bars discussed above. (2) The ban on the use of a single symbol for such familiar concepts as heat of reaction. (3) An implied ban on the employment of simple thermochemical equations as hitherto used. A mode of expressing thermochemical data is given. I am in agreement with this for purposes of tabulation, although a purist might correctly object that the thermodynamical expression adopted for heat of reaction endows it with the dimension of "calorie" instead of "calorie per equational mol". Most readers of the report will, however, infer that the ordinary thermochemical equations of the past, all the symbols of which represent fully defined mathematical quantities, and which can therefore be treated by the ordinary methods of algebra, are banned. (4) The ban on the use of symbols such as U to express changes or differences in the magnitudes represented. When we remember that such symbols are by original definition referred to an arbitrary zero condition, it becomes obvious that by making the 'reactant' state the arbitrary zero, the quantity ΔU becomes equal to U , and an insistence on the use of Δ is unnecessary. Arising out of this ban we have the abbreviations proposed for $X_s - X_L$, which are as long as the expression abbreviated. I prefer the symbol X_{s-L} , which is clear, and useful in such cases, say, as the summing of potential differences, etc.

HENRY J. S. SAND.

Sir John Cass Technical Institute,
E.C.3.
Oct. 2.

Effect of Viscosity on Ionic Mobilities

IN the course of some measurements of electrolytic conductivity, I have determined the effect of increasing concentrations of phenol upon the equivalent conductance of a very dilute solution of hydrochloric acid in water at 25°. Using the viscosity data of Swearingen¹, m is found to be 1.000 in the equation $\lambda' = \lambda F^m$, where λ' is the measured equivalent conductance, λ the predicted equivalent conductance in the absence of phenol, and F the relative fluidity of the phenol solution. Above 0.30 normal phenol concentration, m becomes increasingly less than 1. Stokes's law would predict $m = 1$. The concentration of hydrochloric acid was 10⁻⁴ normal.

This type of measurement is of particular interest for the following reason. The deviation of the stoichiometric ionization constant of a weak acid from the Debye-Huckel limiting law: $\log K_T = \log K_S - 1.013\sqrt{C_i}$, where K_S and K_T are the stoichiometric and thermodynamic ionization constants respectively, and C_i the ionic strength, can only be explained by a decrease in the ionic mobilities as the proportion of unionized acid increases. Progressive change in the activity coefficients of the ions and molecules concerned can explain only a small fraction of the deviation. This is clearly shown by the work of MacInnes and Shedlovsky² on acetic acid, and by similar investigations on propionic and

normal butyric acids which I shall publish shortly. Davies³ was the first to point out that if mobilities are corrected for viscosity according to the simple law $\lambda' = \lambda F$, the observed deviations largely disappear. This is an indirect demonstration that viscosity is mainly responsible for what MacInnes and Shedlovsky term the medium effect.

It is not feasible to measure the medium effect directly, but the kind of experiment I have performed for phenol approximates closely to a direct method, since, due to the high mobility of hydrogen ion, the effect on hydrogen and chloride should not differ markedly from that on hydrogen and phenate ions. The ionization of the very weak phenol will be inappreciable in the presence of hydrochloric acid.

Many years ago experiment⁴ showed that for various systems the exponent m differed widely from 1. It is to be wondered whether, if these experiments were to be repeated to-day with all the benefits of modern technique, m would not turn out to be 1, at least at the lower concentrations of the non-electrolyte.

I understand that Dr. Shedlovsky has made a similar investigation of the medium effect in acetic acid. It is hoped that he will be stimulated to publish these experiments, which precede mine by many years.

DONALD BELCHER.

Laboratory of Physical Chemistry,
Cambridge.
Sept. 24.

¹ Swearingen, *J. Phys. Chem.*, **36**, 785 (1932).

² MacInnes and Shedlovsky, *J. Amer. Chem. Soc.*, **54**, 1429 (1932).

³ Davies, *Phil. Mag.*, **4**, 249 (1927), and 'The Conductivity of Solutions' (1933), p. 141.

⁴ Green, *J. Chem. Soc.*, **98**, 2023 (1908).

Neutrino Theory of Light in Three Dimensions

THE neutrino theory of light is based on a fundamental hypothesis of Jordan¹, according to which the emission of a photon must be considered either as emission of two 'coherent' (parallel) particles—neutrino and antineutrino—or as a kind of neutrino Raman effect, without change of direction. This hypothesis permitted Jordan to construct, in the one-dimensional case, the Bose amplitudes required for photons, from the neutrino amplitudes which satisfy the Fermi statistics.

When attempting to construct the commutator rules in the three-dimensional case, the main difficulty is to obtain coherent emission of neutrino and antineutrino².

We should like to propose the following three dimensional generalization of the one-dimensional expression given previously³ for the relation between the amplitude of photon (b) and neutrino or anti-neutrino respectively (a or c , respectively):

$$b(\mathbf{k}) = \lim_{\sqrt{2}} \frac{\epsilon i}{\sqrt{2}} \int d\mathbf{l} \left\{ \frac{a^+(1)a(1+\mathbf{k}) + c(1+\mathbf{k})c^+(1)}{[\sqrt{(\mathbf{k}+1)^2 + k_0^2} - \sqrt{l^2 + k_0^2} - k] \sqrt{[(\mathbf{k}+1)^2 + k_0^2][l^2 + k_0^2]}} \right. \\ \left. - \frac{c(\mathbf{k}-1)a(1)}{[\sqrt{(\mathbf{k}-1)^2 + k_0^2} + \sqrt{l^2 + k_0^2} - k] \sqrt{[(\mathbf{k}-1)^2 + k_0^2][l^2 + k_0^2]}} \right\}$$

where $\epsilon = \mu \sqrt{\frac{c^2}{4\pi h}}$, $k_0 = \frac{\mu c}{h}$, $d\mathbf{l} = d\mathbf{l}_x d\mathbf{l}_y d\mathbf{l}_z$

and μ is the mass of neutrino.

With $b^+(\mathbf{k})$ constructed analogously, the required Bose commutation rules are verified immediately for $\chi(\mathbf{k})$ and $b^+(\mathbf{k})$ if the amplitudes of neutrinos and antineutrinos obey the Fermi statistics, and if all the states above a certain one are unoccupied.

Regarding ϵ as the 'charge' of neutrino, we see that the coherence condition is fulfilled, both 'charge' and mass of the neutrino particles tending to zero, but their relation remaining finite and equal to $\sqrt{\frac{c^2}{4\pi\hbar}}$ (neutrino) and $-\sqrt{\frac{c^2}{4\pi\hbar}}$ (antineutrino).

In the same way, it is possible to take into account the spin of neutrino particles and to obtain a formula⁴ correspondingly generalized.

A. SOKOLOV.

Siberian Physical-Technical Institute,

Tomsk.

Sept. 13.

¹ Jordan, P., *Z. Phys.*, **93**, 464 (1935).

² cf. Jordan, P., and Kronig, R. de L., *Z. Phys.*, **100**, 500 (1936).

³ Sokolow, A., *NATURE*, **139**, 1071 (1937).

⁴ cf. Sokolow, A., "On the Neutrino Theory of Light (three dimensional case)", *Phys. Z. Sowjetunion*, in the press.

Dry Crossing of the Nile

READERS who have followed the correspondence under this head¹ may be interested to learn that the dry crossing, which is situated at a point some

10½ miles downstream of Nimule, is definitely reported by Mr. N. B. Watney, district commissioner, West Nile, to be breaking up².

My original informant, a native, told me that the crossing formed in 1917, disappeared in 1921, and reformed about 1930—it was certainly well in evidence when I first saw it from the air in the following year. Tradition has it, I learnt, that the dry crossing forms in times of famine and disappears in times of plenty. Recorded famine years are 1898, 1908, 1918–19 and 1928. Thus if these figures are any guide, we should be on the verge of another famine; but administrative precautions in this regard have been well in hand for some time.

Dr. Hurst suggests³ that he saw the beginnings of this dry crossing in 1924, but it seems that this is not so, for the sudd he refers to was "at a point where the river narrowed suddenly". This it does not do at the dry crossing, and a satisfactory explanation of its repeated formation at that particular spot has yet to be found.

There is a mistake in my original letter¹; "1930" should read "1931".

E. J. WAYLAND.

Geological Survey Office,

Entebbe, Uganda.

Oct. 14.

¹ *NATURE*, **139**, 961 (June 5, 1937).

² *NATURE*, **139**, 904 (June 12, 1937).

³ *Uganda Journal*, **4**, No. 4, 350 (May 1937).

Points from Foregoing Letters

PHOTOGRAPHS taken with a rotating camera by Dr. T. E. Allibone and J. M. Meek show that, in laboratory spark discharges as in lightning, a pre-discharge or 'leader stroke' traverses the whole of the inter-electrode gap before the main discharge occurs. The leader stroke begins from one or both electrodes, travelling at a rate of 20–40 km. per second (faster at reduced pressures). Its direction may be deduced from the branching of the discharge.

The haemocyanin molecule is split into halves and eighths by means of ultra-sonic waves with a frequency of 250,000 per sec. This is inferred by Sven Brohult from sedimentation experiments carried out with the ultra-centrifuge.

Dr. M. Dixon states that iodoacetate, in the concentration required to abolish yeast fermentation, completely inhibits the alcohol dehydrogenase but does not affect any other dehydrogenase tested. This may explain the inhibition of the fermentation. The action is on the enzyme itself and not on the coenzyme or an enzyme-coenzyme complex.

When egg albumen is precipitated with metaphosphoric acid, the ratio of 'bound' phosphorus to nitrogen corresponds to the free amino groups in the albumen, according to Dr. H. Herrmann and G. Perlmann. If clupein solution is used, the ratio corresponds to the number of positively charged amino groups in the clupein molecule.

The growth-promoting hormone, auxin, accelerates the 'streaming' of protoplasm in cells of coleoptiles of young oats, according to Prof. K. V. Thimann and Miss B. M. Sweeney. The effect lasts about half an hour, longer if fructose is added; oxygen supply also a factor. The authors conclude that the respiration of the young oat coleoptiles comprises at least three processes: one, accelerated by auxin, controls proto-

plasmic streaming and growth; another, also accelerated by auxin, oxidizes sugar and accelerates growth but does not affect streaming; other oxidation reactions which do not affect streaming or growth and are not affected by auxin, are influenced by substances such as histidine and dimethylphenol.

Prof. R. H. Stoughton and D. R. Hole find that, as in the case of cereals and fodder, when the short-day ornamental Mexican plant *Tithonia speciosa* is exposed to short days during the early stage of growth and afterwards to long days, there is a notable acceleration of flowering, and a change in the entire habits of the plant.

Dr. H. J. S. Sand criticizes some of the recommendations made by the Joint Committee of the Chemical, Faraday and Physical Societies on Symbols for Thermodynamical and Physico-Chemical Quantities, namely, its ban on (1) the use of symbols with a bar drawn through them to indicate quantities leaving the system; (2) the use of single symbols for familiar concepts such as the heat of reaction; (3) the employment of simple thermochemical equations as hitherto used; (4) the use of symbols such as U to express changes or differences in the magnitudes represented.

Mr. Donald Belcher finds that, in aqueous solutions of phenol at 25°, the ionic mobilities of hydrochloric acid are proportional to the fluidity to a high degree of accuracy up to 0.3 normal phenol. If this is true for other systems, it is of importance in the interpretation of dissociation constants as determined from conductance measurements.

A. Sokolow proposes a formula for the relation between the field of the photons and neutrino in the three-dimensional case.

Research Items

Boats of Victoria Nyanza

THE question of the origin of the boats of Victoria Nyanza is raised by Mr. G. W. B. Huntingford (*Man*, September) in reference to a suggestion by Mr. J. Hornell that they were due to a possible Indonesian migration to the highlands of Kenya or a long-continued contact with Indonesia along the east coast of Africa. Mr. Hornell pointed out that the peculiar features of these boats, a bifid bow and penetration of the thwarts through the side planks, are features of Javanese and Maduran construction. Mr. Huntingford argues that there are no other traces of Indonesian influence in the Lake region. The Nyanza boats have nothing in common with the coast boats, and there is no sign of Indonesian influence in the Kenya highlands. The enlarged false prow of the Nyanza boats may be an African adaptation without understanding of the branch found on drawings of early Egyptian boats. The Bantu may have taken it over from the Nilotes. Further, both the Egyptian and the Scandinavian types may have originated in Crete. A clay model (Early Minoan I) has something that looks remarkably like a bifid prow. In the same issue of *Man*, Mr. Hornell replies. Against the Egyptian origin, the Egyptians always pegged, and never sewed, the planking of their boats; and the beak of the bifid prow has been much exaggerated in representation. It is not structural but ornamental. Against the argument for an indigenous origin is the lack of skill in boat-construction of the Bantu. As regards the argument against Mr. Hornell's hypothesis of an Indonesian origin, there are cultural features suggesting Indonesian influence in Tanganyika; and there are resemblances to the present-day coast boats in, for example, the sewn planks which characterize Nyanza boats. The absence of outrigger is not vital.

Ethnology of Wallis Island

UVEA (Wallis Island) was visited by Mr. Edwin G. Burrows in 1932 for the purpose of furnishing a report on the ethnological relations of the inhabitants (*Bernice P. Bishop Museum, Bull.*, 145). The nearest islands are Futuna (112 miles), Samoa (186 miles), Fiji (240 miles) and Tonga (332 miles). Uvea has an area of 23 sq. miles. It has been known to Europeans since 1767; and since 1837 there has been a French Catholic Mission in the island, which has strongly affected the culture of the inhabitants, especially in such matters as marriage. The population is increasing. In 1837 it was estimated at not more than three thousand. In 1923 it numbered 4,878. In physical appearance the inhabitants are described as tall, light brown to copper, robust and well proportioned. The cranium is brachycephalic, but occipital flattening is practised. The language is a dialect of Polynesian. Kinship governs social and economic groupings, but politically is important only as limiting succession to titles, the political unit following territorial lines regardless of kin. Yet there are indications that the names of certain villages indicate clusters of kinsfolk. Exogamy has been supplemented by church regulation of marriage.

Brother and sister avoidance formerly was very strict. Polygyny was formerly permitted to certain chiefs. There is no term in the language for the biological family, and the recognized kinship group is the lineage, tracing descent from a common ancestor through the father. The mother-line is recognized secondarily. The nucleus of the kin is the group sharing a homestead. The culture relation is Western Polynesian with elements from Tonga and other islands.

Linkage Relations of Parallel Mutations in *Drosophila*

A COMPARISON of the known genes in *Drosophila melanogaster* and *D. pseudo-obscura* is made by Dr. A. H. Sturtevant and Dr. C. C. Tan (*J. Genetics*, 34, No. 3). Some 25 new mutations of *D. pseudo-obscura* are pointed out as parallel or homologous to those of the other species, in addition to 29 already known; but their arrangement in the chromosomes is different in the two species. *D. pseudo-obscura* has 5 pairs of chromosomes whereas *D. melanogaster* has 4 pairs. The right arm of the X-chromosome in *D. pseudo-obscura* is also known to be homologous with the left arm of chromosome III in *D. melanogaster*. Four or five other species appear to agree in having a two-armed X-chromosome like that of *D. pseudo-obscura*. Chromosomes III and IV of *D. pseudo-obscura* are joined to form II of *D. melanogaster*. The mechanism by which such exchanges of chromosome arms can have happened is discussed. The linkage relationships show that many rearrangements of genes within the arms have taken place, and that since these two species diverged from a common ancestor, at least nineteen such inversions have occurred and become established. By similar methods it is hoped to work out the phylogenetic relationships of other species in the genus, such as *willistoni*, *virilis*, *hydei* and *junebris*.

A New Blow-fly Repellent

FOR the prevention in sheep of myiasis, which exacts a heavy toll in most sheep-rearing countries, many tests have been carried out with a multitude of chemicals, without revealing any thoroughly satisfactory repellent for blow-flies. In Great Britain the most promising recent dip is W. Moore's oil emulsion dip containing paradichlorobenzene used by the team of workers at Aberdeen under Prof. James Ritchie, but every new suggestion should be thoroughly tested. H. O. Monnig has been experimenting with some oils of common South African plants and shows that steam-distilled oil of *Tagetes minima* has strong repellent properties for blow-flies and that it is suitable for use in a blow-fly dressing. (*Onderstepoort J. Vet. Sci. Anim. Ind.*, 7, 419; 1936). As larvicides, carbon tetrachloride and tetrachlorethylene were found to be effective against the maggots, but the latter had a harmful effect upon wounds. The materials were used as a dressing in an emulsion, the emulsifier which acted most satisfactorily being wool-grease. The author gives particulars for the preparation of a suitable emulsion.

Enzymes of Wood-Rotting Polypores

THE study of fungi which induce the rotting of wood is of great importance, from both practical and theoretical points of view. Polyporaceous fungi often bring about such rotting, and their enzyme equipment has been the subject of study by Dr. S. R. Bose and S. N. Sarkar (*Proc. Roy. Soc., B*, 123, 193-193; July 1937). Eight species of polypore fungi were examined, and an imposing array of enzymes has been found. Invertase, raffinase, maltase, amylase, emulsin, hemicellulase, cellulase, pectinase and ligninase seem to furnish the possibility of destroying extra-cellular, almost any common carbohydrate. Lipolytic and proteolytic enzymes were present in small quantities, catalase appeared as an intra-cellular enzyme, whilst laccase was found in *Polytictus sanguineus*, *Daedalia flavida* and *Trametes acetines*. Extra-cellular enzymes were more abundant than those inside the cell, and their activity appeared to be greater in the vegetative fungus than in the fruiting organism.

Hybrids of the Rhododendron

A PAPER by Mr. F. C. Puddle (*J. Roy. Hort. Soc.*, 2, 9, 393-398, Sept. 1937) gives some useful information about the possibilities of hybridizing the numerous species of *Rhododendron* now available to horticulturists. The activities of plant collectors have added the beauties of the eastern kinds to the better-known European species. Taxonomists have recognized two sections, the Lepidote and the Elepidote, in the genus *Rhododendron*. It is usually difficult, and frequently impossible, to hybridize between these sections. The Elepidote species of *Rhododendron*, however, interbreed readily with the Auteum series of *Azalea*, although they are plants with more remote taxonomic relationship. Practical considerations for the prosecution of experiments in hybridization are given, and breeders are invited to consult the Stud Book of the Rhododendron Association, which shows the results of more than four hundred crosses the offspring of which have possessed horticultural value.

Antarctic Structure

SOME further evidence in favour of the probable structural relationship of New Zealand to King Edward Land in the Ross Sea is adduced in certain of the bathymetrical work of the Byrd Antarctic Expedition 1933-35. Mr. S. E. Ross, in a paper on the Ross Sea in the *Geographical Review* of October, notes the discovery at the entrance to the Ross Sea, some two hundred miles south of Scott Island, of the Iselin Bank, with a minimum depth of 700 metres and a length of about 200 miles and separated by a deep gully from the continental shelf. Further to the south-east lies the Pennell Bank. The course of the Antarcticides may possibly run from New Zealand via Macquarie and Scott Islands and these two banks into King Edward Land. Thus the Pacific Basin appears to be separated from the deep water farther west. King Edward Land turns out to be peninsular in character, extending south-east from Cape Colbeck, and there is considerable evidence that the line of folds is continuous with the Edsel Ford range farther east. Mr. F. A. Wade, writing on the borderlands of the Ross Sea in the same review, points out the resemblances of this range of folded sedimentaries and intrusive igneous rocks to the

Graham Land region, in spite of the igneous rocks being of the Atlantic rather than the basic Pacific type. It is noteworthy that many indications of former more extensive glaciation were found in this range.

Lhuyd's Maps of England and Wales

THE Ortelius atlas published in Antwerp in 1573 included maps of England and Wales and of Wales prepared by Humphrey Lhuyd. In 'Humphrey Lhuyd's Maps of England and of Wales' (National Museum of Wales, 1937. 1s.), Dr. F. J. North discusses these maps, particularly that of Wales, as regards means of preparation and sources of information. The outline of Wales is reasonably good and many rivers and places are shown. Mountains are indicated by conventional hummocks. The scale is about 8 miles to an inch. The manuscript of the map is unknown and probably does not exist. Dr. North gives reasons for his belief that Lhuyd's map was not based on angular measurement but that it was founded on one of the editions of the Ptolemy map of Great Britain, or some other maps which was based on Ptolemy. In his compilation Lhuyd probably owed some details to Lily's map of the British Isles (1546), Mercator's map (1564) and Nowell's manuscript maps. The basis of the English part of Lhuyd's map appears also to be Nowell's, Mercator's and an unknown map related to both.

Coal Measure Rocks

THE Safety in Mines Research Board has published as Paper No. 98 a report by H. M. Hudspeth and D. W. Phillips entitled 'Coal Measure Rocks: Part I.—Classification, Nomenclature and Relative Strengths' (London: H.M. Stationery Office. 1s. net). The more important rock structures bearing on the strengths of rocks and on roof control are discussed with special reference to the programme of research on rock falls in mines which was initiated some years ago. The strata are classified into five standard groups—sandstones, siltstones, mudstones, shales and clays—according to grain size and constitution. The general petrological characters of the chief rock types are summarized and also their relative strengths and bending capacities. The varied nomenclature used to describe the rocks in the different coalfields of Britain is listed with a brief description of each term. A scheme of strata notation is suggested which is sufficiently comprehensive to illustrate the rocks met with during coal mining. The report will in due course be supplemented by others dealing with Coal Measure rocks in relation to roof control.

Meteorology of Lower Egypt

IN a paper entitled 'Temperature and Relative Humidity in the Atmosphere over Lower Egypt' (Prof. Note 75. M.O. 336c. London: H.M. Stationery Office. 2d. net.) Mr. W. D. Flower gives tables of monthly mean values of these quantities from the results of observations made in aeroplanes in the early morning from 1922 until 1930 at three inland stations in Lower Egypt—Helwan, Heliopolis and Ismailia—covering roughly the range 30°-32° north latitude. The observations were made while the aeroplanes were ascending, the time taken to reach the height where pressure was only 650 millibars being about an hour, and the ascents generally began

between 7 a.m. and 8 a.m. local time. Temperature means are for 500-metre intervals, and are based on a good number of observations up to 4,000 m. They show little lag with height in the time of the maximum and minimum of the annual march. There is a gradual increase of temperature from January until August and a rapid decrease in the last three months of the year, but the rate of rise between April and May is retarded above 1,000 m., owing doubtless to a tendency for short periods of very high temperature in April at such levels that has been noted by earlier writers. The mean lapse rate is not very different from that observed in England in the early morning, but observations made in the early afternoon show that it then exceeds the dry adiabatic rate from January until August up to 1,000 m. and exceeds it at times in all months, while in May and June this is often the case up to 2,000 m. The observations of relative humidity show that the mean is so low as 24 per cent at 4,000 m. in August; the mean vapour pressure, however, is higher than that in England at all levels, in spite of the occurrence of such extremely low values as 0.1 millibars at 2,500 m. on one occasion in March and at 3,000 m. once in October. The paper concludes with a discussion of the formation of early-morning clouds in summer, which are attributed to the greater radiation from layers of moist air; they sometimes develop downwards from the top of the moist layer so as to reach the ground and cause fog.

A New Purine in Tea

THE known purines occurring in plants are caffeine $C_8H_{10}O_4N_4$, theobromine, $C_7H_8O_2N_4$, and theophylline, $C_7H_8O_2N_4$. These may be considered as end-products of purine metabolism in plants. In addition to these, some substances such as adenine and guanine, adenylic acid, vernine or guanosine, xanthine and hypoxanthine occur, the non-methylated purines being probably degradation products of plant nucleic acids. While uric acid has long been known as a characteristic oxidation product of purines in animals, it has only recently been found to exist in small quantities in plants (30–250 mgm. per kgm. dry plant). A methyl derivative of uric acid has now been detected for the first time in tea by T. B. Johnson (*J. Amer. Chem. Soc.*, 59, 1261; 1937). A residue from several million pounds of tea obtained in the commercial removal of caffeine was available and from this about 10 gm. of crystals were picked out. These were found by very careful examination, both chemical and crystallographic, to be 1,3,7,9-tetra-methyl-2,6,8-trioxypurine, derived from 2,6,8-trioxypurine (uric acid). It had been synthesized by Emil Fischer in 1884. As Prof. Johnson says: "By the discovery of this purine in tea, we not only increase the number of characteristically methylated purines occurring in the plant kingdom to four (theobromine, theophylline, caffeine and tetramethyl uric acid), but we also stimulate a new interest in the possible natural occurrence of other methyl derivatives of this series, and also in the mechanism of the plant metabolism of purines in general."

Sublimation and Condensation of Crystals

T. ALTY (*Proc. Roy. Soc., A*, 161, 68) has investigated the interaction of vapour molecules with a crystal surface by measuring the rate of sublimation of crystals into a vacuum. When the crystal is in equilibrium with saturated vapour the number of molecules incident on the surface can be determined

from the vapour pressure. The number retained by the surface is equal to the number which leave it and is assumed to be the same as the rate of evaporation in vacuum. The fraction of the incident molecules which condense is called the condensation coefficient. Measurements on liquids have shown that it is nearly unity for benzene and carbon tetrachloride and is of the order 0.04 for water and alcohol. Similarly, the present work shows that iodine and naphthalene have coefficients of condensation unity, while camphor and benzoic acid have much smaller coefficients. The value 0.17 was obtained for camphor. As in the case of the liquids, it seems that non-polar substances have unity values for the condensation coefficient.

A Theory of Ball Lightning

THERE exists a considerable number of descriptions of ball lightning, usually associated with thunder storms. Th. Neugebauer (*Z. Phys.*, 106, 474) has now produced a theoretical explanation of the phenomenon. He shows that a number of charged particles—electrons and positive ions—may form a compact gaseous mass if the electron density is very high and of the same order as the density of gas molecules. The mass of gas is held together mainly by the 'exchange forces' of quantum mechanics—the electrons form, under the assumptions made, a non-degenerate gas. The theory shows that the ball may disappear in one of two ways as the electron density falls owing to recombination—either the ball may collapse or it may explode, according to whether the radiative loss of energy keeps pace with the falling exchange forces. These modes of disappearance both occur in the descriptions of ball lightning. The electron density necessary for a coherent ball is much higher than can be attained in laboratory discharges but it is suggested that it may be reached in lightning flashes of normal type.

Ionosphere Observations in Japan during a Solar Eclipse

THE results of observations on the ionosphere made in Japan during the total solar eclipse of June 19, 1936, are described in a paper by T. Minohara and Y. Ito published in the *Electrotechnical Journal* of October 1937. This journal is an abstract section in English of the *Journal of the Institute of Electrical Engineers* of Japan. The observing station was at Iwamizawa, Hokkaido, and this site was selected because maximum totality of the eclipse occurred in the ionosphere at a height of 260 km. above the observing station. Using the usual type of pulse emitter, the effective heights and critical frequencies of the E , F_1 and F_2 regions of the ionosphere were measured with automatic recording apparatus covering the frequency range 1.5–15 Mc./sec. The result reproduced in the paper shows that the effect of the eclipse was very distinct in the case of the F_1 region but very obscure in the other cases. The ionization density in the F_1 region was approximately proportional to the exposed area of the sun's disk, thus indicating that the ionization was due to ultra-violet light. In the case of the F_2 region, the ionization increased somewhat during the eclipse, an effect which might have been due to decrease in temperature, with consequent contraction and increase in ionization density in the region of the ionosphere concerned. Alternatively, the effects observed may be attributed to the magnetic disturbance which accompanied the eclipse.

Lubrication and Lubricants

UNDER the auspices of the Institution of Mechanical Engineers, in collaboration with some forty-five other technical institutions and societies, a general discussion on lubrication and lubricants was held in London on October 13-15. The discussion centred around more than a hundred papers contributed by leading authorities throughout the world: the meetings were extremely well attended and the essential objects of the promoters—to review the present state of knowledge and to discuss the major problems of lubrication and lubricants—were attained with a considerable degree of success. Much valuable and interesting information and data were made available, while pleasing evidence was afforded of the great amount of research attention now being given to every aspect of lubrication, also of the growing concern and interest in its problems shown by designers and operating engineers. Not the least valuable feature of the discussion was the interest in, and the divergence of views on, certain fundamental aspects, which will undoubtedly stimulate further research in this field.

An adequate review of the papers, all of which were available at the meeting*, cannot be attempted in a limited space, but it may be useful to give an indication of some of the problems revealed and discussed. For convenience of discussion, the papers were placed into four groups.

JOURNAL AND THRUST BEARINGS

The first group of papers relate to the problems of journal and thrust bearings. Swift describes the application of the results of his modified Reynolds' theory of the journal bearing film to design; he uses the correction for end leakage deduced by Kingsbury from experiments with an electrical analogy apparatus. Boswall gives data for the 120° journal bearing, and Prandtl and Hanoog report experimental work which indicates that partial bushes behave like articulated plane pads. It is apparent that experimental results and theory are in agreement in a general way for thick film conditions in journal bearings. A number of papers deal with the more critical conditions as failure is approached. Needs, also Bradford and Vandegrift, consider the effect of pressure on viscosity, and its relation with friction, pointing out that what might appear to be an 'oiliness' effect of a fatty oil could be due actually to the smaller effect of pressure on its viscosity. This pressure effect on viscosity can only become material, however, when the film thickness is of the order of 1μ , and the irregularities of the surfaces with present-day standards of finishing begin to affect the behaviour as this thickness is approached. Moreover, Kyropoulos mentions another complicating phenomenon in the decrease of viscosity which accompanies flow-orientation of a lubricant consisting of long-chain molecules. Heidebroek and Brillié describe the local interference of surface irregularities with the film pressure development, and the latter refers to the increase of friction due to oil whirls which, he considers, are formed in the tiny valleys of the surface.

Experimental work on the approach to failure is included in the papers by Tenot and Jakeman and Fogg, the latter showing the effects of the usual variables on 'seizing' temperature; also Clayton shows how the change of shape of the bush due to running-in increases the safety of a bearing. Guy and Smith, also Soderberg, describe current practice regarding turbine bearings, emphasizing the cooling function of the oil. These authors mention the troublesome vibration which occurs with these lightly-loaded high-speed bearings, and Newkirk refers to suggested means of combating this difficulty; it is apparent that the phenomenon is not yet fully understood. Risk of ignition of escaping oil due to contact with the hot parts of a turbine is considered by Chittenden; with the view of avoiding this difficulty Samuelson has carried out experiments with a water-base lubricant, and shows that the bearing performance is in some respects improved, even though the viscosity is only one tenth of that of the usual oil. Guy and Smith refer to the great need for co-operative research into bearing behaviour under the high-speed conditions of turbine operation.

Thrust bearing design is based mainly on Michell's original work. Reference may be made to the use of pivoted pads for journal bearings (Gibson), and to the mass-produced, low-friction Nomy bearings (Odqvist), which work on the Michell principle but have rotating instead of stationary pads. Linn and Sheppard describe a thrust bearing in which the pressure film is induced by tapering the leading edges of the lands, there being no tilting elements. Several papers describe the use of synthetic resin bonded materials, and two the use of rubber, for journal bearings, both being water-lubricated.

INTERNAL COMBUSTION ENGINES

In the section devoted to the lubrication of internal combustion engines, many papers deal with bore wear, and it is apparent that both corrosion and abrasion are involved. The much greater wear due to starting than to running is brought out by Yeates. On the other hand, Taub and Young do not consider that corrosion is normally the main cause of wear. Everett and Keller refer to the very sensitive iron contamination method of measuring wear. Williams shows that lower viscosity gives higher wear under cold conditions, but this may be offset to some extent by the more rapid arrival of a thin oil after starting; Barrington and Lutwyche show the decrease of cranking torque with decrease of viscosity. Bass, Bouman and Norlin agree that 'oiliness' dopes have little effect, though Taylor considers the piston rings to operate most of the time under boundary conditions in which 'oiliness' dopes would be expected to have an effect. Rosen, however, shows that anti-oxidation dopes reduce wear considerably, and Barrington and Lutwyche show a decrease of cranking torque due to additions of oleic acid, but not with compounded oils.

Opinions differ on the question of oil consumption. Taub advocates plentiful supply to the cylinder with drastic scraping by high-pressure rings, while Ottaway does not favour high-pressure rings and regards limitation of the supply from the big-ends

* Institution of Mechanical Engineers. General Discussion on Lubrication and Lubricants. Group 1: Journal and Thrust Bearings. Pp. 300. 2s. 6d. Group 2: Engine Lubrication. Pp. 216. 2s. 6d. Group 3: Industrial Applications. Pp. 162. 2s. 6d. Group 4: Properties and Testing. Pp. 226. 2s. 6d. (London: Institution of Mechanical Engineers, 1937.)

as necessary. Taylor suggests that the sudden increase of consumption at high speeds is due to change from boundary to fluid film conditions, but Taub ascribes it to ring flutter.

The problem with internal combustion engine bearings is temperature rise. White-metals lose fatigue strength rapidly with increase of temperature (Macnaughtan, Williams), and consequently crack in service unless the temperature can be kept down. Williams gives results of actual temperature measurements in the bearings of an engine, showing the increase with increase of speed and inlet oil temperature, and decrease with increase of oil flow. Neave and Sallitt review the various copper-bearing alloys, including lead bronze, which is often used as a substitute for white-metal under high-duty conditions. Mickelsen suggests that, in view of the importance of cooling, it might be possible to lubricate the bearings with water or a water-oil mixture.

Several papers deal with filtration and oil purification by various types of apparatus, including de Langen's magnetic filter for removing iron particles. The importance of removing the fine particles which get into the clearance spaces of bearings is being realized, though it is difficult to achieve this with a filter of reasonable size.

RECIPROCATING STEAM ENGINES

Turning to the subject of the lubrication of reciprocating steam engines, the French and German State railways consider that various grades of superheated cylinder oil are desirable according to the degree of superheat in the cylinder, whereas Canadian National and English railways use only one grade. The majority favour compounded oils, the decomposition products of the fatty oil being thought to form stable and resistant boundary films. The oil is now supplied by pump instead of by a hydrostatic system, but there is some difference of opinion between the English and French railways as to the part of the stroke at which it is best to supply the oil.

In marine practice, according to Freeman, superheated steam valves, pistons and liners are lubricated by mechanical lubricators feeding into the steam pipe or round the high-pressure liners. Auld and Nicholson deal with oil circulation systems, and the changes that may occur in the oil. Nicholson emphasizes the advantages of a small amount of oil of the correct type properly applied; overfeeding may result in deposits in the cylinders and steam chests.

H. J. G.

[To be continued.]

Adult Education in the United States

ADULT education has been much discussed of late, especially from the point of view of education for citizenship in a democracy. This is a point of view now very widely canvassed in America, having found an enthusiastic advocate in Dr. J. W. Studebaker, the United States Federal Commissioner of Education. A year ago his bulletin "Education for Democracy: Public Affairs Forums" was noticed in these columns, and an appreciation of the 'Forum' system, based on six weeks' personal participation, by the secretary of the British Institute of Adult Education, was published in Bulletin No. VII of the World Association for Adult Education. The Forums are organized within the framework of the public school system under the control of the local education authority and are conducted by expert leaders using varying techniques according to the size and composition of the membership. Addressing the National Education Association last February on "Crucial Issues in Education" (Pamphlet No. 74. Superintendent of Documents, Washington. Pp. 20. Price 5 cents), Dr. Studebaker announced that nineteen public forum demonstration centres, officially sponsored by him and financed, as a temporary measure, with federal funds, were operating in as many States. In the preceding five months more than 350,000 people had attended 3,854 forum meetings.

Closely associated with the public affairs forums is the Commissioner's educational radio service, exemplified by a series of thirteen half-hour dramatic items broadcast on Monday evenings at 10.30, having as their theme, under the title "Let freedom ring", the "long struggle for the rights and liberties set forth in the Bill of Rights of the Constitution of the United States". The Commissioner stated that his office had received in seven months, in connexion with this radio service, 250,000 communications from

radio listeners. A radio script exchange service has been organized, moreover, and "hundreds of student groups are adapting and rewriting these radio scripts for their own productions", in association with dramatic art and social science classes and radio workshops. The Commissioner announced that he had officially made a request for the reservation in Washington of certain high-frequency wave-lengths for the exclusive use of local educational agencies and for the free discussion of civic affairs.

The address terminated on a note of urgency: "There is no time to lose. These programmes for popular enlightenment in the protection of popular self-government must be promoted in every State and community. I leave this crucial issue upon your conscience." The issue in question, arising out of the conflict between dictatorship and democracy, "a major conflict which is swiftly reaching the stage of a crisis throughout the world" is elsewhere phrased as "What more can education do to undergird American democracy".

One of the speakers at a discussion on adult education in the Education Section of the British Association at the recent meeting in Nottingham suggested that education unrelated to a specific social ideal is, in our day, an impossibility, that real education must be propagandist, aiming either at assisting to maintain stability or at preparing for change, and that adult education, to be a live force, must support "the organized working-class movement". Dr. Studebaker's adult education policy is frankly propagandist but exposes the fallacy of representing the aims of stability and change as mutually exclusive. He defines education's social ideal as a society where the majority will is law and in which the right and privilege of the minority to advocate a change are protected.

A New Hydro-Electric Power Scheme in Sweden

A FULL description of the hydro-electric power scheme at Krangede, Sweden, which has been in operation for six months, is given in the *Asea Journal* of May and June, published by the Asea Company of Vasteras. Krangede is situated in about lat. 63° N. at the site of a natural fall on the lower part of the Indalsälven, an important river in the inland district of Sweden draining a large area containing many lakes and extending back to the Norwegian borders. The link with the power station lies well up in 'Norrbotten', and in the south consists of a high-voltage feeder carried direct down to a main substation at Horndal in South Dalecarlia. It is thus within convenient range of Stockholm and is in touch with the large supply networks of central and southern Sweden.

It was anticipated long ago that before 1940 the demand for electrical energy in the southern and middle parts of Sweden would make the delivery of large bulk supplies from the north economically feasible. The great industrial activity of the last few years has accelerated the increasing demand for electrical power. The Krangede scheme was carried out and is owned by a private company comprising several large industrial businesses and the Stockholm municipality. The scheme has several unique features. The whole generating plant is underground, and the equipment is of the most modern design, as it has to deal with a transmission voltage of 220 kilovolts.

Unregulated, the water flow in the river at Krangede is very variable. The maximum flow is about 2,000 cubic metres per second and the minimum is often only about 100 cubic metres per second. Work at present proceeding on one of the lakes near the source of the river on the Norwegian borders is expected to increase the minimum flow by about 40 per cent. The power station is designed for a head of 190 feet, and with the plant at present installed it has a consumption of about 140 cubic metres per

sec. The dam has a length of about 240 yards and has four spillways. The generating plant is housed in a chamber blasted out of the solid rock, the machine room floor being 131 feet below the surface of the ground.

To prepare a turbo-alternator for starting, a special switch is operated and a window in it becomes illuminated by a flickering light. Until the lubricating oil and cooling water are circulating properly and other starting devices have moved into the starting position, this light goes on flickering. When everything is ready to start up the turbine, the light becomes steady. The control room is situated on the top story of the building and its windows command a good view over the outdoor switchgear and the dam. A mimic busbar system is provided at the control desk and includes switches and position indicators. On the front of the control desk are push-buttons controlling the operating of the system.

The two generators at present working are each of 35,000 kilovolt ampere capacity when running at 167 revs. per min. The height of each generating unit is nearly 30 feet and its total weight is 427 tons. The main transmission line connects the generating station to the Horndal substation, and as the transmission conductors work at 220 kilovolts, it was necessary to make their diameters large so as to avoid the formation of coronas (brush discharges) on them. The supporting towers are 56 feet in height and the conductors are hung on suspension type insulators with sixteen insulators per string. The normal span is 263 yards and the spacing between the phases 23 feet.

The official tests made on the generators at full load and a pressure of 8,400 volts gave an efficiency of 97.8 per cent at unity power factor. The voltage wave generated is practically sine shaped, the maximum deviation from this form being only about one per cent.

Woods on Private Estates

IN his presidential address as chairman of the Department of Forestry of Section K (Botany) at the meeting of the British Association at Nottingham, the Hon. Nigel Orde-Powlett took as his subject "The Present and Future of Estate Woodlands". Mr. Orde-Powlett first dealt with the value of the existing private woods to Great Britain during the Great War, pointing out that although the Forestry Commission is now planting on some scale, its area under forest is only one eighth of the nominal woodland area of the country, the remainder being privately owned. It is therefore a matter of vital national urgency that it should be made possible for owners to institute a wise forest policy on their estates. There is also the social aspect of the problem—the drift from country to town. This is due to many causes, but Mr. Orde-Powlett holds the opinion that woodlands afford employment which is congenial, and that well-managed woods can afford to give adequate pay to the staff maintained. Since the

majority of the private woodlands are not run on business lines they are under-staffed. If properly run, many thousands of additional men could be employed, with an increase of small-holders—and the forest worker forms the best type of small-holder.

The attitude of the private owner of woodlands varies. Most woods are run at a loss and their owners are incredulous as to their financial possibilities; or they are regarded as a nest-egg only to be realized in dire necessity; or the owner is averse from even cutting a single tree. It has been estimated that the average annual output per acre in Great Britain is less than 20 cu. ft., whereas under good management three to four times that volume might be produced.

There are three causes for this position, says Mr. Orde-Powlett, and all of probably equal importance. The first, and it may be asserted in the interests of continuity and good forest management, the most important, is taxation, and especially the death duties. It is true that duties are not payable on the

timber until the woods are felled; but on a private estate, although the woods may form only a portion, perhaps only a small percentage, of the total area, they may yet have to pay a share of the duties out of all proportion to the income of the person concerned. This spells chaos in management and precludes an owner from having a proper 'working plan' in force, since death will probably result in its clauses becoming unworkable. In other words, continuity in the management of the woods is an impossibility. Moreover, as under the present system of taxation every proprietor knows that in the course of three or four generations the estate must be broken up, there is no encouragement towards correct woodland management. Mr. Orde-Powlett suggested conditional remission of death duties on agricultural land, the condition being that the sum so remitted should be spent on improvements which would be defined over a period of years.

Another cause is the neglect of owners to thin their woods properly and so obtain an intermittent revenue and also to fell the timber when it has reached maturity for market purposes. In this connexion, it has been suggested that all woodlands should be taken over by the State. Not only is this in opposition to the ordinary forestry economy in those European States where the best forest management is in force, but also it would be quite impracticable in Great Britain; and the same objections apply to the introduction of any form of compulsion on the part of the Government.

Mr. Orde-Powlett dealt with the present assistance available from the woodmen's training schools in existence, with the efforts of the various forestry societies, and the new type of consultant forester of which there are now a few firms. Good as is the work done by all these, their efforts only apply to those

owners whose interest in their woods is already awakened. The majority do not fall within this category. As Mr. Orde-Powlett says, "a real comprehensive improvement depends on the arousing of forest consciousness amongst owners and in providing them with means to acquire knowledge". He advocates the establishment by the Forestry Commission, at a cost of twenty thousand pounds or so a year, of a comprehensive advisory service throughout the country.

"I would have woodland advisers, highly trained foresters, each with his area of country," says Mr. Orde-Powlett. This would be an excellent scheme if it was inaugurated by the owners themselves, a group of owners in a locality engaging and paying the salary of the highly trained woodland adviser. Otherwise, if engaged by Government (a sum of £20,000 is to cover salaries, offices, etc.) what prospects of a career would these advisers have? Even if such a service were inaugurated, what continuity to their work could be assured, as Mr. Orde-Powlett points out, with estates being broken up and dispersed in four generations, if not sooner, as a result of death duties. It would be quite impracticable for the State then to step in and take over as a working proposition small areas of woodland, however good the local management may have been, scattered all over the country.

If the Government has a real belief in the possibilities of forestry or its necessity in the interests of the community, the land must be so taxed that a continuity of management—and in forestry this means a continuity throughout a century and more—is assured. Without such an assurance it is difficult to see how the expenditure of public money in the interests of the private landowner can be justified.

Fibre Cores in Winding Ropes

WE have received the Safety in Mines Research Board Paper No. 97 upon "The Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes", by J. E. O. Mayne*. The author states that the fibres used for the cores belong to the 'hard' group, the object of which is to provide a firm support for the steel strands of the rope. The material arrives in Great Britain in bales containing a number of so-called 'heads' and are subjected to the following four processes: (1) 'hackling', (2) spinning the fibre into yarn, (3) spinning the yarn into strands, and (4) spinning the strands into a complete core. To enable the fibre to be spun, it must be wetted by a so-called 'batching' fluid, which is 5-15 per cent of the weight of the fibre in thin mineral oil; the core is then treated with heavy mineral oil, which forms a lubricant; severe internal corrosion has been found in ropes containing Stockholm tar, and this material should on no account be used; this is perhaps one of the most valuable observations in the whole work. It is stated that "It is understood that the use of coal tar is also objectionable."

The author, who has experimented upon the subject

for some time, arrives at the following conclusions. (1) Batching and impregnating oils used in core manufacture do not decompose sufficiently, in practice, to cause appreciable corrosion of wire; on the contrary they protect it. (2) Darkening of the oil is due to the presence of impurities such as coal dust and iron oxide, and the oils retain their protective value until they are squeezed out. (3) Internal corrosion can take place without penetration of the rope by water containing harmful salts or acids derived from sources external to the rope. (4) Manila (and some other) fibres used for cores contain and are liable to develop formic and acetic acids as a result of bacterial action. (5) These acids can corrode wire ropes in the presence of moisture, even in the absence of oxygen; pressure between wire and core tends to accelerate the rate of attack, since it tends to remove the protective oils and increase the contact between fibre and steel. (6) The erratic distribution of corrosion is due to the sporadic nature of bacterial action. (7) Most of the harmful acid in raw manila fibre can be removed by cold water treatment, and it is suggested that subsequent bacterial action might be prevented by treating the washed fibre with an antiseptic which would not corrode steel. The practicability of these preventive measures has not yet been demonstrated."

* Mines Department: Safety in Mines Research Board. Paper No. 97: The Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes. By J. E. O. Mayne. Pp. 38+4 plates. (London: H.M. Stationery Office, 1937.) 1s. net.

Science News a Century Ago

Instructions for Travellers

IN the *Athenaeum* of November 11, 1837, a note said: "In the instructions drawn up by the scientific men of France, for the use of the two vessels, the *Ictolabe* and the *Gelée*, which are about to circumnavigate the globe, we perceive that Mr. Ward's plan of transporting plants is highly recommended, as well as that of Mr. Luschath, which can also be applied to seeds, in order to preserve their germinating powers. L. de Blainville eagerly requires microscopic marine animals, the *Spirula* with its inhabitant, that of the *Jarullus flammeus*, which is wanting in the collections in France, parasitical insects and worms; and strongly urges experiments to be made on the emperature of living man, and beings of an inferior order, under different circumstances. . . . He sets forth the important novelties likely to be found in New Guinea, the Moluccas, and Celebes, in the reefs and bays of which probably exist a multitude of fishes and Mollusca, and particularly requests the acquisition of the Apteryx, from the New Holland region, which is supposed not to have any wings. . . . M. de Freycinet recommends hydrography, observations of the tides and currents, such descriptions of the countries visited as will set forth their resources to future navigation. . . . and M. Corder states the ignorance which prevails concerning the southern hemisphere, and the consequent value of the smallest atom of rock from this quarter."

Hybrid Ferns

IN the *Athenaeum* of November 11, 1837, it is stated that "A triumph has been obtained by M. Martens, the professor of chemistry at the University of Louvain, and Dr. l'Hermier, over those who assert that no hybrid plant can be produced where no parents exist. The former shook the fronds of the *Thymogramma calomelanos*, and the *G. chrysophylla*, reciprocally over each other, at the time when the fructification was fully developed, and thus produced a new plant which is to be called *G. Martensii*. It is worthy of remark that the hybrid plant bids fair to be easily propagated in our greenhouses, while the parents constantly languish and die. While M. Martens was making his experiments at Louvain in Belgium, Dr. l'Hermier watched the same process taking place naturally in the woods and savannahs of Guadaloupe, and sent some dried fronds (in excellent preservation) of the hybrid to M. Bory de Saint-Vincent."

The Moon's Equatorial Horizontal Parallax

ON November 11, 1837, Thomas Henderson, Astronomer Royal for Scotland, read a paper to the Royal Astronomical Society entitled "The Constant Quantity of the Moon's Equatorial Horizontal Parallax, deduced from Observations made at Greenwich, Cambridge and The Cape of Good Hope in 1832 and 1833." Previous to this, by using a method based on the theory of gravity, Burchardt had found that the constant part of the lunar parallax under the equator amounted to $57' 0''$ while Damoiseau arrived at $57' 0.9''$ for the constant and Plana computed it at $57' 3.1''$. By another method founded on observations made simultaneously at different parts of the earth, Lacaille had obtained $57' 4.6''$, Lalande $57' 3.7''$ and Du Séjour $57' 6.0''$. While at the Cape

in 1832-33, Henderson determined a great number of declinations of the moon with the view of arriving at a more accurate value of this element, and by a comparison with his own observations made at Greenwich and Cambridge, obtained $57' 1.8''$ for the constant of the equatorial parallax.

Observations on Rain

THE issue of the *Gentleman's Magazine* of November 1837, contains the following account of a paper recently communicated at a meeting of the Warwickshire Natural History and Archaeological Society: "The Rev. G. Childe made public his observations on Rain. He said it was a general but erroneous opinion that the greatest quantity of rain that fell in any month of the year fell in February. From his own observations (during eight or more years) he ascertained that in July was the greatest quantity, September second, August third, October fourth, June fifth, April sixth, November seventh, May eighth, February ninth, instead of first, December tenth, January eleventh and March twelfth. It would be found that if there were a deficiency of rain in the winter months December, January and February, that deficiency would be in great part compensated by an excess in the three summer months July, August and September."

University Events

CAMBRIDGE.—Dr. H. Brück, of the University of Berlin, has been appointed first junior observer in the Solar Physics Observatory.

W. G. Palmer, of St. John's College, has been approved for the degree of doctor of science.

It is proposed to confer the degree of M.A. on Dr. D. G. Catchside, University lecturer in botany, and S. D. Elliott, University demonstrator in the Department of Pathology.

Miss M. L. Tomlinson has been elected to a staff fellowship at Girton College.

OXFORD.—On November 2 in Congregation the degree of M.A. by decree was conferred on Lord Nuffield, so that he is now a full and voting member of the University.

On November 16 the Chancellor will preside at the Congregation at which Lord Nuffield will be thanked for his recent gifts. There will then be voting on the decrees relating to the new benefaction to the medical school and promulgation of the statute relating to the gifts to the proposed Nuffield College (see p. 700) and the chemistry school.

Dr. L. J. Witts has been appointed Nuffield professor of clinical medicine as from 1938.

H. J. B. Atkins, Trinity College, R. B. Scott, Brasenose College, A. W. D. Leishman, University College, and E. P. Edmonds, Keble College, have been granted the degree of M.D.

J. G. Daunt, Exeter College, has been awarded the Scott scholarship for research in physics.

The curators of the University Chest have been authorized to receive from the Rockefeller Foundation in the year beginning October 1, 1937, a sum not exceeding 3,000 dollars as a contribution towards scientific apparatus, material and special cages for primates required for research in the Department of Human Anatomy.

Societies and Academies

Paris

Academy of Sciences, September 13 (*C.R.*, 205, 473-500).

GABRIEL BERTRAND: The presence and distribution of boron in the potash salts of Alsace. The quantities of boron found ranged from 1 to 10 parts per million in the salt, and from 50 to 500 parts per million in the interposed clay sheets.

ALBERT F. BLAKESLEE: Doubling the number of chromosomes in plants by chemical treatment.

J. G. VAN DER CORPUT: The Goldbach-Vinogradov theorem.

OCTAV ORICESCU and GH. MIHOC: The asymptotic trend of the sum of the variables of a discontinuous Markoff chain.

PAUL PÉTRY: The interpretation of observations and measurements relating to breakers. Study of the forces produced by waves striking a breakwater and of the velocities of the parts of the breaker.

PIERRE ERNEST MÉRCHÉ: Parameters and characteristic curves of carcing with circulation.

JEAN HÉLY: The gravitic wave induced by an electromagnetic wave in a refracting medium.

JEAN CAYREL: Absorption measurements of thin plates of copper sulphide. Application to the comparison of their thicknesses.

HUBERT GARRIGUE: New results on the green, yellow and red radiations emitted by the night sky.

ROGER LAMBERT: The Miocene of Boutoutou, Niger Colony.

ANTOINE DE CUGNAC: A new hybrid of bromegrass obtained experimentally. The uncertainty of the systematic determination of spontaneous hybrids.

MARCEL AVEL: The experimental study of the part played, in the regeneration of the head in worms, by the old parts in the immediate neighbourhood of the surface of amputation.

C.R., 205, 501-528.

EMILE BOREL: The regular distribution of the points of a linear enumerable ensemble.

LOUIS LAPIQUE: Neuro-muscular isochronism as an empirical fact. Historical résumé of work in this field, with special reference to objections raised by A. V. Hill.

GEORGES CHARPY: The determination of silicon in steels. In a specification giving a maximum figure for the silicon allowed, it is essential that the method of analysis should be given. Examples of the differences introduced by the method of analysis are given.

ANTOINE APPERT: Nearly isometric measurement.

GEORGES CALUGARĂNO: Invariants of prolongation connected to integral functions.

CHARLES SCHMERRER, PIERRE TABDI and PAUL CAILLOL: A method of measuring angles by fractional repetitions.

MAURICE FALLOT: The magnetic properties of alloys of iron and iridium. Determinations of the Curie points, points of transformation and ferromagnetic moments show a close resemblance with the analogous properties of the alloys of iron with ruthenium and with osmium.

MILLE YVETTE CAUGHOIS: Study of the La satellites for some heavy elements and rare earths.

PIERRE NOBECOURT: Cultures in series of plant tissues on artificial media.

MARCEL AVEL: Study of some complex cases of regeneration of the head in worms.

CH. BRIOUX and EDG. JOURS: Diacetyl in Normandy butters. Results of the examination of 15 specimens.

Moscow

Academy of Sciences (*C.R.*, 15, No. 8, 1937).

L. B. ROBINSON: A system of Riquier and the tensor calculus.

J. D. DUBNOV and N. EFIMOV: Single geodesic grids and the Lie surface.

V. KOZLOV: A relation between the absolute convergence and the unity of trigonometrical development.

H. HILMY: The ensembles of movements that cannot be represented as sums of invariant positive ensembles.

A. L. ŠAGINJAN: The theory of orthogonal polynomials in a variable complex.

S. MICHLIN: On a certain problem of the theory of singular integral equations.

N. RUIN: The Whittaker integral and the periodic solution of the problem of three bodies.

J. MALKIN: The stability of movement in Liapounoff's sense.

V. A. GAVRILINKO: Comparison of experimental and theoretical curves showing distribution of velocities in turbulent uniform flow through pipes.

N. AKULOV: The theory of dependence of the ferro-magnetic properties of metals on temperature.

V. FABRICANT: The theory of radiation of gaseous discharge.

E. KUNDORSKIJ: The problem of the nature of coercive force.

N. A. ŠIRAKOV: Standard substances for exact measurements in the electron diffraction method.

D. I. MIRLIS: Kinetics of wetting and local corrosion of metals in polyphase systems: metal-liquid-liquid and metal-liquid-gas (3).

V. G. KUZNECOV: Röntgenographical investigation of anomalous solid solutions of ammonium chloride in the chlorides of manganese, cobalt and nickel formed in aqueous solutions.

J. L. GOLDFARB and M. V. ANDRITCHUK: Condensation of α -aminonicotine with ω -bromoacetophenone.

V. I. NIKOLAJEV: Chemical signs of the presence of salt deposits and the method of their physico-chemical investigation.

B. N. MAKHAJY: Algae as characteristic fossils.

I. A. SMORODINCEV and S. A. PAVLOV: The method for the determination of the coefficient l .

I. A. SMORODINCEV and A. M. FELDT: Determination of the isoelectric point of thyroglobulin.

B. A. RUBIN, N. M. ŠIRAKIAN and O. T. LUTKOVA: Measurement of the oxidizing-reducing power of living vegetable tissue.

A. ZAMORSKIJ: Algebraic symbolism of the law of hybridization.

S. MEDVEDOVA: The toxins of *Fusarium bucharicum* Jacc. and *Fusarium graminearum* Schw.

V. M. KATUNSKIJ: Dependence of photoperiod reactions of plants on the spectral composition of light.

L. V. ARNOLDI and K. R. FORTUNATOVA: A contribution to the experimental study of the nutrition of Black Sea fishes.

S. E. KLEINENBERG: Distribution of some fishes and of *Idothea algerica* Lucas in the eastern part of the Black Sea.

P. L. PIVOZHNIKOV: A contribution to the study of the origin of northern elements in the fauna of the Caspian Sea.

A. A. VOITEKOVICH: The morphogenetic activity of different parts of the hypophysis (5). Experiments with the implantation of substances from the 'eosinophilous zone' of anterior lobes of hypophysis on tadpoles under natural conditions.

Rome

National Academy of the Lincei (*Atti*, 25, 197-244; 1937).

T. LEVI-CIVITA: Canonical forms of the ds , binaries with a given total curvature.

L. AMERIO: Some complements of the theory of the Laplace transformation.

S. MARTIN IN BIDDAU: Functions of linear operators (1).

I. POPA: Projective-differential geometry of the singularities of plane curves.

G. RACAH: Lagrangian form of electromagnetic forces.

C. TOLOTTI: Problems of plane elasticity with a polydrome Airy function.

P. UDESCHINI: A relative solution to the expansion of the universe.

L. GIALANIELLA: Results of the new longitude determination of the axis of the Senatorial Tower of the Capitol and of the Tower of the First Meridian of Italy at Monte Mario.

Atti, 25, 253-348; 1937.

G. ABETTI: Height of the chromosphere in 1936, and the progress of the solar cycle.

S. MARTIN IN BIDDAU: Functions of linear operators (2).

M. PASTORI: Influence of small viscosities of a fluid in the determination of pressure in single regions.

V. ZAGAMI: Experimental researches on the seminal liquid. Value of the pH of normal human seminal liquid.

E. BIANCHI: Commemoration of the Dalmatian astronomer Ruggiero Giuseppe Bosovich.

G. A. MAGGI: Tangential derivatives of the potential function of surfaces.

G. ARMELLINI: Reduced problem of two bodies of variable masses.

U. CASSINA: An integral-differential equation.

A. DE MIRA FERNANDES: A formal aspect of the tensorial derivation.

E. FROLA: Functional linear transformations and singular integral equations.

M. HADMOVICH: Metric spaces with an allied connexion.

A. PUPPO: Researches on the solar radiation at Col d'Olen (1).

A. MANGINI: Aromatic nitroderivatives (12). The action of some hydrazines on 1-chloro-2:4-dinitro-naphthalene.

G. MARTINO: Probable existence of an unknown alimentary factor which stimulates sexual development.

M. ROMANO: Contribution to the study of the skin of anurans during metamorphosis.

G. SCHREIBER: Definition of the stages in the metamorphosis of *Bufo vulgaris*.

Sydney

Royal Society of New South Wales, September 1.

E. C. ANDREWS: The structural history of Australia during the Palaeozoic.

H. W. WOOD: Note on the Shortt clock at Sydney Observatory.

F. LIONS: Synthetic substances allied to strychnine.

G. K. HUGHES and F. LIONS: The synthesis of 2-aminomethyl-benzimidazole and related substances.

Vienna

Academy of Sciences, July 1.

F. WESSLEY and K. SCHÖNOL: Chasmanthin.

H. PETERSSON: Abundance ratio of thorium to uranium in rocks and in the sea. The abundance ratio of thorium to uranium is less in the sea than in rocks of volcanic origin. This is ascribed to the precipitation of thorium along with iron from sea water. In agreement with this view, the amount of thorium in sedimentary rocks is relatively high. The precipitation of ionium along with thorium may account for the ratio of radium to uranium in sea water being less than the equilibrium value.

J. SCHINTLMACHER: Shortening of the range of polonium α -particles by oblique emission from the source. The mean range is greatly influenced by the purity of the preparation and the angle of emission; the extrapolated range, however, is not affected. The effect of oblique emission on mean range persists even with very pure preparations.

W. JENTSCHKE and G. SEITZER: Short-range particles emitted when polonium α -particles are scattered by heavy nuclei. These particles are probably scattered α -particles, the range of which has been shortened by oblique emission from the source.

J. HOFFMANN: Photochemical changes in phosphate compounds.

MARIETTA BLAU and HERTHA WAMBACHER: Photographic study of cosmic rays: occurrence of proton-like tracks corresponding to a range in air of several metres.

H. KUN and O. PRZENNIK: Oral administration of male sex hormone, alone and in combination with female hormone. Study of the electrical rat test.

O. PRZENNIK and L. POPPER: Posterior lobe of the hypophysis and the thyroid gland. The excitation of the sympathetic by thyroxin can be prevented by the parasympathetic action of vasopressin.

H. DOSTAL: Reaction kinetics of chain polymerizations.

L. POLLAK and GABRIEL FLAUM-FRIED: The distribution of sugar in the body, and the action of insulin. Phlorizin diminishes the absorption of injected galactose into the organs of the body, but has no effect on the absorption of xylose. This action of phlorizin is inhibited by insulin.

H. KONZETT: Promotion of sleep and narcosis by dyes. Certain dyes, which are not themselves narcotics, are able to reduce the minimum dose of a narcotic required to produce unconsciousness.

E. AHL and O. SCHINDLER: *Pyrrhulina macrolepis* sp. nov. (Pisc., Microcyprini).

F. LINDBER and BELLA BAUMINGER: The combination of sugar and amino-acid.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 8

ROYAL GEOGRAPHICAL SOCIETY, at 5.—J. A. Steers: "The Culbin Sands of the Moray Firth".

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. H. Read: "The Natural History of Metamorphic Rocks".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. A. I. Virtanen: "Biological Nitrogen Fixation" and "Production of Vitamins in Agriculture" (succeeding lectures on November 10 and 12).*

Tuesday, November 9

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. Harold Scott: "Conquest of Disease in the Tropics" (Fitzpatrick Lectures. Succeeding lecture on November 11).

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. T. A. Sprague: "Early Herbs".

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Royal Society, Burlington House, London, W.1), at 9.—Prof. H. J. Fleure, F.R.S.: "Racial Evolution and Archaeology" (Huxley Memorial Lecture).

Wednesday, November 10

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Colour Films of Tibet, taken by B. J. Gould.

ROYAL SOCIETY OF ARTS, at 8.15.—Sir Ambrose Fleming, F.R.S.: "Guglielmo Marconi and the Development of Radio Communication".

Thursday, November 11

ROYAL ASIATIC SOCIETY, at 4.30.—(at the Royal Geographical Society).—Sir Aural Stein: "A Journey of Archaeological Exploration in South West Iran (1935-36)".

Friday, November 12

ROYAL INSTITUTE, at 9.—Sir Daniel Hall, K.C.B., F.R.S.: "Soil Erosion: the Growth of the Desert in Africa and Elsewhere".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT to develop the Information Department and Library Service of the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regent Buildings, Euston Street, N.W.1.

LECTURER IN ORGANIC CHEMISTRY in the City Technical College, Liverpool—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (November 19).

SENIOR RESEARCH WORKER in the Institute of Animal Pathology, Milton Road, Cambridge—The Secretary (November 27).

LECTURER IN ORGANIC CHEMISTRY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

Official Publications Received

Great Britain and Ireland

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin 22. Technique of Grass Seed Production at the Welsh Plant Breeding Station. By Gwylim Evans. Pp. 36+8 plates. 6s. Bulletin 23: Production of Seed of Herbage and Forage Legumes. Edited by R. O. Whyte. Pp. 48+1 plate. 5s. Bulletin 24: Collection of Native Grass Seed in the Great Plains, U.S.A. By B. J. Onder and M. M. Hoover. Pp. 16. 2s (Aberystwyth). Imperial Bureau of Plant Genetics, Herbage Plants. [1810]

Technical Publications of the International Tin Research and Development Council. Series A, No. 60. A Plane Binding Apparatus with Interferometer Strain Recorder for Metallurgical Investigations. By J. W. Cuthbertson. Pp. 14. (London: International Tin Research and Development Council.) Free. [1810]

Forest Bibliography to 31st December 1932. Part 2: B. Silviculture (continued); 3: Natural Reproduction; 4: Artificial Reproduction; 5: Tending; 6: Silvicultural Systems; 7: Notes on Trees. Pp. 1+72-190. (Oxford: Department of Forestry, The University.) 12s. 6d. net. [1910]

Ministry of Health. Fourth Report of the Joint Advisory Committee on River Pollution. Pp. 18. (London: H.M. Stationery Office.) 3d. net. [1910]

Ministry of Health and Scottish Office. Inland Water Survey Committee: Second Annual Report, 1936-37. Pp. 26. (London: H.M. Stationery Office.) 6d. net. [2010]

Medical Research Council. Special Report Series, No. 226: Medical Uses of Radium; Summary of Reports from Research Centres for 1936. Pp. 41. (London: H.M. Stationery Office.) 1s. net. [2010]

Technical Publications of the International Tin Research and Development Council. Series A, No. 61: The Constitution of Tin-Rich Antimony-Cadmium-Tin Alloys. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 44+8 plates. Free. Series A, No. 62: A Study of the Mechanical Properties of Tin-Rich Antimony-Cadmium-Tin Alloys. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 18+1 plate. Free. (London: International Tin Research and Development Council.) [2110]

Metallurgical Abstracts (General and Non-Ferrous) Vol. 3 (New Series). Edited by G. Shaw Scott. Pp. viii+897. (London: Institute of Metals.) 24s. inclusive of 2 "Proceedings" vols. [2110]

Education in 1936: being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (Omd. 5564.) Pp. xii+200. (London: H.M. Stationery Office.) 3s. 6d. net. [2110]

National Institute of Poultry Husbandry. Bulletin No. 14. Table Poultry Production. By A. J. Macdonald and Jean W. T. Kay. Pp. 21. (Newport, Shropshire: Harper Adams Agricultural College.) 6d. [2310]

Other Countries

Colony of Mauritius: Department of Agriculture. Seventh Annual Report of the Sugarcane Research Station for the Year 1936. Pp. 45. (Port Louis: Government Printer.) 60 cents. [1810]

Department of Agriculture. Straits Settlements and Federated Malay States. General Series, No. 27: Reports of the Field Branch for the Year 1936. Pp. ii+167. (Kuala Lumpur: Department of Agriculture.) 50 cents. [1810]

Rubber Research Institute of Malaya. Pp. 20. Annual Report, 1936. Pp. ii+168. 1 dollar. (Kuala Lumpur: Rubber Research Institute of Malaya.) [1810]

Annals of the Observatory of Lund. No. 6: A Study of Double and Multiple Galaxies, together with Inquiries into some General Metagalactic Problems; with an Appendix containing a Catalogue of 837 Double and Multiple Galaxies. By Erik Holmberg. Pp. 160+6 plates. Modelände från Lunds Astronomiska Observatorium, Ser. 2. Nr. 84 (Historical Notes and Papers, Nr. 8): Über die ersten astronomischen Photographien und ihre Reproduktion; Die Form der Sonnenkorona am 28 Juli 1861. Von Björn Svononius. Pp. 22. Nr. 87: Formule and Tables for Computation of the Integrated Magnitude of Stars. By W. Gyllenberg. Pp. 22. Nr. 88 (Historical Notes and Papers, Nr. 10): Studies in Spanish Sources. 1. A Medieval Series of Statements on the Colours of the Plants. By Per Collinder. Pp. 16. Nr. 89 (Historical Notes and Papers, Nr. 11): The Arabic Names of the Stars. By Abdel Hamid Mahmoud Samaha. Pp. 8. (Lund: Lunds Astronomiska Observatorium.) [1910]

Ministry of Agriculture, Egypt. Technical and Scientific Service. Bulletin No. 176: Giza 27, a Wilt-Immune Strain of Long Staple Cotton. By Dr. Tewfik Fahmy. Pp. ii+13+18 plates. (Oairo: Government Press.) P.T. 4. [2010]

Astrophysics Norwegian. Vol. 2, No. 6: Application of Line Integral Theorems to the Hydrodynamics of Terrestrial and Cosmic Vortices. By V. Bjerknes. Pp. 263-340. (Oslo: Jacob Dybwad.) [2110]

The Rockefeller Foundation: International Health Division. Annual Report, 1936. Pp. v+278. (New York: Rockefeller Foundation.) [2310]

U.S. Department of the Interior: Geological Survey. Bulletin 869-B: Kodiak and Vicinity, Alaska. By Stephen R. Coepp. (Mineral Resources of Alaska, 1934.) Pp. iv+93-184. 25 cents. Bulletin 879: Geology and Mineral Resources of the Baker Quadrangle, Oregon. By James Gilluly. Pp. vi+119+8 plates. 65 cents. Professional Paper 186-F: American Cretaceous Ferns of the Genus *Tempekyia*. By Charles B. Read and Roland W. Brown. (Shorter Contributions to General Geology, 1936.) Pp. ii+105-131+plates 27-43. 15 cents. Water-Supply Paper 796: Surface Water Supply of Hawaii, July 1, 1934, to June 30, 1935. Pp. 188. 25 cents. Water-Supply Paper 811: Surface Water Supply of the United States, 1936. Part 11: Pacific Slope Basins in California. Pp. 231. 45 cents. (Washington, D.C.: Government Printing Office.) [2310]

International Hydrographic Bureau. Special Publication No. 23. Limits of Oceans and Seas. Second edition. Pp. 25. (Monaco: International Hydrographic Bureau.) 9 francs. [2310]

Catalogues, etc.

Classified List of Second-hand Scientific Instruments. (No. 112.) Pp. 58. (London: C. Baker.)

The "Newton" and "Wigmore" British Hydriascopes. Pp. 26. The "Ampro" 16mm. Motion Picture Equipment. Pp. 8. The Newton Projection Microscope. Pp. 12. (London: Newton and Co.)

Watson Centenary, 1837-1937. Pp. viii+40. (London: W. Watson and Sons, Ltd.)

The Proteus Tube, Series 3. Pp. 20. (London: Outhbert Andrews.)

Die Askania-Warte. Nr. 7, September-Oktober 1937. Pp. 24. (Berlin-Friedenau: Askania-Werke A.G.)

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SATURDAY, NOVEMBER 13, 1937

Vol. 140

Land Drainage in England and Wales

ONE of the most insistent problems of recent years in the domestic legislation of Great Britain has been that of land drainage. There are many and extensive areas in England and Wales where efficient drainage is a vital necessity to the safety, health and welfare of the inhabitants. inundations which have afflicted such districts in the past, and even now, in spite of definitely organized preventive measures, can still cause widespread devastation with loss of life and property and possible epidemics of disease, have been a source of constant and anxious concern to successive Governments. Ultimately, a Royal Commission was appointed to investigate the matter, and in 1927 its report appeared, making a series of recommendations of a striking and drastic character, which, supported by public opinion, were, after full discussion, embodied in the Land Drainage Act, 1930. Since that date, a fundamental and revolutionary change has been taking place in the drainage administration of the country; and an account of the operations and proceedings taken under the Act has recently appeared*.

The main difficulty of the situation prior to the passing of the Act was the existence of a heterogeneous collection of drainage authorities, totalling some 361, with miscellaneous constitutions, powers and jurisdictions. Moreover, these bodies, however active and well-intentioned, were inadequately provided with funds and lacked the necessary resources for coping with conditions which had naturally changed more or less fundamentally with the lapse of a long period of years since they were first instituted. Some of them, notably the so-

called "Commissions of Sewers" (the word "sewer" originally signified an open watercourse), dated back to a very remote epoch, and these were preceded by a body, still legally in existence, "the Lords, Bailiffs and Jurats of Romney Marsh," which has had an effective career of nearly seven hundred years. Commissions of Sewers were first appointed in the fifteenth century, but were placed on a more permanent basis by the Statute of Sewers of Henry VIII's reign (1531). Thereafter, other bodies were created, either by private Act of Parliament *ad hoc*, or arising out of the provisions of local inclosure awards in connexion with the inclosure of common lands, a process which was at its height in the closing years of the eighteenth and early years of the nineteenth century.

Of this complicated and clumsily ineffective machinery the new Land Drainage Act made a clean sweep, and it repealed all the enactments in regard to flood prevention which had been made through centuries of English history, substituting for them a properly organized and co-ordinated system of administration through authorities designated Catchment Boards, taking their title from the drainage unit adopted by the Royal Commission; namely, the catchment area of each river, which is bounded by the natural watershed or water-parting. These catchment areas vary considerably in character, extent and rateable value. Some areas are largely agricultural, such as the Great Ouse, Rother, Severn, Wye, etc., while others include industrial regions, such as the Yorkshire Ouse, Trent, Mersey and Irwell and the mid-Glamorgan rivers. Another feature of notable contrast is the relative proportion of lowlands and uplands. In the catchment area of the Romney and Denge Marsh Main Drains, the percentage of

*Report of Operations and Proceedings under the Land Drainage Act, 1930, from the passing of that Act (1st August, 1930) to 31st March, 1937. Pp. iv+75. (London: H. M. Stationery Office, 1937.) s. 6d. net.

lowlands is 72·75, while in the Bristol Avon area it is only 3·22.

At the outset, the Act scheduled forty-seven catchment areas—not by any means an exhaustive list, but as many as it was considered possible to deal with at the start. Provision was made for additions, and as a result of these and some amalgamations, there were at the date of the report under consideration forty-eight catchment boards in England and Wales.

The responsibilities of catchment boards are not limited to the drainage or discharge of water from their respective areas. In a number of cases they have the contingent duty of protecting the low-lying marshlands on the sea or estuary frontage from tidal flooding. Thus, in the case of the Essex Rivers Catchment Area, there are, in addition to a length of 380 miles of main river, no fewer than 320 miles of sea or estuary embankment and defences along the north bank of the Thames from the outskirts of London to Dovercourt, and these need constant supervision and repair.

The term 'main river' requires explanation. It is rather difficult to define with exactitude, though the meaning is fairly obvious. But, for the purposes of the Act, the signification has to be a little elastic. The 'main river' may include more than one channel, and, in fact, consist of several independent streams. It has not been altogether easy in some cases to decide where the main river or main channel should end, or what tributaries should be included.

The existence of tributaries and auxiliary streams has given rise to the formation, under the Act, of internal drainage boards, with duties subordinate to those of the catchment boards. Internal drainage boards can be formed for areas "capable of deriving benefit or escaping danger as a result of drainage operations," so that, in certain cases, a drainage district may exist where there is no catchment area.

The financial depression which set in almost immediately after the passing of the Act hampered, to no small extent, the initiation of important schemes of flood protection works, though a little was done where the need was urgent and perhaps desperate. Prior to March 31, 1934, only ten schemes, totalling nearly £300,000, were approved for the purpose of receiving grants out of monies provided by Parliament towards the expenditure incurred by catchment boards in respect of the improvement of existing works or

the construction of new works. Of this amount £179,000 was urgently required for sea defence in Rye Bay and north Norfolk. In the former locality, the sea actually breached the defences in November 1930, washed away a number of bungalows and left a widening gap in the natural shingle bank, which was the only defence at the point. When the financial situation eased, as it did after April 1934, fuller advantage was taken of Government assistance, and greater facilities were afforded for dealing with improvement schemes of a general character. Up to March 3 last, seventy-one such schemes had been approved between fifty and sixty of which are still in course of execution, at an estimated outlay of upwards of six millions sterling.

Attention may appropriately be directed to one feature of the functions of catchment board having an important bearing on a subject which has often been mentioned in these columns. We have in the past pointed out repeatedly how essential it is in the general interests of the country to institute an effective national survey covering all available water resources. After considerable pressure had been brought to bear on the Government by the British Association, jointly with the Institution of Civil Engineers, a Survey was set up a couple of years ago under the auspices of the Ministry of Health, and two annual reports of its activities have already been issued. Whatever misgivings we may have felt about the limitation apparently imposed on the Survey by its association with a department which cannot be said to be interested in the industrial and commercial use of water, the fact remains that, at present, it is the only organization existing for the purpose.

The Survey, however, cannot carry out single-handed all the operations which it is desirable should be covered, and it will have to rely very largely on the co-operation of external organizations. The catchment boards, with their control over the main rivers in their respective areas, can make a very effective contribution to the data necessary for the Survey, by undertaking a comprehensive study of their rivers, and by installing an adequate number of gauges to record the daily flow, so as to determine the run-off under varying conditions corresponding to the incidence of the local rainfall. This is a very important matter, and we are glad to see—even if only in the final sentence of the report—that attention is directed to it in the account of work being done under the Land Drainage Act.

The British Polar Year Expedition to Fort Rae

British Polar Year Expedition, Fort Rae, J.W. Canada, 1932-33

Vol. 1: Discussion of Results; Meteorology, Terrestrial Magnetism and Aurora, Atmospheric Electricity. Pp. xv + 336 + 5 plates. 21s. net.

Vol. 2: Tables; Meteorology, Terrestrial Magnetism, Atmospheric Electricity. Pp. ix + 228. 5s. net. (Published under the direction of the

British National Committee for the Polar Year, The Royal Society, Burlington House, London.) London: Percy Lund, Humphries and Co., Ltd., 1937.)

THE great scientific enterprise of the Second International Polar Year, 1932-33, is now bearing fruit in the publication, by the various co-operating nations, of the reports of their work. It will be remembered that the enterprise was a repetition and extension of the work of the First Polar Year, 1882-83, its main object being to obtain geophysical observations of various kinds at a number of high-latitude stations (mainly temporary) during a complete year; an associated programme of intensified observations in middle and low latitudes was also carried out during the same period.

After the jubilee of the first polar year had been adopted as a suitable date for the project, and while plans were being made, the great economic crisis occurred. Nevertheless, largely through the enthusiasm and energy of Dr. La Cour, president of the International Polar Year Commission, the project was carried through with great success. As regards the British participation, H.M. Government, through the Air Ministry, placed £10,000 at the disposal of the Royal Society for the purpose; this fund was administered by the British National Committee for the Polar Year, of which Sir Henry Lyons and Sir George Simpson were respectively president and secretary.

The British National Committee devoted the major part of its funds to the re-establishment of a station for comprehensive meteorological, magnetic, atmospheric electrical and auroral observations at Fort Rae, on the Great Slave Lake, Canada, where in 1882-83 the joint British and Canadian expedition had had its base. During the Second Polar Year the Canadian Government established its own very valuable Polar Year station at Chesterfield. The report of this second Fort Rae expedition has recently been issued; though it is not the first of the national Polar Year reports to appear, it is one of the most

complete. A few months before, the Royal Society had published in its *Philosophical Transactions* the report of another enterprise subsidized by the British Polar Year Committee, namely, the expedition for radio exploration of the ionosphere at Tromsø, organized mainly by Mr. R. A. Watson Watt and Prof. E. V. Appleton.

The Fort Rae expedition was led by Dr. J. M. Stagg, who made a preparatory visit to Fort Rae in 1931. He was assisted, in 1932-33, by four specialist scientific officers and a steward-mechanic (Messrs. Morgans, Sheppard, Grinstead, Stephenson and Kennedy). Of the six members of the expedition, all but one (Stephenson) were seconded by or drawn from the Meteorological Service, which in this and many other ways gave invaluable support to the expedition. The first Fort Rae expedition had been led by Captain (later Colonel) Dawson, who lived to see the start, though not the return, of the second expedition; its members, like its leader, had been drawn from the army, and military discipline was observed on the expedition. The second expedition, more specialist in character, worked under freer conditions with not less care, patience and success.

The journey to Fort Rae in 1882-83 was arduous and adventurous. Even in 1932 the outward journey took a month, the last part being by boats with a 16-mile land portage. The cost of transport of the five hundred cases of equipment and stores taken by the expedition from England to Fort Rae was still high—nearly a shilling a pound. It may incidentally be noted that despite the prevailing financial stringency, more than fifty firms had made generous gifts of food supplies, clothing and instrumental equipment to the expedition.

Up to 1931, Fort Rae had remained one of the most isolated trading posts of the Hudson's Bay Company, but then a reputedly rich discovery of gold and pitch-blende ores to the north of Fort Rae led to a rush of prospectors, which continued during 1932-33. An air service to the mining camps was organized, and Fort Rae was used as a fuelling station; this enabled the Fort Rae expedition in 1933 to return by aeroplane to the railway at Edmonton, 1,000 miles away. A general narrative of the expedition is given by Dr. Stagg in the introduction to the report; it is graphic and fascinating, and happily does not omit reference to some of the lighter incidents that occasionally enlivened the very full and arduous labours of the party.

The original site of Fort Rae had been abandoned since 1882-83, and the expedition made its headquarters at the new settlement, about fifteen miles away. The old site was, however, intermittently occupied by a section of the expedition, as a sub-station for magnetic observations and for taking auroral photographs simultaneously at the two sites. A telephone line was laid to connect the old and new Fort Rae; the line was slung partly from trees on the lake shore, but mainly on posts cut from similar trees, let into holes cut in the ice of the lake after this had frozen early in October. Had the line not been raised well above the snow-covered ice, it would soon have been severed by the passage of dog sleighs on the winter trails of the Indians.

Space does not permit a detailed description of the many kinds of work undertaken by the expedition, or of the difficulties and accidents besetting such work in the circumstances of Fort Rae. But mention may be made of the dispatch into the stratosphere of twenty-eight balloons carrying meteorographs, designed to register meteorological conditions during their passage through the troposphere and lower stratosphere. One great difficulty in this work was the low chance of recovery of the meteorographs in the difficult and almost uninhabited region round Fort Rae. To increase the chance of discovery of the fallen instruments by Indians on their trapping trails, a brilliantly coloured ribbon, $\frac{1}{4}$ - $\frac{1}{4}$ mile long, was attached to each meteorograph. Actually only two were found and returned, each with satisfactory records: it may be hoped that others may yet become available in years to come.

The report now published consists of two volumes. The basic data obtained are presented in 287 detailed tables, forming vol. 2; 159 of these are meteorological, 111 geomagnetic, and 17 refer to atmospheric electricity. Their choice and arrangement follow lines drawn up by the Publica-

tions Sub-Committee of the International Polar Year Commission to facilitate comparisons between the results of different national expeditions. The International Commission has also made reduced copies of all the photographic magnetic records on Leica film, for the use of investigators who need such complete material; this applies to Fort Rae and most of the other Polar Year stations.

The first and larger volume is devoted to the discussion of the data set out in vol. 2. The part relating to geomagnetism (including auroras, meteorology, and atmospheric electricity are respectively due to Messrs. Stagg, Morgans and Sheppard, and occupy approximately 180, 11 and 25 pages. A future publication on the photographic auroral work of the expedition, not discussed in the present volume, is referred to in the introduction.

Of the three discussions in vol. 1, it may be general be said that they maintain the high standard set by the British Meteorological Office in its Observatories Yearbook, and are worthy of the fine observations on which they rest. It is specially satisfactory that the discussion has been and could properly be undertaken by those who having made them, best know their errors and their excellences.

Over many years, the magnetic records of a series of British antarctic expeditions were entrusted for discussion to the late Dr. C. Chree, whose temperament and expert knowledge made him exceptionally suited for this important task. Dr. Chree is no more, but happily the mantle of Elijah has fallen on Elisha, and in the present discussion Dr. Stagg, a former collaborator and part disciple of Dr. Chree, has fully risen to the important opportunity it afforded. His work as leader, a chief scientific officer in carrying out the observing programme, and as author of the largest and most difficult section of the report, is of outstanding merit.

S. C.

Indirect Rule in Nigeria

Law and Authority in a Nigerian Tribe: a Study in Indirect Rule. By Dr. O. K. Meek. Pp. xvi + 372. (London, New York and Toronto: Oxford University Press, 1937.) 17s. 6d. net.

DR. O. K. MEEK'S investigations into Nigerian anthropology have for long been recognized as standard works of great value, owing to the eminently sound, practical, common-sense point of view with which he discusses subjects which are too often made the pegs upon which to hang fantastic or doubtful speculative theory. This new

book of his does not depart from that high standard which his other works have led us to expect.

We have all come to regard northern Nigeria as so much the home and classic example of 'indirect rule' that it is of especial interest to read, in this scholarly work, of the application—and misapplication—of the principles involved in this great ideal to the so-called 'pagan' areas in the south.

The writer of this notice has for long pointed out that one of the dangers which still menace the successful application of indirect rule lies in

the misconception which still exists in many quarters regarding the true status and functions of *soi-disant* African 'kings' or native rulers, and of the democratic basis which underlies every form of indigenous African Government, however apparently autocratic it may seem. To the West African, democracy implies that the affairs of the State must rest, not in the hands of the few, but in the keeping of the many.

In this book, Dr. Meek—besides giving us a very full and interesting account of Ibo customs and beliefs—tells us calmly of the happenings that led to, and resulted in, 'the women's riots' of November 1929. These disturbances developed from an almost total disregard of certain fundamentals, and were the sorry penalty the Nigerian administration had to pay for their misconception of the Africans' idea as to what forms the elementary basis of their social law and order.

The principal native executive officers, in the persons of the chiefs—so dearly beloved by a certain type of administrative officer—had gradually assumed the titles and functions of highly despotic rulers. The efficient and quite intricate decentralized system of government, which had once upon a time enlisted the co-operation of private, family, kindred and tribal groups in the administration of law and order, had gradually come to be ignored or brushed aside. The kind of indirect rule which Mary Kingsley, half a century before, had declared to be a parody, became the recognized form of administration.

African women, as once again Miss Kingsley could have foretold, rose—very literally—in arms. It was, indeed, a sorry tale, but at any rate the story need never be repeated if those who have the welfare of African peoples in their hands will only study carefully such a work as this.

Dr. Meek's advocacy for the inclusion of young educated Africans, that is, those educated on European standards, is also one of very real necessity if this great experiment in trusteeship is to have a full chance of success. After all, it is in the hands of such that the future of black Africa will surely lie.

The reviewer of this excellent book has only one minor complaint to make. It seems strange to note the complete absence, in a volume dealing with Nigeria and indirect rule, of even the name of the founder of this African Empire and of this African ideal—Sir George Goldie. Yet, long before the phrases 'dual mandate' and 'indirect rule' were ever coined, he had laid down the foundations of both, and formulated his policy, in words which cannot be bettered, even to-day.

"If the welfare of the native races is to be considered, if dangerous revolts are to be obviated, the general policy of ruling on African principles through native rulers must be followed. . . ."

The book is printed and produced as befits the traditions of the Oxford University Press.

R. S. RATTRAY

Catalytic Reactions

(1) The Catalytic Action of Surfaces

By J. E. Nyrop. Second edition. Pp. 102. (Copenhagen: Levin and Munksgaard; London: Williams and Norgate, Ltd. 1937). 7s. net.

(2) Katalytische Umsetzungen in homogenen und enzymatischen Systemen

Von W. Frankenburg. Pp. xi + 444. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 36 gold marks.

IT is probably true to say that the problem of the mechanism of heterogeneous catalysis has been and still is one of the most hotly debated topics in physical chemistry. A wealth of papers and books advocate rival theories, each supported by an abundance of experimental fact which can scarcely be discussed critically and impartially by one author.

(1) In the book under review, a rather novel viewpoint is adopted in order to attempt to bring heterogeneous reactions within the confines of one co-ordinating theory. Dr. Nyrop makes two

postulates in his theory: (a) adsorption is accompanied by ionization of the adsorbed molecules, the latter being thus held to the surface by ionic forces; (b) the lower the ionization potential of the impinging molecule, the higher its degree of adsorption. These postulates immediately imply that catalysis will not be observed unless the surface is capable of ionizing the interacting molecules. Furthermore, if two different kinds of molecules interact, it is necessary to ionize both.

Support for these views is initially mainly derived from experiments on the activation of molecules by low-voltage electrons in which ionization invariably precedes reaction. The question as to whether this idea can be applied *mutatis mutandis* to catalytic surfaces is one best settled by the reader of the book. There can be no doubt that some of the kinetics of heterogeneous reactions, such as the inhibiting effect of reactants and of products, may be accounted for by a consideration of the relative ionization potentials of such molecules. But whether surfaces normally

employed in catalysis are capable of effecting ionization of molecules requiring some 10–15 volts, when the work function of the surface in question may be less than half this value, is rather a moot point upon which judgment must be reserved. None the less, this monograph is a bold attempt to break away from the conventional and explore other methods for the elucidation of the intricacies of heterogeneous catalysis.

(2) While heterogeneous catalysis is at present treading a somewhat thorny path, homogeneous catalysis progresses in a more deliberate and systematic manner. Dr. Frankenburg's book in its thoroughness and completeness is the best proof of the latter contention. In fact, it might fairly be asked if this subject comprises the whole of that part of chemistry dealing with reactions with the exception of heterogeneous phenomena in the gas phase.

The book is naturally divided into three sections, preceded by an introduction to chemical dynamics, which is given in a straightforward manner without digressing too far into rigorous methods. This is the best compromise since, for the understanding of the remainder of the book, a detailed treatment is not necessary and indeed might prove a 'potential barrier' over which many readers would be disinclined to pass. The first section comprises an

account of well-known homogeneous catalytic reactions such as the effect of moisture on chemical change, a brief but sufficient description of a number of typical chain reactions, together with a discussion of simple gas-phase bimolecular reactions. In the second section, acid and base catalysis is given an adequate treatment. Included in this section is an account of oxidation in the liquid phase, with a return to the chain treatment of these processes. The section is brought to a close by a discussion of some reactions in organic chemistry, such as condensation, dehydration, etc. Finally, the last section treats heterogeneous catalysis in the liquid phase, namely, enzymatic reactions. A few pages are also devoted to reaction induced by colloidal metals.

The field thus covered is so large that exhaustive treatment of every aspect of the subject cannot be expected. The great merit of the book, however, lies, as it should, in the ease with which the reader may consult and understand any small portion without having to read the preceding hundred pages.

After perusal of these books the reader has every reason to inquire of the chemist: Are all chemical reactions catalytic? He would be a bold person who would answer in the negative.

H. W. MELVILLE.

Measurement of Radiant Energy

Measurement of Radiant Energy

Edited by W. E. Forsythe. Contributors:—Charles G. Abbot, Elliot Q. Adams, Loyal B. Aldrich, Ernest F. Barker, Bentley T. Barnes, William W. Coblentz, Paul H. Dike, Gustave Fassin, William E. Forsythe, Kaason S. Gibson, George R. Harrison, Herbert E. Ives, Loyd A. Jones, Lewis R. Koller, Henry F. Kurtz, A. Herman Pfund, Bartholomew J. Spence, Donald C. Stockbarger, A. Hadley Taylor, Willibald Weniger, Archie G. Worthing. Prepared under the direction of A. C. Hardy, Herbert E. Ives, and W. E. Forsythe. Pp. xiv + 452. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30s.

THE successive chapters of this book deal with fundamental ideas; sources of radiation; principles of analysis; spectrometers, general and particular; thermal, photo-electric and photographic measurement; densitometers; galvanometers; spectrophotometry; pyrometry; photometry; special problems. Many of these topics are each the subject of treatises as long as this book; accordingly it was necessary for the

editorial committee to decide exactly what was the gap in the literature that they proposed to fill.

In my opinion they have not performed this duty satisfactorily, and for this reason the book, in spite of excellence in some details, falls much below the high standard which the publishers have set themselves in other books of the same series. The editors might have aimed at an encyclopædia, mentioning every problem that might possibly arise in their field and indicating where a complete discussion of it was to be found. They might have aimed at an original work, discussing only problems that have been unduly neglected. Or they might have aimed at criticism, selecting from the vast amount of recorded knowledge that which is of special and permanent value. Actually they have confused all three aims. A few topics receive more than their proper share of space, because something new has to be said of them. Although every topic appears to be mentioned, the text, combined with the references, is sometimes quite inadequate to convey important information concerning them (luminescence, heterochromatic photometry, 'barrier-layer' photo-cells are examples). While some

sections are admirably critical, others are mere compilations of quite elementary facts and ideas.

The best sections are undoubtedly the most critical. Chapters iv (spectrometric instruments and their adjustment), vi (radiometry), x (galvanometers), xii (pyrometry) appear to me admirable; if the other chapters had shown equal knowledge and insight, the book, though it would have been a mere set of essays on slightly related subjects, might have been of great value. Chapter viii (photographic measurement) approaches the encyclopædic ideal, but is open to the objection that other works of greater length discuss the same matter with equal skill and in necessarily greater

detail. Chapter i (fundamental ideas) might have been abbreviated to a simple list of formulæ; on the other hand, not even Messrs. Forsythe and Ives can treat photometry (chapter xiii) adequately in 18 pages. The remaining chapters seem to me satisfactory so far as they go, but undistinguished; it is difficult to guess to whom precisely they are addressed.

These are, however, all matters of opinion; the editor's and authors' names are a sufficient guarantee that there will be no serious errors; I can only hope that others will find in this work a higher value than I have been able to put upon it.

NORMAN R. CAMPBELL.

Nutrition and Dietetics

(1) The Little Things in Life :

the Vitamins, Hormones and other Minute Essentials for Health. By Prof. Barnett Sure. Pp. xii + 340. (New York and London: D. Appleton-Century Co., Inc., 1937.) 8s. 6d. net.

(2) Elements of Foods and Nutrition

By Mary T. Dowd and Prof. Alberta Dent. Pp. xiii + 279. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 8s. 6d. net.

(3) Dietetics Simplified :

the Use of Foods in Health and Disease. By Prof. L. Jean Bogert. With Laboratory Section by Mame T. Porter. Pp. ix + 637. (New York: The Macmillan Co., 1937.) 12s. 6d. net.

THIS series of American books dealing with nutrition illustrates some of the methods by which the results of scientific inquiry may be made generally available for the benefit of a community.

(1) The method adopted by Prof. Sure is to present the more dramatic aspects of the subject in a form which may appeal to the intelligent layman. In "The Little Things of Life" he describes the part played by vitamins, mineral elements and hormones in the regulation of living processes, his main theme being the influence of these chemical substances on nutrition and therefore on health. Though written in "non-technical language", the account he gives is more detailed than might be expected from the title. Laymen introduced for the first time to the new knowledge of nutrition might digest more easily a plainer story, in which less attention is given to the chronological sequence of individual discoveries. The general public is usually content with getting some grasp of the main significance of scientific discoveries and is not deeply interested in settling questions of priority.

Nevertheless, the persistent reader will obtain much interesting information from this volume, and he should be duly impressed with the way in which recent biochemical work is being applied to the prevention and treatment of human disease.

(2) The little book by Dowd and Dent is avowedly a text-book for use in schools, and fulfils well its purpose of providing a basis for the teaching of good food habits to children in their more advanced forms. The subjects dealt with include not only the physical and chemical properties of the individual components of food and their function in nutrition, but also the principles of food selection for the purpose of securing good nutrition, with due regard to the cost of living. A useful chapter is added on common food fallacies, in which the fantastic views of certain types of food faddist are exposed. Numerous illustrations are included.

(3) The last of these books, "Dietetics Simplified," is again a text-book, but with an appeal to a more specialized audience—students of domestic science, hospital dietitians, nurses, medical students and perhaps intelligent housewives. The first two sections contain a clear and practical exposition of the principles of nutrition as applied to the normal human being. These are followed by a section devoted to the use of diet as a therapeutic agent in disease. It is shown how the normal good diet may be modified to suit the particular requirements of the subjects of disease. The reasons for advising the suggested modifications are given and these are in accord with current medical and scientific thought. The last third of the book is a practical manual of menu-planning and cookery. All those whose work includes the planning of diets for promoting health and treating established disease will find in this volume a mine of valuable information.

A History of Psychology in Autobiography (International University Series in Psychology.) Vol. 3. By James Rowland Angell, Frederic Charles Bartlett, Madison Bentley, Harvey A. Carr, Sante De Sanctis, Joseph Fröbes, O. Klemm, Karl Marbe, Charles Samuel Myers, E. W. Scripture, Edward Lee Thorndike, John Broadus Watson, Wilhelm Wirth. Edited by Carl Murchison. Pp. xvii+327. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1936.) 22s. 6d. net.

THE thirteen American, English, German and Italian psychologists whose autobiographies appear in this volume were selected in 1928, like those in the two previous volumes of the series, by a committee of five members of whom the editor was one. The idea of making eminent representatives of one branch of science tell the story of their intellectual development is not a new one, and was probably suggested in this instance by the series edited about fifteen years ago by Prof. L. G. Grote of Halle, in which the history of medicine of the present time is related in an autobiographical form.

Undoubtedly the most vivid autobiography in the present volume is that of the late versatile Prof. Sante De Sanctis, who although he claimed to be "above all and essentially a physician", was also the author of important work on psychology in relation to children, religion, criminology and dreams. In addition to the lively narratives of F. C. Bartlett and C. S. Myers, reference should be made to the contributions of Harvey A. Carr, notable for his work on the psychology of animals, O. Klemm, the author of a history of psychology and works on experimental and racial psychology, E. W. Scripture, the pioneer in experimental phonetics and speech neurology and E. L. Thorndike, well known for his work on child study, educational psychology and the measurement of intelligence. Several contributors discuss the educational aspects of psychology, especially F. C. Bartlett, who maintains that all teaching in psychology should be as informal as possible, and emphasizes the importance of a good practical training in physiology, biology and the elements of physical science as well as some instruction in philosophy and logic. Fröbes stresses the value of his five years' work as a teacher in mathematics, physics and chemistry in relation to his subsequent career, and Angell modestly declares that his influence on the course of psychological development was due less to his own investigations than to his students, who afterwards had highly successful careers.

The usefulness of the work would have been considerably increased if a bibliography had been attached to each autobiography.

Glastechnische Fabrikationsfehler

Von Dr. Hans Jebsen-Marwedel. Herausgegeben mit Unterstützung der Deutschen Glastechnischen Gesellschaft E.V. Pp. x+295. (Berlin: Julius Springer, 1936.) 48.60 gold marks.

MOST glass technologists will be familiar with Dr. Peddle's book "Defects in Glass", published some ten years ago, and will remember how this systematic

exposition of the faults in glass-making was welcomed. They will, if they read German, also be familiar with Dr. Jebsen-Marwedel's papers dealing with the melting and refining of glass, devitrification and kindred problems.

In the book now under review much of this work reappears in a connected form. The pace of the advance in glass technology is well illustrated by the difference in scope of the English and German works and by the wealth of documentation in the present one. Whilst in the latter Dr. Jebsen-Marwedel draws heavily on his own work, he does not rely entirely on it by any means, for of 639 references which are scattered throughout the book at the ends of the various sections, his name only appears in something less than ten per cent. The value of the work is enhanced by the lavish use of illustrations, both photographic and diagrammatic. The 295 pages contain in all 441 figures, and one colour plate is reproduced from the *Glastechnische Berichte* to show the effect of the 'oxygen pressure' in the melt on the colour of iron-containing glasses. Even those whose knowledge of German is rudimentary may learn much from the figures. Special mention may perhaps be made of the 'three dimensional' one illustrating the effect of diameter and temperature on the rate of rise of a bubble through a glass melt, and of the one showing the effect of furnace atmosphere and temperature on the residual SO₂ in the melt.

The setting out is clear, the type and reproduction of the figures excellent, and, save for a few understandable mistakes in names foreign to the proof reader, typographical errors are remarkably few for a first edition.

Altogether, the volume represents a notable contribution to the glass technologist's reference library and, though its price will probably prevent many from putting it there, it cannot be regarded as unduly expensive.

M. PARKIN.

Field Tests for Minerals

By E. H. Davison. Pp. viii+60+12 plates. (London: Chapman and Hall, Ltd., 1937.) 7s. 6d. net.

IN spite of the existence of other books of this type, designed as ready aids to mineral determination by relatively simple methods, Mr. Davison may be congratulated on producing a comprehensive summary of field tests in a form convenient for the traveller whether in settled or unsettled lands, at a relatively low price. The book, as it should be, is practical, and includes tests for all the minerals the student or prospector is likely to find. There is little room for criticism, but it might perhaps be possible to include in future editions black-and-white sketches of the results of microchemical tests, such as the "colourless highly refracting plates" characteristic of antimony; to many such would be more useful than some of the illustrations given of hand specimens. For one who has to 'travel light' in places where even the simplest apparatus or common reagents are unobtainable, a list of indispensable articles might save both time and inconvenience.

The book will prove useful to students, whether beginners or advanced.

J. P.

Die Fernrohre und Entfernungsmesser

on Dr. Albert König. Zweite Auflage. Pp. v+242. Berlin: Julius Springer, 1937.) 24 gold marks.

SHORTLY after the Great War, Dr. König, whose association with Messrs. Carl Zeiss of Jena eminently fitted him for the task, published his book on the telescope and range-finder. It dealt particularly with the more important fighting service optical instruments such as binoculars, sighting telescopes, submarine periscopes and range-finders, with the intricacies of which so many people through necessity had become familiar.

The second edition, in comparison with the first, which appeared at a time of great depression, is an excellent production, well illustrated and printed. It is stated in the preface, which modestly describes the book as a "Büchlein", that about half the original illustrations have been discarded and replaced by twice the number of new ones. The text has been correspondingly revised not only in the practical but also in the theoretical portions. A new section has been devoted to the important recent developments of anti-aircraft height- and range-finders of various types.

Many readers will find the historical descriptions of interest and particularly the additional chapter at the end which summarizes the history of the telescope from Lipperhey to Porro. Its invention has been attributed to Lipperhey in preference to Hansen, to whom Borel accorded the honour.

The use of abstruse mathematics has been avoided to an even greater extent than in the first edition, but the usefulness of the book to the student has not been prejudiced thereby. This excellent edition embodies so much new material that it may be read with advantage by those already familiar with the contents of the original work. J. W. F.

Zusammenhänge zwischen physikalischen Eigenschaften und chemischer Konstitution

von Prof. Dr. Robert Kremann. Mitbearbeitet von Dr. Max Pestemer. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 41.) Pp. xvi+225. (Dresden und Leipzig: Theodor Steinkopff, 1937.) 16 gold marks.

IT is characteristic of the present state of natural science that books appear with increasing frequency dealing with borderland subjects between physics and chemistry. This is all to the good, since boundaries have been needlessly rigid in the past.

In the book before us, it is natural that the molecule forms the basis of discussion, but stress is laid upon the relation between physical properties of the molecule as such, and the constitutional effects which derive from them. A particularly welcome chapter is that concerned with the forces of cohesion and surface potential, which concludes with some useful information about melting points. The interest of the volume is that the authors have produced a compact treatise upon chemical physics, rather than upon the conventional physical chemistry. The diagrams are too cramped to be very helpful, but the text is clear and concise. F. I. G. RAWLINS.

Lectures on College Algebra:

a Text Book for the use of Intermediate Students of Indian Universities. By S. B. Dandekar. Pp. xii+402. (Indore City: Vinayak and Co., 1936.) 8 rupees; 5s.

THE author of this very interesting volume claims to present a course in algebra, suitable for the use of intermediate students of Indian universities, in a manner quite different from that given in other books. An attempt is made—with commendable success—to deal with fundamental principles and methods in a simple, logical and connected form which will at once arouse the student's interest in, and enthusiasm for, the subject.

Beginning with preliminary notions, the topics considered, taken in order, include surds, theory of indices, ratio, proportion, variation, complex quantities, theory of quadratics, the progressions with applications to interest, annuities and scales of notation, logarithms, permutations and combinations, the binomial and exponential theorems, partial fractions and determinants. There is no doubt that it would be difficult to find any other book that deals with so comprehensive a course in such an order. It is certainly a long way from preliminary notions to complex quantities; yet the latter form the subject matter of chapter iii. There are, however, alternative courses of reading suggested to suit the particular needs of different types of student.

The whole treatment, whilst being very succinct, is quite sound, and the style of presentation one which compels interest from the beginning.

F. G. W. B.

Volumetric Analysis

By A. J. Mee. Pp. vii+223. (London: William Heinemann, Ltd., 1937.) 7s. 6d.

THIS useful text-book is meant primarily to cover the course of volumetric analysis necessary for the various school and university examinations. It deals especially with the growing tendency on the part of examiners to set questions dealing with the application of titrimetric methods to the solution of practical chemical problems. While this does not convert the work into a treatise suitable for the industrial chemist, it certainly covers a surprisingly large field and will be found of value not only to students but also to many others who make use of such methods of analysis. The subject-matter is quite up to date, and contains sections dealing with the use of ceric sulphate, titanous sulphate and chloride, potassium bromate with special reference to the evaluation of 8-hydroxyquinoline in metal complexes by means of bromate-bromide mixture and, in addition, there are given numerous interesting precipitation methods.

The text is set out mainly in the form of exercises which the student is expected to carry out, these being carefully and lucidly described and adequately explained. Additional exercises are given at the end of each chapter and there are also included a large number of problems. Two short appendices deal respectively with automatic burettes and pipettes and with mixed and universal indicators, while a third appendix contains a list of materials required in working out the various problems. G. R. D.

Chemotherapy of Amœbicides*

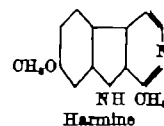
By Dr. F. L. Pyman, F.R.S.

RESEARCH on amœbicides was greatly facilitated by the technique developed by Dobell and Laidlaw (1926), and Laidlaw, Dobell and Bishop (1928) for testing amœbicides *in vitro*. Emetine has for long been the principal drug used in the treatment of amœbic dysentery, but it has some undesirable by-effects, amongst others a nauseating effect. In a search for substances having the amœbicidal action of emetine without its nauseating effect, a number of alkaloids very closely related to emetine in chemical structure were made at an earlier period. When tested by Dale and Dobell (1917), by an early laboratory method, several of them, *O*-methylpsychotrine (a substance which differs from emetine structurally only in containing two hydrogen atoms fewer) and *N*-methylemetine, for example, were found to be more toxic to *Entamoeba histolytica* than emetine itself. Clinical trials of *O*-methylpsychotrine (Jeppé and Meakins, 1917) and *N*-methylemetine, however (Low, 1915; Wenyon and O'Connor, 1917), showed them to be of little or no value in the treatment of amœbic dysentery.

The method of Dobell and Laidlaw, however, depending on the cultivation of amœbæ in a medium consisting partly of solid (inspissated fresh horse serum) and partly of liquid (egg-white diluted with Ringer's fluid) with a little starch, gave results which fell into line with the clinical results. Emetine was found to be fifty times as toxic to amœbæ *in vitro* as *N*-methylemetine, iso-emetine, and *O*-methylpsychotrine, which are clinically inactive. Later, Laidlaw, Dobell and Bishop described a simpler medium, consisting of 1 part of sterile horse serum, 8 parts of Ringer's fluid with a small quantity of sterile solid rice-starch, disodium hydrogen phosphate being added as a buffer. In this medium they found that the amœbæ were destroyed in four days by emetine 1' in 5,000,000, provided that the medium did not become too acid. We have made use of this method in the work which I am about to describe.

A homologous series of normal alkylharmols, from methylharmol (harmine) up to dodecylharmol, was examined, and it was found that both bactericidal and amœbicidal activity increased, on ascending the homologous series, up to a point and then started to fall. Peaks of bactericidal activity were reached at butyl for *B. typhosus* and at amyl

for *S. aureus*, whilst the peak of amœbicidal activity was reached at *O*-*n*-nonylharmol.

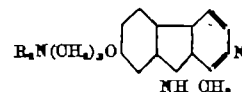


Compound.	B.W. Coefficients <i>B. typhosus</i> <i>S. aureus</i>	Minimum concentration lethal to <i>Entamoeba histolytica</i> .
Harmol	1	1 m 40,000 to 1 m 80,000
Harmine	<1	
<i>O</i> -ethylharmol	25	1 m 80,000
<i>O</i> - <i>n</i> -propylharmol	225	1 m 80,000 to 1 m 120,000
<i>O</i> - <i>n</i> -butylharmol	350-400	1 m 20,000 to 1 m 80,000
<i>O</i> - <i>n</i> -amylharmol	850	1 m 100,000 to 1 m 200,000
<i>O</i> - <i>n</i> -hexylharmol	50	1 m 100,000 to 1 m 200,000
<i>O</i> - <i>n</i> -heptylharmol	30-35	1 m 200,000
<i>O</i> - <i>n</i> -octylharmol	15	1 m 200,000 to 1 m 300,000
<i>O</i> - <i>n</i> -nonylharmol	10-15	1 m 200,000 to 1 m 500,000
<i>O</i> - <i>n</i> -decylharmol	10	1 m 100,000
<i>O</i> - <i>n</i> -dodecylharmol	5	1 m 100,000 not lethal

The salts of this and other high members of the series were very sparingly soluble in water, and consequently a further series of compounds was prepared, with the hope of obtaining more readily soluble compounds.

The method adopted was to add a further salt forming group to the molecule in the form of a terminal dialkylamino-group, such as is employed in the antimalarials, plasmoquine and atabrin.

In this way there was made a series of derivatives of harmol having the general formula given below, the salts of which proved, as had been expected, to be readily soluble in water.



The size of both R (the N-alkyl groups) and the number of carbon atoms in the chain separating N from O was varied, and the results may be illustrated by reference to a series in which the decyl group ($x = 10$) was a common factor, whilst the dialkylamino group was varied.

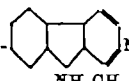
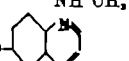
Compound.	Minimum concentration lethal to <i>Entamoeba histolytica</i> .
<i>O</i> - <i>n</i> -dimethylaminodecylharmol	1 m 300,000 to 1 m 500,000
<i>O</i> - <i>n</i> -diethylaminodecylharmol	1 m 200,000 to 1 m 500,000
<i>O</i> - <i>n</i> -di- <i>n</i> -butylaminodecylharmol	1 m 750,000 to 1 m 2,000,000
<i>O</i> - <i>n</i> -di- <i>n</i> -amylaminodecylharmol	1 m 750,000 to 1 m 3,000,000
<i>O</i> - <i>n</i> -di- <i>n</i> -butylaminoundecylharmol	1 m 750,000 to 1 m 4,000,000
<i>O</i> - <i>n</i> -nonylharmol	1 m 200,000 to 1 m 500,000
Harmine hydrochloride	1 m 2,000,000 to 1 m 10,000,000

It was thus found that the activity of member at the peak of the series, such as *O*-*n*-di-*n*-butylaminoundecylharmol, was many times that of

* From the presidential address entitled "Researches in Chemotherapy" to Section B (Chemistry) of the British Association, delivered at Nottingham on September 2.

2-*n*-nonylharmol, and this fact led us to suspect that the harmol residue might not be an important contributor to the amoebicidal properties of the molecule.

A number of compounds were then prepared in which dibutylaminodecyl (or undecyl) groups were introduced into molecules of varying structures. The last columns in the following tables show the limits of the range of the minimum concentration found lethal to *Entamoeba histolytica* in three days, under the conditions laid down by Laidlaw, Dobell and Bishop (*loc. cit.*).

Compound.	Minimum concentration lethal to <i>Entamoeba histolytica</i> .
$(C_4H_9)_2N.(OH)_{11}.O-$ 	1 in 750,000 to 1 in 4,000,000
$(C_4H_9)_2N.(OH)_{11}.O-$ 	1 in 100,000
$(C_4H_9)_2N.(OH)_8.O.OO.CH_3$	1 in 100,000
$(C_4H_9)_2N.(OH)_{10}.O.OO.C_4H_9$	1 in 100,000
$(C_4H_9)_2N.(CH_2)_{10}N.(C_4H_9)_2$	1 in 2,000,000

It was thus shown that the attachment of the group $(C_4H_9)_2N.(OH)_8$ to a simple substituted amino group gave very high efficiency.

A long series of tetraalkyldiamino paraffins of the general formula $NRR'.(OH)_8.NRR'$ was then prepared, and the minimum amoebicidal concentration under the optimum conditions for emetine determined.

In the first place, derivatives of heptane and decane were examined; of the heptane series the tetraethyl-diamino and tetra-*n*-butyldiamino compounds were prepared and tested. The tetrabutyl member of the series was superior as an amoebicide to the tetraethyl one, but neither showed more than a fraction of the efficiency of the best harmol derivative. More promising results were obtained with the corresponding decane derivatives, and ultimately the efficiency of dibutylaminoundecylharmol was equalled or even, in some of our tests, surpassed.

The following table shows the results of a test in which a number of decane derivatives of the general formula $R_2N.(OH)_8.NR_2$ were examined simultaneously, so that the 'peak' of the series could be ascertained. This was found at α -tetra-*n*-amyldiaminodecane, which was used as a standard of comparison in later work. For brevity, it is referred to below as T.A.D.D.

Compound.	Minimum concentration lethal to <i>E. histolytica</i> .
α -Decanes	
Tetra- <i>n</i> -propyldiamino	1 in 250,000 not lethal
Tetra- <i>n</i> -butyldiamino	1 in 1,500,000
Tetra- <i>n</i> -amyldiamino	1 in 3,000,000 (or less)
Tetra- <i>n</i> -hexyldiamino	1 in 1,000,000
Tetra- <i>n</i> -heptyldiamino	1 in 250,000 not lethal

A similar test indicated that the corresponding

series of undecane derivatives also showed the peak with the tetraamyldiamino member.

Next, keeping a tetrabutyl or tetraamyl group constant, the hydrocarbon residue was varied. The following table shows the results of two tests on these series of compounds.

Compound	Minimum concentration lethal to <i>E. histolytica</i> . Test 1.
α -Tetra- <i>n</i> -butyldiamino-	
nonane	1 in 800,000
decane	1 in 1,000,000
undecane	1 in 2,000,000
dodecane	1 in 1,500,000
tridecane	1 in 1,000,000
α -Tetra- <i>n</i> -amyldiamino-	
octane	1 in 400,000
nonane	1 in 1,000,000
decane	1 in 2,000,000
undecane	1 in 1,500,000
dodecane	1 in 800,000

As the results of the foregoing experiments, α -tetra-*n*-amyldiamino-*n*-decane (T.A.D.D.) was selected for further study. The conditions of all the amoebicidal tests described above were those most favourable for emetine, that is, in a faintly alkaline medium. It is well known (Laidlaw and others; Henry and Brown, 1923) that the exceedingly high efficiency of emetine *in vitro*, of the order of 1 in 5,000,000, is only found in alkaline, neutral or only very faintly acid media. Our results afford abundant confirmation of this fact. When endeavouring to assess the value of an amoebicide in the treatment of amoebic dysentery by comparison with emetine *in vitro*, it appears therefore necessary to consider carefully the hydrogen ion concentration likely to be met with in the areas infested with amoebae.

We have been unable to find any reference to the actual hydrogen ion concentration in the amoebic ulcer, but Knowles and others (1923) found that the pH of a number of stools containing motile amoebae averaged 6.22. They also reported the results of experiments on kittens artificially infected with *E. histolytica* in which the colon and rectum of the animals were minced in saline and the hydrogen ion concentration of the suspension determined. The average pH value obtained in these experiments was 6.33, and the livers when similarly treated showed an average pH value of 6.34.

Furthermore, a considerable amount of work has been carried out upon the reaction of living, dead and diseased body cells, and the work of Rohde (1927) and Chambers and others (1927) suggests that the contents of the ulcers may have a hydrogen ion concentration more acid than pH 7.0.

A consideration of these papers suggested that in any comparisons of amoebicides with emetine

in vitro the effect of acidity should be studied, particularly when the amœbiocides are to be administered orally, and that tests should be carried out at a pH value of 6.2 or 6.3.

Under these conditions T.A.D.D. is three to five times as efficient as emetine. Moreover, when blood is added to the medium even at pH values otherwise favouring emetine, T.A.D.D. and emetine are of very similar amœbiocidal value, the former at times showing a definite superiority.

The toxicity of T.A.D.D. to mice has been compared with that of emetine, with the following results:

	Median Lethal Dose (mgm./gm.)		
	Oral	Subcut	Intraven
<i>α</i> -Tetra- <i>α</i> -amylidiammodecane dihydrochloride	0.45	0.35	0.04
Emetine dihydrochloride	0.04	0.06	0.013

It has thus only one tenth of the toxicity of emetine when administered orally to mice and one sixth on subcutaneous injection. Its therapeutic index is therefore much more favourable than that of emetine, and it appeared to be an exceptionally promising compound for clinical trial in conditions of ill-health due to infestation with *Entamoeba histolytica*. At this point, it was

recommended to and accepted by the Therapeutic Trials Committee of the Medical Research Council for clinical trial. It was tried clinically by Prof Warrington Yorke, who has kindly allowed me to state his results. He finds that T.A.D.D. has some action in amœbic dysentery, when administered orally, but is not sufficiently active to be of any real value. Unfortunately, it cannot be given intramuscularly, subcutaneously or intravenously as it is intensely irritating.

It appears, therefore, that the comparison of the amœbiocidal values of emetine and T.A.D.D. with a faintly alkaline medium gives a better indication of their relative clinical value than the comparison in a slightly acid medium. This knowledge will be of value in further work on the subject.

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A New Conception of Supraconductivity*

By F. London, Institut Henri Poincaré, Paris

5. According to these conceptions, *there cannot exist any magnetic flux 'frozen' in the interior of pure supraconductors*; a permanent flux should only be found confined to the *hollows of supraconducting rings*. The topological connectivity of a supraconductor, therefore, is a property extremely characteristic of its behaviour: the multiplicity of its connectivity, diminished by one, immediately indicates the number of independent conservative quantities, that is, of independent invariant magnetic fluxes.

Actually, however, in the classical experiments of Kamerlingh Onnes, already there have been found magnetic fields 'frozen' in even simply connected supraconductors. It was these permanent fluxes which seemed at that time directly to indicate the elementary phenomenon: an *infinite conductivity*. We, on the contrary, do not consider these experiments as representing the elementary case of the phenomenon, but rather as a relatively complicated affair which can be reduced to a still more elementary phenomenon.

According to our conceptions, we interpret these magnetic fluxes 'frozen' in the interior of the supra-

conductors as follows*: One knows that the presence of a magnetic field exceeding a certain critical value H_T (depending on the temperature T), destroys the supraconductivity. Now it can happen that some magnetic fluxes are confined in certain regions of the metal in such a manner that the critical magnetic field is there exceeded, whereas in the supraconducting regions the supraconductivity is maintained. Thus the appearance of the permanent fluxes should be conditioned by the formation of a complicated structure of the supraconducting and the normal phases in the metal in such a way that the supraconducting regions constitute rings embracing the magnetic fluxes in their non-supraconducting hollows.

6. It is easy to see that, even in very simple experiments, such a *mixed structure of the two phases* must automatically arise. This can be shown by considering, for example, a supraconducting sphere which is brought into a homogeneous magnetic field.

The sphere pushes back the magnetic lines of force and compresses them in the region near the equator. An elementary calculation shows that the intensity of the field immediately on the

*Continued from page 796.

equator (H_e) is one and a half times greater than that (H_∞) at great distance from the sphere :

$$H_e = \frac{3}{2} H_\infty$$

With an external field $H_\infty = 2/3 H_T$, therefore, the field on the equator attains just the critical value H_T , whereas everywhere else it is smaller than H_T . When we now intensify the field a little, the supraconductivity will be destroyed in the sphere immediately behind the equator. But then the magnetic field can enter this region and the magnetic lines of force will be less compressed. As a consequence the magnetic field at the equator will be a little less than H_T , and the supraconducting state will here reappear. If now we intensify the field a little more, the supraconductivity will be destroyed anew immediately behind the equator, whilst the supraconducting layer just formed will move farther into the interior of the sphere.

7. At first sight it seems extraordinarily difficult to make such a microstructure of layers accessible to theoretical treatment. To do this it would be necessary to solve a very complicated boundary problem for which the shape of the boundaries has still to be determined, whilst even their number is not yet known. It is possible, however, to avoid this practically insoluble problem, if one abstains from determining that microstructure in detail and rather restricts oneself to considering the *mean values* of the field strengths taken over this microstructure of the phases. Actually it is these mean values of the fields which are above all the object of the experimenter.

The theory of this mixture of the two phases, sometimes called 'intermediate state' is, therefore, nothing but a consistent application of the theory of the 'pure supraconducting' phase; but formally it forms for itself an independent whole. Here we will only give some of the results.

The variables of the theory of this intermediate state are the *averages* of $\mathbf{h}$ and of $\mathbf{e}$ taken over the microscopic structure. These are the quantities which Lorentz identifies with the quantities $\mathbf{B}$ and $\mathbf{E}$ of Maxwell's theory :

$$\mathbf{B} = \bar{\mathbf{h}} \quad \text{and} \quad \mathbf{E} = \bar{\mathbf{e}}$$

Here we will restrict ourselves to the pure magnetostatic case. The theory can be completely characterized by indicating the free energy F which, it has been calculated, is given by :

$$F = H_T \left[\sqrt{B_x^2 + B_y^2 + B_z^2} - \frac{1}{2} H_T^2 \right] \quad (10)$$

(for $|\mathbf{B}| < H_T$)

By its derivatives with respect to B_x, B_y, B_z the free energy defines the quantities H_x, H_y, H_z ,

of the macroscopic Maxwell equations. One gets :

$$H_x = \frac{B_x}{\sqrt{B_x^2 + B_y^2 + B_z^2}} H_T, \text{ etc.} \quad (11)$$

This equation can be simply interpreted by stating that in the intermediate state there is a diamagnetic permeability dependent on $\mathbf{B}$ which for $B < H_T$ is given by

$$\mu = \frac{|\mathbf{B}|}{H_T}$$

Moreover, one has the equations

$$\text{curl } \mathbf{H} = 0 \quad \text{div } \mathbf{B} = 0$$

and the usual boundary conditions.

Although on account of equation (11) this theory is not a linear theory (like the theory of the pure supraconducting state or the ordinary Maxwell theory), it is nevertheless of extreme simplicity; (11) simply states that the magnetic field strength $\mathbf{H}$ is always parallel to the magnetic induction $\mathbf{B}$, but that it has always the absolute value H_T , independently of the value of $\mathbf{B}$. From this, among other things, it follows that, in the domain of the magnetostatics of the intermediate state, the magnetic lines of force are always straight lines.

For $B=0$, however, according to (11) the field $\mathbf{H}$ is not defined as to its intensity or as to its direction. This comes from the fact that for $B=0$ the pure supraconducting regions become unlimitedly large, which signifies that the description with the mean values $\mathbf{B}$ and $\mathbf{H}$ can no longer be legitimate and that one has now explicitly to apply the equations of the pure supraconducting state to the superconductor as a whole. Obviously the case $B=0$ cannot simply be considered as a limiting case of the non-linear theory.

8. We cannot enter here into a detailed discussion of the relation between theory and experiment. On the whole, one can say that the results of the theory agree fairly well with the experiments. With respect to the pure supraconducting state there is full agreement. Practically there exist three phenomena only : (1) the permanent current in a ring ; (2) the current without electric field in an open supraconducting wire, which is fed by normal conducting leads ; (3) Meissner's experiment. The consistent representation of these experiments was the basis of our theory. The greater part of the experiments (actually the Meissner effect also) concerns the transition between the normal and the supraconducting state and deals therefore with the intermediate state. Particularly striking in this respect are recent experiments of De Haas and Guinau, of Mendelssohn and of Shoenberg* as to the transition, qualitatively discussed above, of a sphere in a magnetic field. These experiments are in very

good agreement with the statements of our theory of the microstructure. In many cases, it is true, the experiments¹⁰ of the transition phenomena seem yet to be obscured by hysteresis and other retardation effects, which prevent the realization of thermal equilibrium and render difficult the theoretical discussion. The theory can also account qualitatively for these disturbing effects¹¹, though there still remains something to be done. But for a reasonable discussion of these questions we would have to occupy ourselves with much more detail than could be given here.

The macroscopic theory we have discussed shows that it is possible to interpret the phenomena in a way which avoids the paradoxes that seemed hitherto to render impossible any theory of supraconductivity. The new interpretation includes, moreover, a very simple description of the phenomenon in the language of wave kinematics. The next stage will have to be the

development of the electronic basis of this theory. One might presume that the new aspect here presented of supraconductivity may also give an indication for the construction of a molecular model of the superconductor¹².

¹⁰ The following interpretation seems first to have been given by Gorter, C. J., *NATURE*, **138**, 681 (1933). Gorter, C. J., and Casimir, H., *Physics*, **1**, 305 (1934).

¹¹ London, F., *Physics*, **2**, 450 (1936); *NATURE*, **137**, 991 (1936).

¹² The magnetostatic part of this theory has also been developed by Pelleris, R., *Proc. Roy. Soc., A*, **155**, 613 (1936), quite independently of our conceptions, as a pure phenomenological description of a new 'intermediate' state, different from both the pure supraconductive and the normal state. But it can be shown¹³ that, thermodynamically speaking, the intermediate state has not to be considered as a further independent phase but as a mixture of the two phases.

¹³ De Haas, W. J., and Guinan, A., *Physics*, **3**, 182, 534 (1936). Mendelssohn, K., *Proc. Roy. Soc., A*, **155**, 568 (1936). Schoenberg, D., *Proc. Roy. Soc., A*, **155**, 712 (1936).

¹⁴ For example, De Haas, W. J., and Casimir-Jonker, M. J., *Physics*, **1**, 291 (1934).

¹⁵ London, H., *Proc. Roy. Soc., A*, **153**, 650 (1935). Keosom, W. H., and Van Laer, P. H., *Physics*, **4**, 499 (1937). Grayson Smith, H., *Trans. Roy. Soc. Canada*, **51**, 31 (1937). De Haas, W. J., Hengelaar, A. D., and Guinan, O. A., *Physics*, **4**, 595 (1937).

¹⁶ (Added in the proof). In a paper just published (*Phys. Rev.*, **53**, 214 (1937), J. O. Slater has tried to sketch such a molecular model for our theory. See also Slater, J. O., *Phys. Rev.*, **51**, 195 (1937), and London, F., *Phys. Rev.*, **51**, 678 (1937).

Bicentenary of the Birth of Galvani

Celebration at Bologna

THE great contribution of Luigi Galvani to the advancement of the sciences of electricity and electro-physiology has been fittingly celebrated by a scientific congress held on October 17-20 at the invitation of the City and University of Bologna, the historic centre of learning where Galvani worked.

Galvani was born on September 9, 1737. In his early years it is recorded that he wished to enter the Church, but that on the insistence of his family he took to the study of medicine, and at twenty-five years of age had become lecturer in anatomy in the University of Bologna. Here his work lay in the field of anatomy and physiology until his great electro-physiological discovery made in 1791. It has been stated that the discovery arose from an observation that when animals were suspended on iron railings by copper hooks, a twitching of the muscles resulted. His published work states, however, that he observed the twitchings in the dissected muscles of a frog's leg whenever a spark was passed from a neighbouring electric machine to some other object, the only condition being that the animal should be in contact with some metal or other good conducting substance. A further experiment showed that the same convulsions could be obtained by the "sole application of some conducting arc", of which one extremity touched the muscles and the other the

nerves or spine of the frog. The motion was believed by Galvani to result from a union of the negative charge of the muscle with the positive electricity proceeding along the nerve.

The discovery attracted the attention of Volta, working in Como, who thereupon made an extensive series of experiments. He showed in particular that convulsions could be excited in the legs or other members of the animals by "metallic touching either of two parts of a nerve only or of two muscles" provided only that an arc consisting of two metals was employed. He ascribed the effects seen to the electricity produced by the contact of dissimilar metals, and showed also that the electric current acted not on the muscles directly but through the medium of the nerves. These results, which were communicated to the Royal Society in 1793 by his countryman Cavallo, led directly to his construction in 1800 of the voltaic pile.

At the opening session of the recent Congress, attended by the King and Queen of Italy and members of the Government, Prof. Q. Marjorana delivered a commemorative address on the life and work of Galvani. Later in the day the delegates were invited to a formal opening of a library and collection of records of Galvani. For these sessions, Bologna made public holiday. The streets were lined with troops; girls from the villages paraded

in traditional costume, the Balilla were out in force, and the sober black of the party uniform contrasted vividly with the splendour of historic costumes and academic robes. We cannot, it seems, compare with the totalitarian States in our devotion to men of science of the past.

The scientific work of the Congress was divided as was fitting into sections dealing with physics, experimental biology and radiobiology. At the plenary session, addresses were delivered by Prof. Niels Bohr on biology and atomic physics, by Prof. E. D. Adrian on the electrophysiology of the sense organs and by Prof. A. Gunsett on radiobiology and radiotherapy.

Prof. Bohr discussed the bearing on biological problems of the latest developments of atomic theory. In particular he discussed how far the limitation of the classical idea of causality resulting from the "Principle of Uncertainty" could serve to harmonize the mechanistic and vitalistic views of biological processes. He pointed out that the absorption of only a few light quanta or perhaps one light quantum is sufficient to produce a retinal impression, and that the limitation to the efficiency of the eye is almost certainly imposed by the atomic nature of the light quantum. It seems probable also that other organs have similar limits. Furthermore, it appears that the regularities peculiar to atomic processes which are foreign to causal mechanics are at least as important for the understanding of the behaviour of living organisms. Atomistic features are therefore of essential importance in biological processes.

The recognition of this importance is not, however, sufficient for a comprehensive explanation of biological processes, and it becomes necessary to examine the position of the vitalists, that a peculiar force unknown to physics governs all organic life. Prof. Bohr believes, however, with Newton that the foundation of science is the belief that Nature under the same conditions will always exhibit the same regularities. If, therefore, the analysis of the mechanism of living organisms could be probed as far as that of atomic phenomena, one would scarcely expect to find any features differing from the properties of inorganic matter.

It is necessary to remember, Prof. Bohr continued, that biological experiments differ from physical experiments in the necessity for keeping the organism alive, and that this restriction imposes uncertainties as to the physical conditions to which they are subjected. It might well be that this uncertainty is just sufficient to allow the organism to conceal from us the secrets which are connected with life, just as in physical experiments the disturbance produced by observation often prevents a strictly causal description of the phenomena. Great caution should, however, be

exercised in such considerations, and he considered that quite unwarranted applications of the "Principle of Uncertainty" have been made by many writers.

Prof. E. Fermi gave an account of the beautiful experiments carried out by his school in Rome on the properties of neutrons and on the important information obtained on the position and life of excited states of nuclei. He described experiments which show that fast neutrons lose the greater part of their energy on scattering by heavy nuclei such as lead.

Prof. G. v. Hevesy gave an account of his work on the use of radioactive phosphorus as an indicator in biological processes. Radiophosphorus, which can be produced in large quantities by a transmutation process, emits electrons and decays with a convenient period of 14 days. By adding radiophosphorus to the food of animals, the path of the phosphorus atoms can be traced through the different stages of the metabolic process. Thus the greatest part of the phosphorus enters the blood stream, and after a few minutes the bulk of the phosphorus atoms present in the blood in the phosphate stage will exchange places, principally with those present in the skeleton but also with those present in the muscles and other organs. At an appreciably slower rate proceeds the synthesis of the numerous organic phosphorus compounds present in the organism.

Prof. P. Debye described new experiments on the dielectric loss in liquids, using undamped electric waves having a wave-length of the order of a centimetre. The experiments show that molecular rotation does not play a great part in the dielectric loss, probably owing to the rotation being prevented by the quasi-crystalline structure of the liquid. The loss seems rather to result from relative motion of the component units of the molecule.

Prof. W. Bothe gave two new examples of the existence of radioactive isomers—atomic nuclei having the same charge and mass but having different decay constants. Thus ^{80}Br can be produced either by adding a neutron to ^{79}Br or by detaching a neutron from ^{81}Br . In both cases two radioactive products are produced having half-lives of 18 min. and 4.2 hours. He gave also new information on the resonance energies of light nuclei, showing that the same resonant states can be produced by different types of transmutations.

Prof. W. Heisenberg discussed the mechanism of shower production by cosmic rays. He differentiated between two processes. In the cascade process, showers are built up from the successive conversion of electron energy into radiation, radiation into pair production and then further loss of electron

energy to radiation. This process, described theoretically by the theories of Oppenheimer and Coulson, Bhabha and Heitler seems to be confirmed by Wilson chamber photographs of Street and Stevenson showing the 'build up' of the shower. A second process results from the conversion of the energy of a heavy particle into positive and negative electrons through the intermediary of proton-neutron transitions. Experimental results on cosmic rays were discussed by Prof. B. Rossi.

Dr. F. W. Aston gave an account of his recent measurement on the masses of nuclei by the method of close doublets, and Prof. M. L. E. Oliphant and Dr. J. D. Cockcroft described other recent work of the Cavendish and Mond Laboratories, Cambridge, including a description of the new High-Voltage Laboratory and its equipment and the recently reported peculiar properties of liquid helium.

In all, about twenty physical papers were communicated to the Congress.

Obituary Notices

Mr. W. S. Gosset: "Student"

WILLIAM SEALY GOSSET, who died after a short illness on October 16, was best known to statisticians throughout the world by his pseudonym "Student", under which his scientific contributions were published. He was born on June 13, 1876, and became in turn a scholar at Winchester and at New College, Oxford, where he worked at mathematics and chemistry. In 1899 he joined the firm of Arthur Guinness, Son and Company, and a few weeks before his death had been appointed head brewer; his handling of statistics was only one of many duties.

Gosset's work brought him at an early stage against the problem of interpreting routine tests in chemical analysis, and at the suggestion of one of his chiefs he turned his mind to the question of what help the theory of probability could bring to the practice of brewing. He first met Karl Pearson in the summer of 1905, and a year later went to London to spend some months in the Biometric Laboratory at University College. Throughout his life he was to gain much from the continuation of this contact between 'student' and 'professor', but from the very beginning he launched out on research lines of his own which were to prove of very great importance to the development both of the theory and practice of mathematical statistics.

Under Galton, Weldon and Pearson, the Biometric School had been mainly concerned with the handling of comparatively large samples from biological populations, but Gosset in his daily work was forced to attempt to draw conclusions, leading to executive action, from the analysis of relatively small numbers of observations. Thus he might need to answer such a question as, "What is the accuracy of this arithmetic mean based on 8 observations (the population standard deviation being unknown)?" Thirty years ago a statistician was forced to reply somewhat as follows: "Following the method appropriate for large samples the odds are 19 to 1 that your unknown population mean lies between (say) 22.1 and 24.6, but as the sample is so small this statement is entirely unreliable." Gosset's work has, however, made possible a far more useful answer, namely, "If you have taken reasonable precautions to see that your sample is randomly selected, the odds are 19 to 1 that the

limits 21.8 to 24.9 include the unknown population mean." At the expense of somewhat broadening limits which before had little meaning, definite information has replaced a counsel of despair. This process of making full allowance within the statistical test itself for uncertainty regarding the standard deviation due to small numbers, by use of what in fact are ratios instead of absolute measures, has sometimes been termed 'studentizing'; the conception involved has been the basis of a rapid theoretical advance without which many of the problems of agriculture and industry could scarcely have been brought within the range of statistical inquiry.

But Gosset's contribution was only in part a theoretical one; he recognized the risks involved in basing action on the application of statistical calculus to few observations, yet all his work as a practical statistician in industry went to show that, with due precaution, these risks could be taken with economic advantage. Thus all that he wrote, whether on the reliability of the mean and standard deviation, on methods of measuring correlation, on the problem of counting cells with a haemocytometer or on the checking of routine analysis, helped to give confidence to those who were trying to apply similar methods in the face of scepticism or even opposition.

Besides dealing with questions which concerned the chemist and biologist, Gosset's work led him into the field of agricultural experimentation. His paper of 1923 "On Testing Varieties of Cereals" was one of the most important early contributions to an era which has been notable for the introduction of precise statistical methods into agricultural research. His influence spread very widely in later years, not only through the medium of his written papers, but also through a correspondence which linked him to experimenters all the world over. He was always ready with advice and friendly criticism, and many must have gained from his suggestive mind the initial ideas which have borne fruit in their later research.

Much could be written, if space allowed, of the charm of Gosset's personality, with its modesty, unconventionality and tolerance. It is to be hoped that it will be possible to do fuller justice elsewhere to a man who has occupied a very special place in the hearts of so many friends in Great Britain and abroad.

E. S. P.

The Right Hon. J. Ramsay MacDonald, F.R.S.

THE sudden death of Mr. Ramsay MacDonald from heart failure, on Tuesday night, at seventy-one years of age, while on a voyage to South America, will be deeply regretted by his many friends in scientific circles. He left England on November 4 for a three months' holiday, which he described as "the first he had ever had free from care", and a wireless message stating that he passed away on November 9, at 8.45 p.m., was received a few hours later.

Mr. MacDonald's last speech in public was made at the Royal Institution on October 22, when he delivered the Radford Mather lecture of the British Association on "Science and the Community". The main part of this discourse was published in *NATURE* of October 30, and it is of melancholy interest to record that the same issue contained personal appreciations of the work and influence of his friend, Lord Rutherford, to whom he referred in terms of affectionate regard in his lecture.

As a young man, Mr. MacDonald was a keen student of science, and it was through the accident of circumstances that his interests were diverted into social and political fields. When he went to Bristol more than fifty years ago, to take charge of a boys' club, his ambition was to become a science teacher, and he took particular interest in geology. It happened, however, that he came into contact with a very remarkable group of social reformers in Bristol at that time and soon associated himself with their movement. Even when he left Bristol to come to London he continued his studies of scientific subjects at the Birkbeck College and privately with the view of obtaining a scholarship or exhibition upon successful results in the old Science and Art Departments examinations. It was impossible, however, for him to find sufficient time for the intensive study required, outside his daily working hours, to prepare himself for one of the scholarships then tenable at the Normal School of Science, South Kensington, now the Royal College of Science, and he had to abandon his early hopes.

It was through his social work that Mr. MacDonald became associated with the daughter of Dr. J. H. Gladstone, F.R.S., the distinguished chemist, and niece of Lord Kelvin, and they were married in 1896. They worked together for social reform in complete sympathy until Mrs. MacDonald's death in 1911; one of their two sons is Mr. Malcolm MacDonald, Secretary of State for Dominion Affairs.

After Mr. MacDonald had resigned his office as Prime Minister and First Lord of the Treasury in 1935, he became Lord President of the Council, and as such was responsible to Parliament for the reports of the Department of Scientific and Industrial Research, in the work of which he took particular interest. He was elected a fellow of the Royal Society in 1930 under the special rule which provides for the election of a limited number of persons who "have rendered conspicuous service to the cause of science". He was elected a member of Parliament for the Scottish Universities in 1936 and held this seat at the time of his death. This is not the place to survey

his political career or his influence as a statesman, but we are glad to express grateful appreciation of the encouragement he always gave to scientific work and to record the esteem in which his memory is cherished in scientific circles.

Prof. E. J. Rapson, F.B.A.

WE regret to record the death of Prof. E. J. Rapson, professor of Sanskrit in the University of Cambridge, which took place suddenly at Cambridge on October 3, at the age of seventy-six years.

Edward James Rapson, the son of the Rev. E. Rapson, vicar of West Bradley, Somerset, was born on May 12, 1861, and was educated at Hereford Cathedral School and St. John's College, Cambridge, where he was elected a classical foundation scholar in 1883. He studied Sanskrit under Cowell and Bendal, taking a first class in the Classical Tripos of 1883 and the Indian Languages Tripos two years later. He was awarded the Brotherton Sanskrit scholarship in 1885 and the Le Bas prize in 1886, and was elected to a fellowship at St. John's in the following year. In the same year he became librarian of the Indian Institute, Oxford, where he was associated with the then Boden professor, Sir Monier Monier-Williams. A few months later he joined the staff of the British Museum, taking charge of the collection of Indian coins. In 1903 he was appointed professor of Sanskrit in University College, London, and in 1906 went to Cambridge, where he occupied the chair in Sanskrit until his retirement in 1936, when he was accorded the title of emeritus professor.

Pre-eminent as scholar and teacher in Sanskrit, it was through palaeography and numismatics, and more especially the numismatics of the early Indian dynasties, that Rapson made his outstanding contributions to Indian studies. When he joined the staff of the British Museum, knowledge of the early history of India was largely a blank. It was in great part owing to his studies that this gap has been filled to no little extent. Of this the evidence will be found in his "Indian Coins" (1897), his contributions to the British Museum catalogue of Indian coins, and his communications in the *Numismatic Chronicle*, of which he was editor, the *Journal of the Royal Asiatic Society*, and other scientific and learned periodicals. His abilities as scholar and historian found wider scope as editor of the first two volumes of the "Cambridge History of India". The first volume, on Ancient India, to which he himself contributed four chapters, was published in 1922; but the second is still uncompleted, though the later volumes have appeared.

WE regret to announce the following deaths:

Prof. H. B. Fantham, Strathcona professor of zoology in McGill University, Montreal, since 1933, professor of zoology and comparative anatomy in the University of the Witwatersrand, Johannesburg, in 1917-32, on October 27, aged sixty years.

Dr. J. A. Voelcker, C.I.E., consulting chemist to the Royal Agricultural Society of England, on November 6, aged eighty-three years.

News and Views

Royal Society Medallists and Officers

HIS MAJESTY THE KING has been graciously pleased to approve the following recommendations made by the council of the Royal Society for the award of the two Royal Medals for the current year: Prof. N. V. Sidgwick, in recognition of his distinguished, stimulating and continuous work on valency and on molecular structure; Prof. A. H. R. Buller, in recognition of his researches on the general biology and sexuality of the Fungi. The following awards have been made by the president and council of the Royal Society: Copley Medal to Sir Henry Dale, in recognition of his important contributions to pharmacology, particularly to the pharmacology of muscle and of neuromuscular transmission; Davy Medal to Prof. Hans Fischer, in recognition of his work on the chemistry of the porphyrins, particularly his determination of their detailed structure by degradation and his syntheses of porphyrins of biological importance; Buchanan Medal to General F. F. Russell, in recognition of his work in relation to public health problems in many parts of the world on behalf of the International Health Division of the Rockefeller Foundation; Sylvester Medal to Prof. A. E. H. Love, in recognition of his researches in classical mathematical physics, particularly the mathematical theories of elasticity and hydrodynamics; Hughes Medal to Prof. Ernest O. Lawrence in recognition of his work on the development of the cyclotron and its application to investigations of nuclear disintegration. The following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on November 30: *President*, Sir William Bragg; *Treasurer*, Sir Henry Lyons; *Secretaries*, Sir Frank Smith and Prof. A. V. Hill; *Foreign Secretary*, Sir Albert Seward; *Other Members of Council*, Prof. R. Whytlaw-Gray, Prof. G. P. Thomson, Prof. J. Proudman, Prof. D. M. S. Watson, Dr. F. L. Pyman, Prof. E. J. Salisbury, Prof. S. P. Bedson, Prof. M. Greenwood, Prof. J. Mellanby, Sir Thomas Holland, Dr. G. T. Bennett, Prof. J. Chadwick, Prof. D. Keilin, Prof. J. Graham Kerr, Sir Robert Pickard, Mr. H. R. Ricardo.

Ludwig Stieda (1837-1918)

CHRISTIAN HERMAN LUDWIG STIEDA, an eminent German anatomist, was born at Riga on November 19, 1837, the son of a tradesman. His medical education was carried out at Dorpat, where his teachers in anatomy were Reissner, Bidder and Kupffer, and he won a silver medal in anatomy. After qualifying in 1861 he went to Gießen, where Leuckart inspired him with an interest in the anatomy of worms, and later to Erlangen, where he studied under Gerlach and Herz. In 1862 he moved to Vienna, where he attended lectures by Oppolzer, Skoda, Hebra, Hyrtl

and Brücke, with the last of whom he studied histology. In 1864 he was appointed prosecutor at Dorpat and in the following year lecturer on comparative anatomy in the veterinary school there. In 1866 he was elected extraordinary professor of anatomy and nine years later full professor in succession to his former teacher Reissner. He held this office for ten years, during the last three of which he was dean of the medical faculty. In 1885 he was appointed director of the anatomical institute at Königsberg, where he remained until his retirement in 1912. His death took place at Gießen on his birthday on November 19, 1918. As well as being a successful and attractive lecturer, Stieda was a man of very wide interests and a prolific writer, as is shown by the bibliography of his works compiled by Peisler (*Anat. Anzeiger*, 52, 134-42; 1919-20). His anatomical investigations included comparative studies of the central nervous system in vertebrates, the formation of bone, and the development of the lungs, thymus, thyroid and carotid glands. His interest in the history of medicine is shown by his biographies of naturalists and medical men. He was also the author of several articles and reviews on archaeological, anthropological and ethnographical subjects.

The Writings of Galvani

IN connexion with the commemoration at Bologna of the bicentenary of the birth of Galvani, attention may be directed to an interesting memoir in the *Annals of Science*, 1, No. 3, July 1936, by Prof. J. F. Fulton and Prof. H. Cushing, of the Yale University School of Medicine, entitled "A Bibliographical Study of the Galvani and the Aldini Writings on Animal Electricity". Modest and shy, Galvani showed the greatest indifference to having his name appear in print, and thus out of all the known discourses or lectures prepared by him during the twenty-five years between his professorial appointment and the appearance of his famous "De vivibus electricitatis", only three, making a total of thirty printed pages, appear to have been published. Galvani's lack of self-assurance was not, however, shared by his nephew Giovanni Aldini (1762-1834), professor of physics in the University of Bologna, and it was he who took up the cudgels in defence of his uncle's thesis. Galvani's memoir appeared early in 1791 and two reprints were issued the same year. Next year, after Volta's criticism of Galvani's views, Aldini published an edition with annotations, and a German translation was made by Dr. J. Mayer (1752-1807) in 1793. The subject of animal magnetism had by then become a matter for widespread controversy. Galvani died in 1798, but a year or two later Aldini visited England, gave lectures on galvanism at Guy's and St. Thomas's Hospitals and was presented with a gold medal. His "Improvements

n Galvanism", printed in London in 1803, has the title-page embellished with a representation of the medal. Altogether twenty-eight items are included in the bibliography, all of them being very fully described, while there are photographs of several of the title-pages.

Radcliffe Observatory, Pretoria

THE date of completion of the 74-inch reflector for the new Radcliffe Observatory at Pretoria has been further postponed by a second unsuccessful attempt to cast the disk of Pyrex glass for the large mirror. The first disk was cast by the Corning Glass Company in July 1936, and on being taken from the annealing oven in the following December was found to be useless. A second disk was cast in June of this year, and the disappointing, and unexpected, news has recently been received that this disk also has been a failure. The company is proceeding to make a third disk, and it is to be hoped that on this occasion better fortune will attend its efforts. The other arrangements, though somewhat behind schedule, have been proceeding with greater smoothness. The buildings of the Observatory on the magnificent site to the south-east of Pretoria, 600 feet above the city, which was generously presented to the Radcliffe Trustees by the municipality, are nearly completed. They consist of an office block, three residences and the circular building of brick and concrete to house the telescope.

THE Radcliffe observer (Dr. H. Knox-Shaw) and Mr. E. G. Williams, the second assistant, have already taken up residence at the Observatory, but Dr. R. O. Redman, the chief assistant, is remaining in England for the present to superintend the construction of subsidiary apparatus. The steel revolving turret, under construction by the Cleveland Bridge Company, is due to reach Pretoria early in the new year, to be followed a couple of months later by the mechanical parts of the telescope, which Sir Howard Grubb, Parsons and Co. have nearly finished. It had been planned to have the large mirror for the 74-inch telescope aluminized when completed, in view of the marked success of this form of reflecting surface as applied to the large mirrors in America. There is, however, no apparatus in England capable of dealing with a mirror of this size, and the estimated cost of the outfit, vacuum chamber and pumps, namely, £1,500, is much more than the resources of the Radcliffe Trustees, already greatly strained by the recent rise in the cost of materials, can afford. It seems likely, therefore, that the new telescope, although thoroughly up to date in other respects, will have, at any rate to begin with, a silvered mirror.

Exhibition of Wilson Track Photographs

It is now twenty-five years since C. T. R. Wilson first succeeded in making visible and photographing the tracks of single ionizing particles by his condensation method. An exhibition has been arranged at the Science Museum, South Kensington, to

illustrate the great variety of effects which have been investigated by means of Wilson chambers during the past twenty-five years. The exhibition will be open free to the public from November 19 until the end of February 1938. The centre-piece of the exhibition is Wilson's original apparatus with which the photographs published in 1912 were taken; the apparatus has been kindly lent by the Cavendish Laboratory, Cambridge, where Wilson's pioneer work was carried out. The remainder of the exhibition consists of a collection of more than eighty photographs, which have been contributed by research workers from many countries. An introductory group of twelve photographs illustrates in as simple a way as possible some of the main properties of alpha and beta rays, X-rays and cosmic rays, for the benefit of those who are not familiar with them. The main collection of photographs is arranged in a series of groups showing typical effects produced by alpha, beta and gamma rays, X-rays, protons, deuterons, neutrons and cosmic rays, while a small group illustrates the phenomenon of induced radioactivity. The section devoted to cosmic rays includes a copy of the photograph taken by Anderson in 1932 which gave him conclusive evidence for the existence of the positive electron, while the discovery of cosmic-ray 'showers' is illustrated by copies of Skobel'syn's pioneer photographs, from which he showed that pairs and groups of 'straight' cosmic ray tracks occur more frequently than is to be expected by chance. In order to bring home to visitors to the exhibition the three-dimensional character of Wilson tracks a number of pairs of stereoscopic transparencies have been mounted for viewing in turn in a stereoscope. A small handbook (London: Science Museum, or H.M. Stationery Office, 6d., by post 7d.) has been prepared by Dr. F. A. B. Ward, an officer of the Museum, who has arranged the exhibition.

Indian Hydro-electric Development

THE hydro-electric power scheme, known as the "Ganges Grid", was formally inaugurated on November 2, when Sir Harry Haig, Governor of the United Provinces, opened two new generating stations near Meerut, which are supplied with water-power from the Ganges Canal. The potentialities of the canal as a source of power were first investigated in 1920 in connexion with a series of local applications, and these gradually led to the development of the available resources on a larger scale, in order to extend the benefits of agricultural irrigation over a wide area. The exploitation of the "Grid" project has cost Rs. 343 lakhs (more than £2,500,000) and it now produces a gross output of 29,000 kilowatts. The energy is distributed by means of some four thousand miles of transmission lines to 1,600 sub-stations scattered over the eight western districts of the United Provinces; thence it is supplied to 88 towns for the purpose of pumping water from rivers or from State tube-wells for land irrigation. The power is also utilized to work agricultural machinery on private farms. Sir Harry opened at the same time the State tube-well irrigation system, consisting

of considerably more than a thousand wells, the greater number of which are in operation and irrigate an area of a million and a half acres. The capital outlay on the system has been about Rs. 126 lakhs (£945,000). The execution of the "Grid" project has been in the hands of Sir William Stampe, formerly chief engineer of the Irrigation Department of the United Provinces.

Tring Museum

ABOUT the time of the recent meeting of the British Association in Nottingham, it was announced in the Press that the late Lord Rothschild had bequeathed the buildings and collections of his museum at Tring to the nation on condition that the trustees of the British Museum should undertake their custody and maintenance. The president of the Association, Sir Edward Poulton, expressed in his address the hope that this condition would be accepted, and the committee of Section D (Zoology) forwarded a resolution to the Council, recording its opinion "that the continuance of the Tring Museum as an active centre of scientific research is a matter of the utmost importance from a national, and indeed from an international, point of view. For many years", the resolution continues, "the collections preserved there, more particularly the vast and unequalled collection of Lepidoptera, have attracted research workers from all over the world and have been the means of adding largely to our understanding of the problems of geographical variation. The Sectional Committee earnestly desire that the permanent conservation of these collections and the continuance of the facilities for their study provided by the munificence of the late Lord Rothschild will be ensured by their being placed in the custody of the Trustees of the British Museum." The Council of the Association has now adopted this resolution.

Royal Institute of International Affairs

THE report of the Council of the Royal Institute of International Affairs submitted to the eighteenth annual general meeting on November 2 refers to the establishment of a chair of international economics at the Institute, Chatham House, London, S.W.1, as a result of a gift of £20,000 from Sir Henry Preece. Prof. Allan G. B. Fisher, of the University of Western Australia, has been appointed as the first holder of this chair and will assume his duties in January 1938. It is hoped that this is the first of what will become a group of research chairs devoted to the study of international affairs, and the council contemplates the establishment of research chairs in British Commonwealth relations, international law and institutions and Far Eastern affairs as soon as provision can be made for them. In addition to these important developments, which were largely inspired by the work of Prof. Arnold Toynbee, holder of the Stevenson research chair in international history, the council has been able to maintain its programme of research by individual scholars and by study groups through the support of the trustees of the Rockefeller

Foundation, who in January 1937 renewed for a further five years their grant of £8,000 a year. Four reports in the Study Group Series were completed during the year, covering "The British Empire", "The Problem of International Investment", "The Colonial Problem" and "The Republics of South America: a Political, Economic and Cultural Survey". Particulars of these, and of other publications of the Institute, are included in an appendix. The Rockefeller Foundation has also made a special grant for an investigation of the refugee problem. The report includes particulars of a number of other research projects which are in progress as well as meetings held and study groups in being. It is expected that the African Research Survey will be completed and published early in 1938, the preliminary survey having been extended to cover administration, economics, scientific research and social relations.

Tyneside Geographical Society

THE Tyneside Geographical Society celebrated its fiftieth year of existence at Newcastle-upon-Tyne on November 4-6. On November 4 a jubilee meeting was held with the president of the Society, the Duke of Northumberland, in the chair. The chief speaker at this meeting was Sir William Goodenough, who was one of the two representatives of the Royal Geographical Society at the celebrations. After this meeting, a dinner was held at the Royal Station Hotel, when Lord Polwarth, president of the Royal Scottish Geographical Society, proposed the health of the Tyneside Geographical Society. Sir Thomas Oliver acknowledged the toast and included in his response references to the past activities of the Society over the last fifty years. The health of the guests was proposed by Mr. Herbert Shaw, who held the office of secretary of the Society for nearly forty years. He expressed the gratitude of the Society to the Royal Geographical Society, the Royal Scottish Geographical Society, the Geographical Association and the Manchester Geographical Society for sending representatives to the celebrations. The toast was acknowledged by Lord Eustace Percy, rector of King's College, and by Prof. E. G. R. Taylor of Birkbeck College, University of London. On November 5 the Robertson Memorial Lecture of the Geographical Association was delivered in King's College by Prof. A. G. Ogilvie, of the University of Edinburgh. The subject of the lecture was "Minerals, Land Forms and Life". On November 6 an exhibition of geographical materials, publications and appliances was held, the official opening ceremony being performed by Lord Eustace Percy.

County Library at Ruislip

THAT a timbered barn, reputed to be of medieval age, used in olden days for the storage of corn and later for haybinders' work and general farm products, might be saved by its own appeal through adaptation for the needs of a public county library is a consideration which might well enter the minds of educational authorities in those rapidly expanding rural areas where sites are valued at exorbitant rates

of purchase. On November 2, Prof. J. H. Clapham, vice-provost of King's College, Cambridge, performed the ceremony of opening at Ruislip, Middlesex, the "Little Barn" (so called for generations) appertaining to the ancient Manor of Ruislip, and now being used as a county library. The homestead of the farm, it should be said, originally constituted, with the acres around, but a fraction indeed of the extensive tracts owned formerly at Ruislip by King's College, Cambridge, the gift of its founder, Henry VI. Not long ago, the College conveyed the farm and surroundings to the people of Ruislip as a gift. Hence the presence of Prof. Clapham was specially opportune and relevant to the occasion. The requisite funds for the adaptation and library furnishing equipment of the barn for its new purposes were provided by the Middlesex County Council, supported by the unwearied efforts of the Middlesex Education Committee. It is of interest to record that Mr. T. E. James, formerly clerk to the Royal Society, who lives at Ruislip, has been appointed by the Middlesex County Council as a representative on the Ruislip-Northwood Local Library Committee.

Oils from Irish Grown Plants

CORK UNIVERSITY PRESS has issued an Agricultural Bulletin, No. 4, with this title. It contains the record of some small-scale experiments, carried out at Cork and elsewhere in the Irish Free State, on the possibility of producing supplies of oil seeds upon Irish soils. Crops of hemp, linseed, poppy, sunflower, rape, mustard and *Mercurialis annua* have been raised with varying success, and the yield of oils determined, as also the main physical chemical characteristics of the extracted oils. The work has been under the direction of Prof. J. Reilly and Mr. Denis F. Kelly, of the Department of Chemistry, University College, Cork. Very indifferent success was met with in these preliminary trials with the annual sunflower and *Mercurialis*, and the authors seem most impressed with the possibilities of native-grown poppy seed oil displacing cotton seed oil in the edible fat and soap industries in Ireland. These trials are, however, of a very preliminary nature; they throw very little light upon the possibility or otherwise of large-scale cultivation of these crops under Irish conditions, but they do establish the yields and main characteristics of the oils to be expected from such oil seeds grown under such conditions.

Horticultural Research in Australia

THE opening in September of a new laboratory under the Commonwealth Council for Scientific and Industrial Research at Merbein, Victoria, is an indication of the store now set by viticulturists on the provision of scientific services for their guidance. Merbein is in the Mildura district on the River Murray, where the first irrigation settlements were established some fifty years ago. Marked changes have taken place of late in horticultural practices in these areas, following particularly upon studies of soils with consequent modification of quantity and frequency of watering, and upon introduction

of communal drainage schemes. The former danger of ruin of blocks by 'salting', or bringing sodium sulphate and chloride and other salts to the surface by excessive watering and insufficient drainage, is almost a thing of the past. The Council is now preparing plans for a further new laboratory at its citricultural research station at Griffith, N.S.W., in an area watered from the Burrinjuck Dam on the Murrumbidgee River.

National Institute of Agricultural Botany

ON the occasion of the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge, the chairman of the council, Captain D. M. Wills, directed attention to the value of the Institute's system of substations. By means of this organization the Institute is able to make recommendations to farmers which are applicable to all districts (with two exceptions) south of a line drawn between Lancaster and Scarborough. There are at present two defective links in the Institute's chain of substations—the Fens and Wales—and the Institute hopes that these defects will shortly be remedied. At present there are substations at Sprowston, Norfolk; Long Sutton, Hants; Cannington, Somerset; Newport, Shropshire; and Askham Bryan, Yorks; on soils ranging from blowing sand to heavy clay. In every case these substations are attached to an agricultural college, institute or station, and the trials are carried out under the supervision of a crop recorder who is responsible to the N.I.A.B. Although the primary purpose of a substation is the provision of trials upon which recommendations can be based, Captain Wills stressed the importance of another aspect of their work. It is possible for a farmer to visit any of these to see, under conditions which may be very similar to his own, trials of the latest introductions of plant breeders both at home and abroad, growing side by side with established varieties. This should enable him to form an opinion as to the suitability—or otherwise—of new varieties to his particular conditions. Finally, Captain Wills expressed the hope that the establishment of a substation in Wales would lead to the discovery of varieties particularly suited to the poorer soils, both in England and Wales.

Mass Observations of Social Problems

"MASS-OBSERVATION" by C. Madge and T. Harrison, with a foreword by Dr. Julian Huxley, the first of a series of projected pamphlets, outlines the technique of a study of social environment and its effects on lines comparable with much bird-watching and observation of natural history, since, largely because of its empiricism, it has, like them, room for the untrained amateur as well as for the trained man of science (London: Frederick Muller, Ltd., 1937. 1s. net). The three sciences most immediately relevant to mass-observation are psychology, anthropology and sociology, and a fundamental plan for research will be evolved by the central organization as a result of suggestions from observers and scientific experts. In the first place, it is intended to mobilize

a numerous and representative corps of observers and to equip and maintain an efficient central organization in touch with all other relevant research associations, however different their methods. The observers will collect their data, which cover as wide a field as possible in order to provide sufficient cross-references to indicate the probable nature of the bias in any individual report. The scientific expert will be required not only as an observer himself but also in drawing up the plan of work, framing well-constructed hypotheses to be tested by mass-observation methods and in suggesting subjects for detailed inquiry, as well as in the interpretation of the data collected and in securing a more rigorous objectivity. The presentation of the results involves further problems, as not only must facts be collected over the widest possible field, but also they must be made known to the widest possible field. As soon as possible, pamphlets at present projected will deal with such questions as popular superstitions, reasons for watching birds, the meaning given to freedom, and will be based on the work of the observers. They will be followed by cheap editions of relevant scientific books, and a monthly bulletin designed for wide circulation is also contemplated. The central office and filing system is at 6 Grote's Building, Blackheath, London, S.E.3.

Mould and Bacteria Killed by New Lamp

In the *International Merchant*, a monthly pamphlet published by the Westinghouse Electric International Company at New York, a description is given of the 'Sterilamp', a gaseous conductor tube which produces very decided germicidal radiation at low temperature and low cost. It has taken nine years to develop. It is claimed that it prevents the growth of mould and bacteria on the surface of meat aged at high temperature and high humidity. It also retards the growth of mould on bakery products. Tests have shown that the lamp is useful in pasteurizing milk and beer. It is particularly useful in sterilizing conditioned air. The lamp generates radiant energy of a particular wave-length of which 90 per cent is in a region of the radiant spectrum which has been found to be strongly germicidal. It is made in lengths of 10, 20 and 30 inches, and the 20-inch size requires only 7 watts. Of great importance when making applications to food is the fact that the unit operates at a temperature only about 5° F. above that of the room. The lamp and auxiliary equipment is now on the market.

W. Watson and Sons, Ltd.

Messrs. W. WATSON AND SONS, LTD., of 313 High Holborn, London, W.C.1, have issued a booklet detailing the history of the firm in celebration of its centenary. Founded in 1837 for the manufacture of optical instruments by William Watson at 71 City Road, the business continued at this address until 1861, when it moved to 313 High Holborn, where it has since remained, and has been continuously carried on by members of the Watson family. The microscope was becoming a feature of the Watson firm in the 'seventies of last century, together with

cameras and lenses, since when telescopes, X-ray equipment, cinematographs, projection lanterns and other optical instruments and apparatus have been manufactured. A pleasing portrait of William Watson, the founder, forms a frontispiece to the booklet, which concludes with a series of plates illustrating the products of the firm during the hundred years of its existence.

Gift to the Royal Cancer Hospital

MR. A. CHESTER BEATTY, who has recently been elected vice-president and a member of the committee of the Royal Cancer Hospital, has purchased the Freemasons' Hospital, Fulham Road, with the intention of presenting the building for conversion into the Research Institute of the Hospital, and Mr. Chester Beatty is equipping the building for this purpose in addition to presenting it to the Hospital. It is well known that the Royal Cancer Hospital has maintained a research institute for many years under the direction of Prof. E. L. Kennaway. Mr. Chester Beatty is also generously entirely re-equipping the Radio-therapeutic Department of the Royal Cancer Hospital, at a cost of some £13,000, with the latest modern high-voltage X-ray therapy apparatus embodying many new features which will prove of inestimable value, not only in the treatment of cancer but also in affording full and adequate protection to both patients and operators during the carrying out of the treatment. The Royal Cancer Hospital is a school of the University of London and, in order to encourage the study of radiology, Mr. Chester Beatty has provided a travelling scholarship which has been accepted by the senate of the University of London. The scholarship will enable a student of radiology, after obtaining the academic diplomas in medical radiology, to spend a year in one of the great radio-logical clinics of the United States of America.

The National Health Campaign

LAST week, November 1-6, marked the beginning of the second month of the National Health Campaign, which was recently inaugurated by the Prime Minister, and this period has been devoted to the general aspects of the campaign and has aroused considerable public interest. During November and December special emphasis is being laid on the services available for mothers and infants, while in January next the child at a later stage, the school age, will be considered, together with the value of co-operation between home and school. The medium of the campaign varies; numerous posters and leaflets have been issued, public meetings and films have been arranged, and the support of the Press and of the wireless is expected.

Announcements

MISS JEAN BATHEN has been awarded the Gold Medal of the Royal Aero Club in recognition of her many Empire flights.

DR. A. G. FRANCIS has been appointed deputy Government chemist in succession to Mr. Andrew More, who retired on November 3.

THE following appointments have recently been made in the Colonial Service: M. Akenhead, agricultural superintendent, Gold Coast; W. E. T. Bond, agricultural officer, Nigeria; J. S. P. Beard, assistant conservator of forests, Trinidad; R. M. Hazley, assistant conservator of forests, Gold Coast; C. A. Banister, dairy bacteriologist, Malta; D. R. Buxton, entomologist, Sleeping Sickness Service, Nigeria; J. Cherry, air survey draughtsman, Tanganyika; K. E. Cowan, inspector of plants and produce, Gold Coast; D. E. Davis, assistant analyst, Medical Department, Hong Kong; W. G. Evans, sleeping sickness control officer, Nigeria; R. K. J. Gascoigne, field officer, Tsetse Research Department, Tanganyika; E. G. Harmer, sleeping sickness control officer, Nigeria; H. Hirst, adviser in animal husbandry, Malta; R. E. Hunter, chief fruit inspector, Palestine; R. R. E. Jacobson, geologist, Nigeria; F. Jones, sleeping sickness control officer, Nigeria; E. M. Kidner, sleeping sickness control officer, Nigeria; R. B. Stonehouse, assistant meteorologist, West African Meteorological Service; I. P. Tamworth, assistant superintendent, Botanical and Forestry Department, Hong Kong; P. E. Trevor, sleeping sickness control officer, Nigeria; E. A. Walters (agricultural superintendent, St. Lucia), agricultural superintendent, Gold Coast; R. Daubney (chief veterinary research officer), director of Veterinary Services, Kenya; J. R. Hudson (veterinary research officer), deputy director of Veterinary Services (Laboratory Services), Kenya; R. W. M. Mettam (veterinary pathologist, Uganda), veterinary pathologist, Nigeria; E. J. Mulligan (senior veterinary officer), deputy director of Veterinary Services (Field Services), Kenya; H. Atkinson (deputy government analyst, Ceylon), government chemist, Cyprus; R. J. Johnston (assistant surveyor general), deputy surveyor general, Ceylon; I. F. Wilson (superintendent of surveys), assistant surveyor general, Ceylon; L. G. Woodhouse (deputy surveyor general), surveyor general, Ceylon.

THE trustees of a fund raised to commemorate Sir William Simpson, the well-known authority on tropical diseases, have offered the London School of Hygiene and Tropical Medicine the fund for the establishment of a prize to be awarded annually to a student obtaining the highest marks at Part I of the January examination for the diploma of tropical medicine and hygiene.

THE Huxley Memorial Lectures of the Imperial College of Science and Technology are now held biennially, and a new series of lectures, commemorating other distinguished men who have served on the staff of the College, was inaugurated in 1936. The second of these lectures will be given on May 4, 1938, in memory of Sir Warrington W. Smyth. Prof. S. J. Truscott has agreed to deliver the lecture, the title of which will be "Metal Mining Enterprise".

THE Home Secretary has appointed the following committee to consider lighting in factories and workshops and to advise about standards of sufficient and

suitable lighting as prescribed in the Factories Act, 1937: Mr. D. R. Wilson, chief inspector of factories (chairman), Mr. J. S. Dow, Mr. John A. Gregorson, Miss Florence Hancock, Prof. H. Hartridge, Dr. C. S. Myers, Sir John Parsons, Mr. William Scholes, Mr. G. W. Thomson, Dr. J. W. T. Walsh, and Mr. H. C. Weston. The secretary of the committee is Mr. R. W. Daniel, to whom all communications should be addressed at the Home Office, Whitehall, S.W.1.

A COURSE of training in the inspection of milk pasteurizing plants will be held at the Royal Sanitary Institute on Thursday, November 25, and Saturday, November 27. Members and associates should apply to the Institute, 90 Buckingham Palace Road, London, S.W.1.

THE British Institute of Adult Education and the National Institute of Industrial Psychology jointly have arranged a conference to discuss the problems of leisure, to be held at Queen Mary Hall, Central Club Buildings, Great Russell Street, London, W.C.1, on Thursday, November 18, at 3 p.m. Invitations are being extended to representatives of organizations engaged in educational, recreative and social work and to selected individuals.

THE portraits of Sir Albert Seward and Dr. F. F. Blackman by Mr. Harold Knight and Mr. Henry Lamb respectively, which were subscribed for by Cambridge friends and British botanists, have been kindly presented to the Botany School, Cambridge. Prof. Brooks and the staff of the School will be "At Home" to subscribers on November 23 at 3.30-5 p.m., when Sir Albert Seward and Dr. Blackman hope to be present.

DR. BERNARD NOCHT, emeritus professor of tropical diseases and tropical hygiene at Hamburg, celebrated his eightieth birthday on November 4.

THE fifteenth International Congress of Ophthalmology will be held in the Semiramis Hotel, Cairo, on December 8-14. The subscription is 50 Swiss francs, and for ladies 25 francs. Further information can be obtained from the secretary, Dr. M. Tewfik, P.O.B. 2001, Cairo.

PROF. M. POLANYI writes further with reference to the paragraph in our News and Views columns of October 30, p. 766, relating to his article on the recent international science congress in Paris. In that note we printed a statement as received from him in his original typescript, together with a correction by him of the editorial modification of it as published in NATURE of October 23. The two statements are contradictory; and Prof. Polanyi now asks us to say that this "was due to my error in sending the editor a typescript in which two symbols (half of a parenthesis and a plural forming 's') were left out. Eliminating these typing errors the text clearly has the sense which I stated in NATURE, October 30, page 766".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 853.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Irregular Ionic Clouds in the E Layer of the Ionosphere

It has recently been found that momentary ionospheric echoes from irregular heights, occasionally as low as 60 km. but generally between 100 and 300 km., can be obtained, even on frequencies well above the critical frequency, if a sufficiently high-power transmitter is used.

A typical example is the (P, f) record shown in Fig. 1. This was taken over an interval of about 40 sec. on a wave-length of 32.35 m. (9,127 megacycles/sec.) at 0049 G.M.T. on the night of November 26, 1936. The transmitter was a high-power commercial station of the Cables and Wireless Co. situated at Ongar, Essex. It was of 40 kw. rating, and was modified to send out impulses of about 1/5 ms. duration at a repetition frequency of 50 per second. The receiver situated at Chelmsford, Essex, was 19.2 km. from the transmitter. The record shows that the echoes differ very considerably from the normal E and F echoes.

By using as a receiving array a pair of frames spaced 20 m. apart in the north-south direction, and determining the difference in phase induced by the signal E.M.F.s in the two aeriols, the angle of the ray relative to the axis joining the two aeriols can be determined.

The ordinary E and F echoes, presumably reflected from a more or less uniform layer, are vertical or nearly vertical, but this is far from the case for the weak echoes first described. Fig. 2 shows an example of the angular measurements made on January 27,

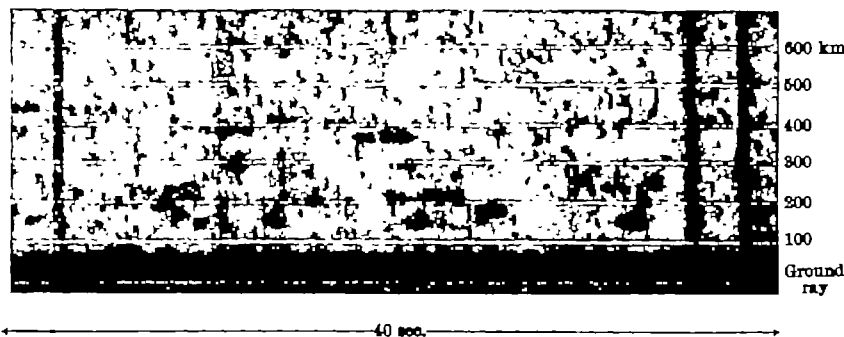


Fig. 1.

P, f RECORD FROM ONGAR (G.O.S. 32.35m.) AT 0049 G.M.T., November 26, 1936.

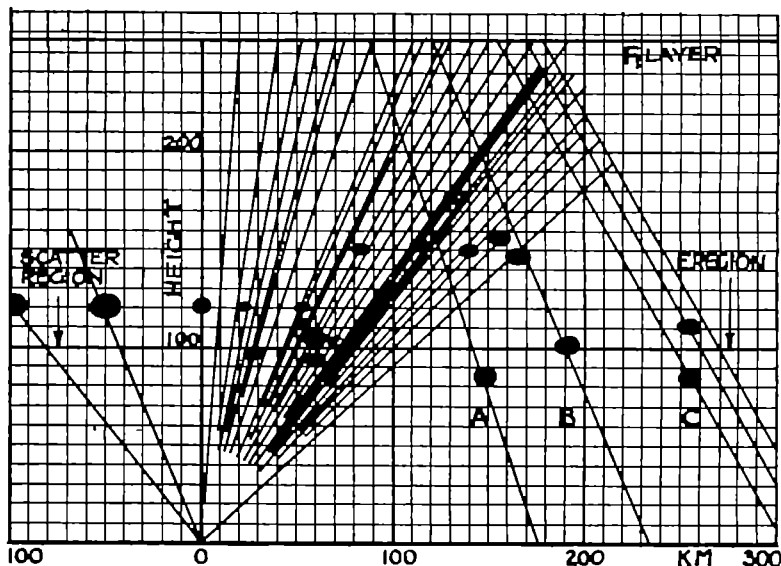


Fig. 2.

1937. The complement of the measured angle gives a lower limit to the angle of incidence, which reaches 45° on occasions.

We can scarcely avoid the conclusion that the echo signals are not regularly refracted from a uniform layer in the ionosphere but are scattered from irregularities or clouds. By plotting the observed equivalent heights along the observed directions, we get an approximate determination of the position of the scatter clouds. The heights so determined are upper limits to the actual heights.

The positions of the clouds all come within or slightly above the E region, if we assume that the few echoes which apparently come from the F_1 region are really reflected at the F_1 layer from points such as A, B, C. The shower of echoes is practically continuous, in the sense that one or more echoes of this type are practically certain to occur in any interval of more than about 5 seconds duration.

This unceasing supply of scatter clouds, which if left to themselves would disappear in the course of a second or so, is a well-established fact, and only explainable on the assumption that there is some

nearly constant external source of ionization. Many of the disturbances in the outer atmosphere are caused by the emission of ultra-violet light or by charged or uncharged particles from the sun. The evidence, however, that the scatter cloud activity is practically equal day and night at high and low latitudes suggests that the sun is not the prime source of ionization.

Other possibilities include (a) small meteorites; (b) high-speed particles distributed more or less isotropically in space, or emanating from the stars in the galaxy. Disturbances (high-frequency noise) have been shown by Janaký to originate in the Milky Way.

There is some evidence that excessive scatter activity is associated with bright hydrogen eruptions from the sun, and if this is so, the possibility exists of a continuous ionizing supply caused by similar eruptions in the stars of the galaxy.

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Ancestors of Some Groups of the Present-day Insects

WHILE studying fossil insects from the Middle Permian deposits of the Sylva River basin in the Urals, I have found among them a certain number of new forms that can be considered as predecessors and, in certain cases, as direct ancestors of some groups of modern insects. A few preliminary remarks on the results obtained are given here.

Up to the present time, the origin and geological age of the Embioptera are not exactly known, their fossil remains being found in deposits not older than the Tertiary. Dr. R. J. Tillyard, in 1918¹, pointed out their resemblance to the embiid *Megagnatha odonatifformis* Bolton found in the Carboniferous deposits of Commeny in France; in 1928, he gave a description of the new form *Permambia delicatula* Till., belonging to the special order of Embioptocida from the Lower Permian of Kansas². In the present year³ he published a paper with a description of a new form, *Protambia permiana* Till., found in the same deposits in Kansas, that belongs, according to him, to the true Embioptera and to his new suborder Protambiaria.

Tillyardambia biarmica n.g. et sp., which is shown in Fig. 1, belongs to a genus that has been named by me in honour of the late Dr. R. J. Tillyard, and I refer it to the true Embioptera but of the independent suborder Epiambiodea. Among the fossils that I had occasion to study, I find, besides the species *Tillyardambia biarmica* n.g. et sp. with long and thin antennae and a tetragonal prothorax, also the species *Tillyardambia antennaeplana* n.g. et sp. with flat antennae and the prothorax in the shape of an irregular rhomb. These forms differ from the modern Embioptera in the following features: (1) the males and females have homonomous wings; (2) the forelegs are of the grasping type without the inflated article of the tarsus with the spinning glands; (3) a large bivalve ovipositor; (4) long multi-articulated cerci. The length of the body of the *Tillyardambia* is 12-15 mm. This genus is very similar to *Protambia* described by Dr. R. J. Tillyard, but differs from it in its dimensions, the size of the ovipositor and other features.

I believe that the ancestors of the whole group of Embiid forms are the Protorthoptera belonging to the family of Spanioderidae⁴. From these must have issued directly the Permian suborder Epiambiodea, then the Protambiaria, and later the present type which, Dr. R. J. Tillyard has pointed out, belong to the special suborder Euambiaria.



Fig. 1.

Tillyardambia biarmica n.g. et sp. ENLARGED.
ACTUAL LENGTH, 12 MM.

Last year I recorded the existence of a new order of Hemipteroptera⁵ phylogenetically connected with Psocoptera and Homoptera⁶. New discoveries induce me actually to modify, in a certain measure, ideas that we had about that group. The new species *Mauric pusillus* nov. sp. (length of the body 5 mm., of the wing 5.5 mm.) with a proboscis-shaped head and many other features shows that the mouth organs of that group were very similar to the sucking apparatus of the Homoptera; the shape of the body and its general appearance are of the type of Psocoptera.

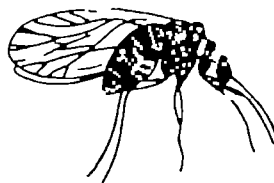


Fig. 2.

Parapsocidium uralicum n.g. et sp. ENLARGED. ACTUAL LENGTH OF THE WING, 4 MM.

The newly found specimens of Psocoptera of the suborder Permopsocida lead me to suppose the existence of a sucking mouth apparatus in that group of insects. The new genus and species *Parapsocidium uralicum* n.g. et sp. (Fig. 2) is very close to the genus *Psocidium* described by Dr. R. J. Tillyard⁷, but the comparative study that I have made of the imprints of insects belonging to the order of Hemipteroptera and the suborder of Permopsocida which I have in my possession induce me to doubt the correctness of the description by Dr. R. J. Tillyard of the imprints of the mouth organs of the *Psocidium*. The head of the insects of both groups is proboscis-shaped and carries, at the extremity, a sucking apparatus perfectly developed in the Hemipteroptera and a little less developed in the Permopsocida.

The order Isoptera (termites) has always been found in deposits not older than the Tertiary. In 1935 Dr. A. B. Martynov, comparing the venation of their wings with that of the Protoblattoidea in his report to

the Russian Entomological Society, suggested that the termites are much more ancient.



Fig. 3.

Uralotermes permianum n.g. et sp. ENLARGED. ACTUAL LENGTH OF THE WING, 18 MM.

I have found a wing imprint of 18 mm. length and 5 mm. width (see Fig. 3) which is much more perfect and more like (in its venation) the wings of some present termites than those of many mesozoic termites. I have called that form *Uralotermes permianum* n.g. et sp. and consider it to belong to the true termites (order Isoptera). I believe that the above-mentioned conclusion supports the theory of Dr. A. B. Martynov about the ancient origin of the termites.

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Sept. 19.

¹ Tillyard, B. J., "On the Affinities of two Interesting Fossil Insects from the Upper Carboniferous of Commeny, France", *Proc. Linn. Soc. New South Wales*, 43, pt. 1 (March 1918).

² Tillyard, B. J., "Kansas Permian Insects. Part 12. The Family Delopteroidea, with a Discussion of its Ordinal Position", *Amer. J. Sci.*, [v] 16, No. 95 (December 1922).

³ Tillyard, B. J., "Kansas Permian Insects. Part 18. The Order Embiaria", *Amer. J. Sci.*, [v] 33, No. 196 (April 1937).

⁴ Handlirsch, A., "Die fossilen Insekten und die Phylogenie der rezenten Formen" (Leipzig, 1906-8).

⁵ Handlirsch, A., Palaeontologie in "Schroder's Handbuch der Entomologie", 3 (Jena, 1925).

⁶ Zalsky, G. M., "Sur un représentant d'un nouvel ordre d'insectes permien", *Ann. Soc. Géol. Nord.*, 60 (February 1936).

⁷ Tillyard, B. J., "Kansas Permian Insects. Part 9. The Order Hemiptera", *Amer. J. Sci.*, [v] 11, No. 65 (May 1936).

⁸ Tillyard, B. J., "Kansas Permian Insects. Part 8. The Order Copeognatha", *Amer. J. Sci.*, [v] 11, No. 64 (April 1936).

Analytical Measurements of Ultracentrifugal Sedimentation

SEDIMENTATION in the ultracentrifuge has so far been followed quantitatively only by optical methods, depending upon the absorption or refraction of light by the substances studied. Even though they have been worked out to a high degree of accuracy, these methods for many important problems need to be supplemented by some procedure allowing chemical tests to be performed in the same run. For example, in a mixture of an enzyme or an antibody with its accompanying impurities, we do not know *a priori* the relationship between optical properties and the amount of active substance, and we cannot therefore definitely state which of the optically observed components in the mixture, if any, carries the activity. As the amount of substances of this kind in most cases can be defined only by an action measured by analytical methods, their sedimentation should be computed from analysis of samples taken out of the ultracentrifugal cell. In this laboratory^{1,2} and elsewhere³, several attempts have been made to take out samples of the ultracentrifuged solutions after concluding an experiment, but the arrangements have not been sufficiently perfect to allow quantitative application.

If we know the amount of substance above or below a certain level in the cell before and after centrifugation, the difference will give us the sedimentation velocity in much the same way as the migration velocity of an ion is calculated from a Hittorf transference experiment. In either case it is a necessary condition that the concentration gradients occurring at the ends of the column of solution do not reach the level which separates the layers to be analysed. As the cells used in the Uppsala laboratory hold comparatively long columns of solution, this condition can easily be fulfilled. A simple deduction gives the following equation for the calculation of the sedimentation constant, s :

$$s = -\frac{1}{2\omega^2 t} \ln \left(1 - \frac{2\Delta}{q\alpha_0} \right),$$

where ω is the angular velocity, t the time, Δ the change in amount of substance above or below the level at which the separation is made, x the distance of this level from the centre of rotation, q the cross-section area of the cell at this level, and α_0 the original concentration of the solution.

To avoid mixing the layers of the centrifuged solution when stopping the rotor, and especially when pipetting out the samples, we have divided the contents of the cell into two parts (of about equal volume in the present construction) separated by a thin wall of bakelite with a large number of fine holes, supporting a piece of hardened filter paper. The sieve plate is made in one piece with the bakelite centre part of the cell. This arrangement effectively prevents mixing for a time sufficient to remove the cell and to pipette out the contents of the upper compartment and rinse it quantitatively. On the other hand, as optical observations indicate, an arrangement including such a highly permeable membrane does not obstruct the free sedimentation. This is probably due to local convection at the membrane rapidly equalizing any small difference in density which would tend to occur as a consequence of an accumulation of material just above or dilution just below the wall. One must remember that density differences are multiplied enormously by the centrifugal force.

The arrangement may, of course, be modified in several ways according to the purpose of study; one may use several compartments and differently placed walls. The cell described here allows optical observations to be made in the same experiment, which is a great advantage.

The method should be of much value not only for the study of substances of specific activity, as mentioned above, but also for a number of other important problems. The sedimentation of substances of low molecular weight is difficult to observe optically, as the rapid diffusion prevents the boundary from leaving the meniscus completely, a circumstance without influence in the analytical procedure described. Interesting possibilities are offered in the field of mixtures of substances of different chemical nature, like carbohydrates and proteins. Separations for preparative purposes, guided by optical observations, should be possible with small quantities of material.

We have made some preliminary experiments to demonstrate the possibilities of the method. A run with carbon monoxide-haemoglobin of $\alpha_0 = 3.4$ per cent concentration gave $s = 3.6 \times 10^{-13}$ by the method described, whereas optical observation of the boundary migration (light absorption method) gave $s = 3.56 \times 10^{-13}$. (Both values uncorrected

for the concentration influence of the carbon monoxide-haemoglobin itself.) A few experiments were made with a type I antipneumococcus horse serum. In the first run, the heaviest globulin component observed was completely centrifuged out of the top compartment, as judged by optical observation. Analytical measurements according to the method of Heidelberger, Sia and Kendall⁴ showed that less than 1 per cent of the antibody originally present was left in the top compartment, whereas 92 per cent was found in the bottom. (We are indebted to Dr. E. A. Kabat for making these analyses.) Centrifuge runs of shorter duration, still leaving the fastest globulin boundary above the membrane, showed a corresponding increase in the analytically determined amount of antibody in the top layer. This indicates that the antibody function is mainly connected with this heavy globulin component, in agreement with earlier findings^{1,2}.

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ARNE TISELIUS.
KAI O. PEDERSEN.
THE SVEDBERG.

¹ Eriksson-Quensel, L.-B., and Svedberg, T., *Biol. Bull.*, 71, 498 (1936).

² Heidelberger, M., Pedersen, K. O., and Tiselius, A., *NATURE*, 138, 165 (1936).

³ Wyckoff, R. W. G., *Science*, 84, 201 (1936).

⁴ Heidelberger, M., Sia, R. H. P., and Kendall, F. H., *J. Exp. Med.*, 58, 477 (1936).

⁵ Blasco, J., Herik, F., and Wyckoff, R. W. G., *Science*, 83, 602 (1936).

Absorption of Tri-brom Ethanol through the Skin

In connexion with a study on absorption of various drugs and chemicals through the intact skin of different animals, an interesting observation was made in this laboratory. It was found that tri-brom ethanol readily penetrates the intact skin of such small animals as rats and mice and produces its characteristic narcotic effects.

A solution of tri-brom ethanol crystals (Winthrop's) was made in 95 per cent ethyl alcohol. When a sufficient amount of this solution was applied to the fur of white mice, it was rapidly absorbed and the animals were anesthetized within 15-30 minutes. The anesthesia lasted 2-3 hours, after which the animals recovered. When larger doses were applied, anesthesia was followed by coma and death. The minimal quantity of a 10 per cent solution of tri-brom ethanol in 95 per cent ethyl alcohol required to anesthetize a mouse weighing 24 grams was 0.85 c.c. In control experiments with ethyl alcohol alone, no narcotic effect was produced, nor was the anesthesia described above due to absorption through the mouth.

Inasmuch as tri-brom ethanol intended for clinical use is combined with amylene hydrate, experiments were also made with a 10 per cent solution of tri-brom ethanol together with 5 per cent of amylene hydrate in 95 per cent ethyl alcohol. The minimal dose of this mixture required to produce general anesthesia, when applied to the skin of mice averaging 24 grams in weight, was 0.75 c.c. The effectiveness of this dose, which is smaller than that required of tri-brom ethanol solution in alcohol alone, is obviously due to the synergism produced by combination of amylene hydrate with the drug.

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Oct. 1.

Production of Artificial Respiration by Rhythmic Stimulation of the Phrenic Nerves

In a study of the effects of drugs on respiration, the various methods used for the production of artificial respiration were found to be unsatisfactory. In an attempt to work out a suitable method for the work, it was found that the phrenic nerves when stimulated rhythmically would carry on respiration for hours and at the same time keep the animal in exceptionally good condition.

The primary currents of two induction coils, in addition to being made and broken by their interrupter operated by the iron core, were closed and opened by a rotary contact. By means of an electric motor and rheostat, this contact was rotated slightly above the normal respiratory rate of the animal. Anesthetized rabbits were used. The phrenic nerve on each side of the neck was isolated just above its point of entrance into the chest and placed in a small shielded electrode. Each electrode was connected with the secondary of one of the induction coils. By placing a sledge key in each of the primary circuits, the action of either the right or the left diaphragm could easily be demonstrated, while changes in the rate of the motor changed the respiratory rate.

The method was found especially useful in experiments where hyperventilation was desired. It obviates the changes in circulation which result when the increased tracheal pressure method of artificial respiration is used. As conductivity in nervous tissue is poor immediately following decapitation, it was found necessary in this preparation to use another method of artificial respiration until the phrenics had sufficiently recovered.

A further study of the method with the view of extending its applications and improving the technique is being carried out.

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A Coloured Intermediate on Reduction of Vitamin B₁

A VERY distinct green yellowish colour appears when vitamin B₁ (synthetic, I. G. Farben.), in a 0.5-1 per cent solution, is reduced with hydrosulphite in the manner described in a previous note¹. The intensity of the colour is highest at the beginning, declines with the declining rate of reaction and disappears at the end. The same transient green colour is observed when the vitamin is reduced with zinc dust in normal hydrochloric acid.

Similar coloured intermediates have been observed on reduction of cozymase² and of nicotinic acidamide methyl iodide³. These compounds are considered as half-reduced pyridines corresponding to the semi-quinones of Michaelis⁴. Therefore, it is suggestive to consider the coloured reduction product of vitamin B₁ as a half-reduced thiazole.⁵

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Carlsberg Foundation,
Copenhagen.
Sept. 30.

¹ Lipmann, *NATURE*, 138, 1097 (1936).

² Adler, Holmström and v. Euler, *Z. physiol. Chem.*, 242, 225 (1936).

³ Karrer and Benz, *Helv. chim. Acta*, 19, 1023 (1936).

⁴ Michaelis, *J. Biol. Chem.*, 23, 311 (1931).

⁵ See also Erlenmeyer, Bipprecht and v. Meyenburg, *Helv. chim. Acta*, 21, 661 (1937).

Constitution of the Poly-acids

THE work of Keggin¹ has placed the constitution of the 12-heteropoly-acids, metatungstates and metamolybdates—for example, $R_3H[SiW_{12}O_{40}] \cdot aq$, $R_3[H_2Mo_{12}O_{40}] \cdot aq$ —on a sure basis, and has indicated that the poly-acid anions may be regarded as co-ordination structures, built up of polyhedra of oxygen ions in the manner first envisaged by Pauling². The constitution of other groups of poly-acids, for example, those with 9 or 11 MoO_4 or WO_4 for each molecule of hetero-acid, is still quite unknown, as also is that of the second main series of poly-acids—the 6-poly-acids, such as the 6-molybdo-periodates.

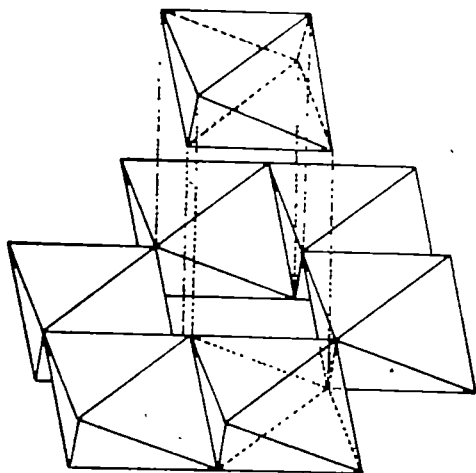


Fig. 1.

These have hitherto been regarded as satisfactorily expressed by the Rosenheim formula, $R_{12-8}[M^*(XO_4)_6]$, and there is good evidence that the central atom is, as shown, in 6-fold co-ordination. It may be predicted, however, from Goldschmidt's table of ionic radii, that the Mo^{6+} and W^{6+} ions must normally be found in 6-fold co-ordination with oxygen, as they are in known oxide structures, such as the 12-poly-acid anions. This conception leads to a new structure for the 6-heteropoly-acids and the related paramolybdates and paratungstates. It may readily be seen that six MoO_4 octahedra may be so arranged, by sharing corners with each of two neighbouring octahedra, that a hexagonal Mo_6O_{24} annulus is built up. The central cavity of this structure is then the same size and shape as one of the MoO_4 octahedra, and can therefore accommodate another cation in the same 6-fold co-ordination (see Fig. 1).

It is suggested that this is the structure of the 6-poly-acid anions. The similarity between the paramolybdates (and paratungstates) and the 6-heteropoly-acids led to their formulation by Rosenheim as $R_3H_2[H_2(MoO_4)_6] \cdot aq$. Sturtevant³ has recently shown that ammonium paramolybdate is correctly represented by the older formula $3(NH_4)_2O \cdot 7MoO_3 \cdot 4H_2O$, or $(NH_4)_6[Mo_6O_{24}] \cdot 4H_2O$. The relation of this to the 6-heteropoly-acids, for example, to $R_3I[Mo_6O_{24}]$, is at once made clear if the paramolybdate is regarded as $R_3[Mo(Mo_5O_{24})]$, with the Mo_5O_{24} structure built around a central MoO_4 octahedron in place of the IO_4 octahedron in the 6-molybdoperiodate.

Moreover, if some hydrolytic process, such as $[Mo(Mo_5O_{24})]^{3-} + H_2O \rightleftharpoons [Mo_6O_{24}]^{2-} + H_2MoO_4$, $[I(Mo_5O_{24})]^{3-} + 3H_2O \rightleftharpoons [Mo_6O_{24}]^{2-} + H_2IO_4 + H^+$ may be postulated in solution, it is possible that

the grave discrepancies between the X-ray evidence and the considerable bulk of physico-chemical evidence as to the complexity of poly-acids in solution might be removed.

In the present state of the subject, a careful X-ray examination of the 6-poly-acids, including the paramolybdates and paratungstates, is urgently desirable

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Sept. 28.

¹ Keggin, F. J., *Proc. Roy. Soc. A*, **144**, 76 (1934).

² Pauling, L., *J. Amer. Chem. Soc.*, **51**, 1010, 2868 (1929).

³ Sturtevant, J. H., *J. Amer. Chem. Soc.*, **59**, 830 (1937).

Determination of the Relaxation Time for the Vibrational Energy of Carbon Dioxide

DURING the past year, we have made a series of measurements¹ on the absorption of sound in gases at ordinary and low temperatures. As is well known, such experiments are of great interest in connexion with the collision mechanism between molecules. These phenomena can also be studied by means of measurements on the dispersion of the velocity of sound. This method is followed by Eucken and his collaborators².

We investigated especially oxygen, carbon monoxide, hydrogen and nitrogen. On the other hand, Eucken has studied carbon dioxide and nitrous oxide, for the reason that for such gases the vibrational energy is great, so that dispersion measurements are easily made. Hence there was hitherto no immediate relationship between our measurements and those of Eucken.

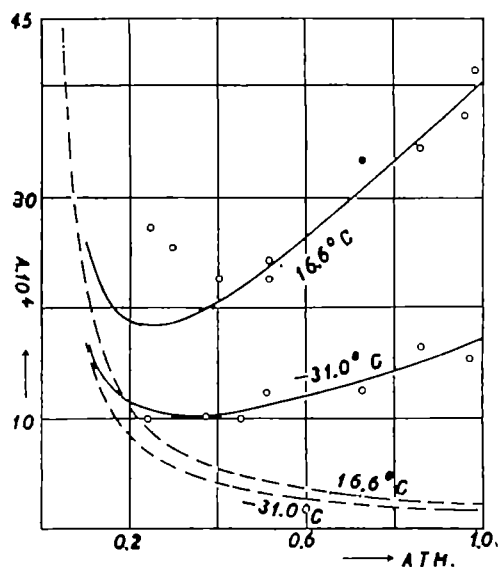


Fig. 1.

Recently we have made absorption measurements on well purified carbon dioxide, so that a direct comparison is possible with the dispersion measurements of Eucken. We have made measurements at 16.6°C. and -31.0°C., and have studied at each of these temperatures how the absorption of sound depends on pressure (frequency used, 304.4 kc.).

The results of our measurements are represented in Fig. 1. From these experimental results the following conclusions may be drawn:

(1) When we calculate the relaxation time at one atmosphere from the absorption coefficient A cm. (Kneessnotation) at 16.6°C . and -31.0°C ., we find respectively $(8.3) \times 10^{-4}$ and $(13.3) \times 10^{-4}$ sec. These values agree very well with the values obtained by Eucken. He finds from his recent measurements $(8.27) \times 10^{-4}$ sec. at 19.5°C .

(2) The full lines of Fig. 1 represent the theoretical curves which are calculated for the relaxation times $(8.3) \times 10^{-4}$ and $(13.3) \times 10^{-4}$ and by supposing that the relaxation time for the transversal oscillation is the same as for the longitudinal vibration. We see that at -31.0°C . and at 16.6°C . (here only for a portion of the curve) the experimental values are on the theoretical curves.

The dotted curves of Fig. 1 correspond to the classical absorption.

(3) As under (2), the experimental values at 16.6°C . deviate from the theoretical curve in the region of small pressures. From the discussion of these deviations we have come to the conclusion that the experimental curve may be described by means of two relaxation times. An estimation of the second relaxation time gives as result $(1.7) \times 10^{-8}$ sec. A possible explanation for this very small relaxation time is an influence of the rotations. On the other hand, a serious objection to such an explanation is that at -31.0° no deviation is found.

(4) Finally, it is necessary to direct attention, as was done by Eucken, to the fact that impurities of the order of a few parts per thousand have an excessive influence on this kind of phenomenon. We believe that such facts must have a great importance relative to chemical kinetics.

The results of these experiments together with others will be published in a more complete form in *Physica*.

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Oct. 4.

¹ van Itterbeck, A., and Mariens, P., *Physica*, **4**, 207 (1937); **4**, 609 (1937).

² Eucken, A., and Becker, B., *Z. phys. Chem.*, **27**, 219 (1934); **27**, 235 (1934). Eucken, A., and Jaacks, H., *Z. phys. Chem.*, **80**, 85 (1935). Eucken, A., and Kümmer, B., *Z. phys. Chem.*, **38**, 163 (1937).

Infra-red Absorption of Carbon Disulphide

Two points of considerable interest in this spectrum have just come to light. With the view of instituting a comparison between the corresponding infra-red frequencies of gaseous and liquid carbon disulphide, the two spectra have been carefully re-examined in this laboratory. Using a prism spectrometer, we have found that the band of gaseous carbon disulphide at 11.4μ , previously supposed¹ to be a doublet with a maximal separation of 13 cm^{-1} , is really a triplet with maxima at 884, 878, and 870 cm^{-1} , having the appearance of a band with a medium intensity Q branch. Up to the present this band has been assigned to $\nu_2 + \nu_1$, but it is difficult to see how the triplet structure can arise from such a combination.

For information on the second point I am indebted to the kindness of the Government Chemist, Dr. J. J. Fox, and his collaborator, Dr. A. E. Martin. Some time ago, Dr. Casie and I² explored certain of the bands with a grating spectrometer, and

resolved the 4.61μ band into a doublet with maxima at 2175.3 and 2162.0 cm^{-1} . Doubt was thrown upon the accuracy of our results by Sanderson³, who repeated the work and found maxima at 2191.2 and 2177.9 cm^{-1} . The two observations are reconciled by the observations of Fox and Martin, who find all three peaks at 2190.2 , 2177.1 , and 2165.4 cm^{-1} , and also obtain the rotational structure. The band has generally been assigned to the combination tone $\nu_2 + \nu_1$, but may arise in part from excited levels. It is remarkable that no evidence seems to have been found for the existence of the double doublets which are such a characteristic feature of the spectrum of carbon dioxide.

With regard to the change of spectroscopic frequencies with change in state, Dr. Angus and I have found somewhat unexpectedly that in spite of the non-polar nature of the substance, there are marked shifts of the order of 30 cm^{-1} in many of the bands in the passage from the gaseous to the liquid state.

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Oct. 8.

¹ *Proc. Roy. Soc., A*, **133**, 236 (1931).

² *Proc. Roy. Soc., A*, **140**, 605 (1933).

³ *Phys. Rev.*, **50**, 209 (1936).

Colour Changes in *Hippolyte varians*

THE demonstration by Perkins¹ that colour changes in *Palaeomonetes vulgaris* were controlled by a hormone that originated in the eye-stalks has since been confirmed and extended by a number of investigators (see Hånström's² review). Gamble and Keeble³ in their classic study of colour changes in *Hippolyte* were the first to describe a diurnal rhythm which persisted under constant environmental conditions. Within the past five years, several papers on persisting diurnal rhythms in the pigmentary system of crustaceans have appeared. The two English investigators interpreted the phenomena of crustacean metachrosis, according to the view of chromatophoral activity prevalent at that time, as being dependent upon the nervous system. We reinvestigated the colour changes of *Hippolyte* to see whether the endocrinal control similar to that found in other crustaceans was present.

It was found that extracts of crustacean eye-stalks (prepared from *Leander serratus* and from *Hippolyte varians*) when injected into test *Hippolyte* were effective in causing concentration of the chromatophores, accompanied by the diffusion of blue pigment into the surrounding tissues. Normal individuals, when kept under normal day and night conditions, exhibit the diurnal rhythm of colour change described by Gamble and Keeble, becoming "nocturnes" at night (the dark chromatophores concentrating to the punctate or stellate condition and the diffuse blue colour appearing in the tissues) and reverting to their original colours during the day. Individuals in which the retinas had been destroyed showed identical diurnal behaviour. Inasmuch as the presence of the crustacean eye-stalk hormone has been found necessary for concentration of the chromatophore pigments, we thought it might be possible to abolish the nocturnal colour phase by amputating both eye-stalks at their bases and thereby removing the source of the hormone. Gamble and Keeble had attempted to

render the eyes functionless by crushing the optic ganglia and by cutting off the eyes. We are able to confirm their results; individuals from which both eye-stalks had been removed were able to pass into the nocturnal colour phase.

The persistence of the diurnal rhythm in such preparations has been cited as proof of the existence elsewhere than in the eye-stalks of additional glandular tissue capable of liberating the chromatophoretropic hormone. We believe this behaviour can be explained differently. Gamble and Keeble reported that the diurnal rhythm persisted under constant external conditions. Thus, normal as well as eyeless *Hippolyte*, regardless of whether they were maintained in constant illumination or in constant darkness, went into the nocturnal colour phase with approaching nightfall and reverted to their "diurnal" phase in the daytime. We have not been able to confirm these observations. Normal *Hippolyte*, individuals with the retinas ablated, and animals from which the eye-stalks had been removed always passed into the nocturnal phase when placed in darkness during the day. Microscopic examination of such individuals revealed the concentrated condition of the red chromatophore pigment. Within ten minutes after removal to light (on a white background) the nocturnal condition began to pass, the diffuse blue coloration having completely faded and the red chromatophores showing signs of pigment dispersion. Twenty to thirty minutes later the chromatophores had become dispersed and the animals were completely dark.

The chromatophores of *Hippolyte* can respond directly to light and to darkness, and the persistence of a diurnal rhythm under constant conditions is negated by the results obtained from observations made during day and night on individuals maintained in darkness.

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¹ *J. Exp. Zool.*, 50 (1928).

² *Exptl. Biol.*, 14 (1937).

³ *Quart. J. Micro. Sci.*, 43 (1900).

The γ -Rays of Polonium

IN a recent note, Champion and Barber¹ have suggested that the γ -rays of radium E may arise from the production of electron-pairs by internal absorption of β -rays, the γ -rays being thus recombination radiation. It seems possible that the γ -rays of polonium² may be due similarly to the production of electron-pairs by internal absorption of α -rays. My analysis³ of the absorption curve of this radiation suggested quantum energies of (1.0 ± 0.1) and (0.4 ± 0.1) million electron volts, equal numbers of the two types (about 12 per million α -particles) being emitted. This is consistent with identification as recombination radiation, and the process is consistent with conservation of momentum and energy.

If this interpretation is correct, all members of the radioactive series that emit α -particles should also emit γ -rays of quantum energies 0.5 and 1.0 million electron volts, the intensity corresponding to a few quanta per million α -particles, since the initial energy of all α -particles is sufficient to produce pairs. Slater⁴

found, in the case of radon, that a weak γ -radiation was emitted whatever the lining of the vessel containing the gas. In the case of most of the other elements, the detection of this relatively weak radiation would be difficult on account of the presence of other, more intense, γ -rays.

It is conceivable that the radiation Slater found to be emitted when lead and tin are bombarded with radon α -particles is connected with the production of electron-pairs, the absorption coefficients being consistent with this interpretation, and the effective cross-section, 10^{-24} cm.² (upper limit), being not inconsistent with the value 10^{-23} cm.² found by Champion and Barber in the case of mercury bombarded with radium E β -particles. This interpretation does not, however, offer any reasonable explanation of the absence of a similar effect when lead and tin are bombarded with polonium α -particles.

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¹ *NATURE*, 140, 105 (1937).

² Bothe, W., and Becker, H., *Naturwissenschaften*, 18, 894 (1930).

³ *Proc. Roy. Soc., A*, 126, 428 (1932).

⁴ *Phil. Mag.*, 42, 904 (1921).

The Function of Experiment

IN continuing to maintain that stringent experimental test of a theory of Nature is pedantic, Mr. Whitrow would appear to be more extreme in his views than are most of the contributors to the symposium on physical science and philosophy¹. Prof. Milne, for example, states that "the relevance of the theorems to Nature would require to be established by observation"². When Mr. Whitrow persists in claiming the support of Galileo³ on the grounds of his (Galileo's) profession of readiness to accept his own theories⁴, he displays an imperfect understanding of the nature of experimental demonstration.

A complete and self-contained experiment must do two things. It must provide a measure of some quantity for comparison with a theoretically predicted value, and it must provide data from which we may calculate the likelihood that any observed discrepancy might be exceeded by chance. When the level of significance of the results is thus calculable from the experiment itself, we are each of us in a position to interpret the experiment without appeal to authority, to reject it or to accept it according as we are difficult or easy to satisfy. Other things being equal, a great number of experiments affords a more sensitive test of a theory than does a few; that is, it is possible to discern smaller 'real' discrepancies against the background of chance variation. It is clear that without experiment, or with only one experiment, it is impossible to estimate 'experimental error'.

Now, it may be that a series of experiments is too meagre to provide within itself an acceptable test of theory, and yet the experimenter may accept it in the light of past experience. He is then, in effect, calling upon past experience to furnish him with a rough estimate of variance⁵. He might even, upon rare occasions, justify himself in accepting theory without test on no better grounds than that he is customarily right ninety-five or ninety-nine times out of a hundred. The general acceptance of this

assertion of his authority must depend upon the extent of his experience and his unquestionable integrity, of which he himself is the only competent judge. He must therefore aim at providing a high level of significance, even though he may upon occasion be justified in not requiring it for his own satisfaction.

It is not obvious why we should suppose that Galileo meant anything more profound than this. He merely expressed confidence in his own judgment, yet he made no assertion of authority but carried out the experiments which he would undoubtedly have demanded of others. It may be pointed out, in conclusion, that to accept one's own theories without adequate test and without a long record of sound judgment is to plead guilty of a very human weakness.

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¹ NATURE, 139, 1008 (1937).

² NATURE, 139, 997 (1937).

³ NATURE, 140, 646 (1937).

⁴ Fable, W. O., NATURE, 140, 646 (1937).

⁵ Fisher, R. A., "The Design of Experiments", p. 39 (Oliver and Boyd).

Relation between Body Size and Metabolism

SIMON 1935, work has been proceeding on the respiration of different genotypes of *Drosophila melanogaster* during the first hours of the puparial period. The work has now been completed, and a

full account will shortly be ready for publication. For the moment, however, it may be said that differences in oxygen uptake per mgm. body weight originally found between the sexes and between the wild-type and its mutant vestigial were later shown to be due to slight differences in the sizes of these animals; when these were eliminated by alteration of the culture conditions the metabolic differences also disappeared. By actual measurement of the surface area of puparia it was further shown that the surface area per mgm. decreased, with increasing body size, at the same rate as did the oxygen consumption per mgm., and that the oxygen consumption was therefore related to the surface area.

Further work is in preparation which will indicate whether this relationship can be extended to other groups of animals, and will also help, it is hoped, to establish the causal nature of the connexion between body size and metabolism. Results already obtained clearly show the necessity, in metabolism experiments on cold-blooded animals, of paying much more attention to body size than hitherto; it is possible that the latter may prove to have considerable importance in problems of an ecological nature.

Using surface area as a standard, it is intended to investigate possible metabolic differences between the various species and races of *Drosophila*.

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Points from Foregoing Letters

IRREGULAR echoes of radio waves reflected from heights between 100 km. and 300 km. indicate, according to T. L. Eckersley, the presence of ionic clouds or irregularities in the ionosphere. Since the effect is noticeable both day and night, the sun cannot be responsible for this ionization, and it is suggested that the responsible agents might be small meteorites or high-speed particles from the stars.

A. Tiselius, K. O. Pedersen and Prof. T. Svedberg describe a new procedure for the quantitative study of ultracentrifugal sedimentation. With a specially modified cell, the centrifuged solution is separated into two portions, each of which can be readily pipetted out and analysed. From the change in the amount of the sedimenting component in one of the layers the sedimentation constant can be calculated. The method is of special importance in the study of substances like enzymes and antibodies, and may also be useful for measurements on very slow sedimenting molecules.

Dr. D. I. Macht finds that tri-brom ethanol in ethyl alcohol solution is rapidly absorbed when applied to the skin of mice, and produces its characteristic anaesthetic effect. The presence of amylene hydrate in the solution helps to produce the narcosis more rapidly.

Prof. R. A. Waud reports that he has been able to carry on artificial respiration in the rabbit by rhythmic stimulation of the phrenic nerves.

The appearance of a transient greenish-yellow colour on reduction of vitamin B₁ has been observed by F. Lipmann, who assumes that it is due to the formation of a semiquinone-like product.

From considerations of atomic radii, Dr. J. S. Anderson arrives at a possible structure for 6-poly-acids (such as the 6-molybdo-periodates). To account for discrepancies between the evidence obtained from X-ray investigations and from physico-chemical evidence he suggests that the 6-poly-acids may be hydrolysed in solution.

The absorption of sound in purified carbon dioxide gas at various pressures up to 1 atmosphere, and at temperatures of 16.6° and -31° C., has been determined by Prof. A. van Itterbeek and P. Mariens. The authors calculate the relaxation time for the vibrational energy (of importance in connexion with the collision mechanism between molecules) and compare the values obtained with those calculated from measurements of sound dispersion. Small amounts of impurities exert considerable influence.

O. R. Bailey reports that the infra-red absorption bands of carbon disulphide at 11.4 and 4.6 μ have three components. Although carbon disulphide is a non-polar substance, shifts in some of the absorption bands have been observed on passing from the gaseous to the liquid state.

Drs. L. H. Kleinholz and J. H. Welsh confirm the fact that extracts of eye-stalks from the Crustacean *Hyppolyte varians* when injected into living specimens (which show diurnal change of colour) produce darkening due to diffusion of blue pigment. They find, however, that specimens which had their eye-stalks removed and were kept in darkness, responded to light at all hours; hence they consider that light acts directly upon the colour-producing mechanism and not necessarily by a hormone.

Research Items

The Marriage of Osiris

IN a study of the origins and character of the Osirian ritual in Egyptian religion, Mr. G. D. Hornblower (*Man*, Oct. 1937) figures a sculptured scene from the inner chamber attached to the Hall of Sukkur (Sokkaris) in the temple of Seti I at Abydos, which depicts the culminating scene of the great rite of the latter half of the month of Hathor, which in the Egyptian calendar is the last of the four months of the Nile flood. In the process of synthesizing the various local cults of Egypt, Osiris came to be identified with the Nile flood (but not with the river), while Isis became Mother-Earth, the flood appearing as a kind of hierogamy or sacred marriage. The sculptured relief at Abydos puts Seti, the king, in special relation with the god at the supreme moment of the adventures in the myth of Osiris. Osiris is here seen lying as a mummy in the "House of Sukkur", that is, the tomb. At his head is his sister-wife Isis, the Great Lady of Magic, who is engaged in calling her dead husband back to life, temporarily, for the purposes here revealed. For Isis, in accordance with the principle of early art, which depicts succeeding events in the same plane, is also shown in the form of a falcon, with her name inscribed by her, hovering over the body of Osiris, who, now resuscitated, is seen in the act of fecundating her. The rite is thus revealed as the solemnization of a sacred marriage. At the feet of Osiris, Horus, the falcon-god, stands protectively, and a falcon also shelters the head of Osiris. This is undoubtedly the outstanding rite of the Egyptian year. Other sacred marriages are known—of Amūn-re at Thebes, in the "Festival of Opet", and of Horus and Hathor at Edfou. It appears that a sacred marriage was a very early general institution which was adapted to Osiris on the establishment of his cult, the festival being observed concurrently in various Egyptian towns.

Early Indian Sites in Virginia, U.S.A.

AN examination has been made of a number of ancient Indian sites in the State of Virginia, U.S.A., by Mr. David I. Bushnell, jun. (*Smithsonian Miscell. Collect.*, 96, 4). These sites have been discovered on the banks of the Rappahannock, beginning at Leedstown, an early colonial settlement some forty miles below the falls, and continuing up the valley. The finds—stone implements, potsherds, beads and clay pipes—are from the surface, and probably represent the midden material from village sites, which have been scattered by the plough. Further research by excavation is eminently desirable. When the English first explored the Rappahannock, they found many Algonquian (Nandtaughtacund) villages in this district, extending up to the large island below the falls near the present city of Fredericksburg. From this point, the territory extending westward belonged to the Manahoac, a Siouan group constantly at enmity with the Algonquians. The finds of the present investigation vary in form and material, and obviously belong to several distinct periods of occupation. They prove that the tribes encountered by the settlers were not the first to

inhabit the country; and indeed it is evident not only that this area was occupied and re-occupied for centuries, but also that a part of the valley below the falls had been abandoned by the Algonquian tribes in 1608 when it was first visited by the English. The occurrence of a beautiful Folsom point of the eastern type near the Millbank creek on the left bank represents an interesting problem, which requires further investigation in order that the evidence of stratification may be made available for the consideration of the antiquity of man in the eastern States. Next in importance to the Folsom point are two axes found above Lamb Creek, which resemble a specimen found some years ago on the Rapidan. These may be earlier than the Algonquian occupation. Argillite points and scrapers resemble those from the Delaware Valley, and may also be pre-Algonquian.

Breeding of Oysters in Tanks

MR. H. A. COLM has gone a long way towards solving the problem of oyster breeding in captivity for the improvement of the oyster industry ("Experiments in the Breeding of Oysters (*Ostrea edulis*) in Tanks, with special reference to the Food of the Larva and Spat. Min. Agric. Fish. Fish. Invest. Series 2, 15, No. 4; 1936). His own experiments during 1936 are particularly described, but these are a continuation of the work of Dodgson and Sherwood from 1919 onwards. It was found in 1918 that a large amount of spat from oysters which had remained in the tanks following some purification experiments had settled. The same occurred during the next two years, and in 1921 an attempt was made to repeat the spat collection on a much larger scale with the view of possibly re-stocking the natural beds. The results showed that food for the young oysters, especially in the free-swimming stage, was all important, and laboratory experiments were specially made to find a good micro-organism on which the free-swimming larva could be fed. These experiments show that the only food which the oyster in its free-swimming existence is able to use is the naked flagellate, and that only the settled spat can feed on green cells surrounded by a cellulose or hemi-cellulose cell wall. The explanation put forward is that the slow penetration of enzymes through such a cell wall during the passage of food through the gut is possible in the spat, but in the larva where the passage is very rapid the cells pass through undigested. In the large-scale experiments where two tanks were used, one was provided with finely divided organic material and the second was used as a control, the result showing a much larger number of larvae which settled in the tank so manured whilst the flagellates were also much more numerous. It is now possible to anticipate with some confidence a spat-fall of commercial value in the tanks, the rapid growth of such spat transferred to cages in the open water showing that the methods employed are effective. Good results are anticipated from further experiments in culturing on a large scale the naked flagellates for the food of the larvae.

Climatic Cycles and Tree Growth

PUBLICATION No. 486 (1937) by the Carnegie Institution of Washington contains a description by V. S. Glick of the principles and methods of tree-ring analysis developed by Dr. A. E. Douglass, which enters very fully into the methods of sampling trees and of reading and correlating the numbers and readings of the annual rings. A survey of ring breadths at different heights on the trunk of *Pinus ponderosa*, which extended even to observations on branches and roots, supplies convincing evidence of the validity of these ring measurements, and the analysis of the correlation between these observations and examination of their value as climatic indicators show how carefully and conservatively the new technique is being developed. Mr. G. A. Pearson, senior silviculturist in the United States Forest Service, discusses the factors influencing the growth of trees, but these have received more adequate treatment in many forestry publications; this volume will rather be consulted for its very full account of the technique developed in reading the ring breadths of trees and in applying such data to the discovery and analysis of climatic cycles.

Fjord Formation

THE coastal mountain belt of North-East Greenland affords ample evidence of a former considerable ice-cover, and the extensive system of fjords in that region provides scope for the study of the origin and development of fjords in relation to erosion processes. Dr. N. E. Odell discusses this problem in a paper on the Franz Josef fjord region of North-East Greenland in the *Geographical Journal* of August and September. Dr. H. Bretz, in a former study of these fjords, considered them to be stream-eroded valleys modified and deepened by ice action, which would, he believes, be accentuated, during ice submergence, on a previously eroded valley. This was also the view of Dr. Nansen. Mr. Odell, on the other hand, considering in detail the possibilities of subglacial plucking, doubts the ability of the ice to do the work suggested. An ice-sheet covering a steep preglacial valley might possibly have the motion necessary for abrading, but would be unlikely to acquire moraine matter, without which the scouring action would not occur. Mr. Odell also shows that the disintegrating effects of basal freeze and thaw would probably be absent. In this and other evidence he inclines to the belief that the greater part of the fjord formation of North-East Greenland must be attributed to a period of partial and complete emergence of the land surface rather than to a time of entire submergence by continental ice.

Basalts from the Carlsberg Ridge

AN important contribution to the petrology of the floor of the Indian Ocean has appeared (Sci. Rep. John Murray Exped., 1933-34, 3, No. 1, 1-30, British Museum, 1937). Dr. J. D. H. Wiseman gives petrographic descriptions and chemical analyses of the Carlsberg Ridge rocks dredged from a depth of 3,885 metres. While mostly angular, some of the specimens are rounded and have a coating of manganese nodule material. Three of the analysed rocks are oligoclase-basalts; the other is hornblende-gabbro-dolerite. Chemically, all are characterized by low total iron, relatively high soda and very low potash, and thus show spilitic affinities. The possibility that the unique alkali relations may depend

on the action of sea-water is discussed, but it is concluded that they are much more probably an index to the nature of the parental magma. The rocks are chemically different from the Deccan traps and other Gondwanaland basalts, and there is strong evidence that they are of submarine origin and do not represent sunken remnants of any former land area. Apart from the very low potash contents, the Carlsberg Ridge specimens are comparable with average basalts from the Atlantic and Pacific Oceans, all of which differ from the Plateau basaltic types of the world in their lower iron contents. Dr. J. H. J. Poole has determined radium in the described specimens and finds the amounts present to be uniformly low, in which respect the rocks also differ systematically from the Deccan basalts.

Deep-Focus Earthquakes in the South-West Pacific

MR. R. C. HAYES has recently made an interesting study of the distribution of normal and deep-focus earthquakes in the south-west Pacific (*Bull. N.Z. Dom. Obs. Wellington*, No. 109, 691-701; 1937). The area considered is bounded by the parallels 0° and 50° S. and the meridians 140° E. and 160° W., and, during the years 1918-34, contains the epicentres of 87 deep-focus earthquakes, of which Mr. Hayes gives a valuable catalogue. These form 11 per cent of the total number of earthquakes recorded in the district. As a rule, the focal depths lie between 100 km. and 200 km.; but, in an area of which the centre is in lat. 25° S., long. 176° E., depths of 500 km. or more were common, while normal earthquakes were almost absent. In the zone between 10° and 30° S., in which the deep-focus earthquakes were most numerous, the maximum monthly number occurred in August.

Atmospheric Pressure at Mauritius

PUBLICATION No. 18 of the Royal Alfred Observatory, Mauritius, by M. Herchenroder, is entitled "The Atmospheric Pressure at Mauritius". It is a discussion of fifty-six years' continuous record of that variable at the observatory at Pamplémousses made with a Kew barograph recording photographically. Mean yearly values for each year from 1875 until 1930 range from 1,008.70 mb. in 1916 to 1,010.82 mb. in 1880, the mean for the whole period being 1,009.69 mb., and show a secular drift. If this drift is a cyclical variation, the period of 56 years is too short to determine its value directly, but it is held to be connected if not identical with a long-period rainfall oscillation that seems to have completed one cycle between 1872 and 1928. Short-period oscillations are superposed on the long-period oscillation, notably periods of nine and seventeen years. The annual variation is shown by plotting the means for each day of each month, and is composed mainly of a very well marked annual wave of 10 mb. amplitude with a minimum on February 9-10, which falls very nearly at the time of the maximum of the annual temperature wave. The diurnal variation is studied by means of harmonic analysis, and this shows that by far the largest component is the 12-hour cycle, the phase of which shifts slightly in the course of the year; that the next in importance is the 24-hour term (mean amplitude 0.394 mb. compared with 0.953 mb. for the 12 hour); that the 8-hour term, although its amplitude is not more than a quarter of that of the 12-hour term even at the seasonal maximum of the 8-hour term in July, shows a large and remarkably systematic double annual

variation both of amplitude and of phase; and lastly, that the small 8-hour term also shows a double seasonal variation but with phase reversed. The lunar daily variation is not determined here, having already been investigated for the forty years 1876-1915 by Chapman.

Synthesis of Vitamin B₁

THE structure previously proposed for vitamin B₁, based on the identification and synthesis of several disintegration products (notably 4-methyl-5-beta-hydroxyethylthiazole, 2,5-dimethyl-6-aminopyrimidine, 2-methyl-6-oxy-pyrimidine-5-methylene sulphonic acid) and the establishment of the mode of linkage of the two nuclei indicated by the presence of quaternary nitrogen in the molecule, has been completed by J. K. Cline, R. R. Williams and J. Finkelstein (*J. Amer. Chem. Soc.*, 59, 1052; 1937) by a synthesis of the vitamin by a method depending on the conversion of a 5-ethoxy-methyl-pyrimidine into the corresponding 5-halo-methyl derivative. Difficulties in obtaining crystalline material were encountered. Ethyl sodioformyl-β-ethoxypropionate was condensed with acetamide hydrochloride in alcohol with sodium, and the resulting 2-methyl-5-ethoxymethyl-6-oxypyrimidine liberated and sublimed in high vacuum. This was converted into the corresponding chloropyrimidine with phosphorus oxychloride, and this into the corresponding aminopyrimidine by heating under pressure with alcoholic ammonia. By heating this with a solution of hydrobromic acid in glacial acetic acid, 2-methyl-5-bromomethyl-6-aminopyrimidine hydrobromide was obtained, and by heating this with 4-methyl-5-β-hydroxyethylthiazole in butanol and diluting with boiling ethanol, needles of vitamin B₁ bromide hydrobromide were obtained. The physiological activity of this compound, C₁₂H₁₁ON₄SB₁·HBr·0.5 H₂O, was found to be equal to that of the natural vitamin. The corresponding chloride hydrochloride was prepared, and its physiological activity established.

Structure of Carbon Suboxide

ABOUT four years ago the structure of carbon suboxide (C₃O₂) was shown by the methods of electron diffraction to be most probably linear and symmetrical. Evidence supporting this view was also derived from investigation of its ultra-violet spectrum and, more recently, from its Raman spectrum. For a molecule possessing a centre of symmetry, spectroscopic selection rules forbid the appearance of Raman-active fundamental frequencies in the infra-red spectrum and vice versa. A paper of Drs. R. C. Lord and A. Wright (*J. Chem. Phys.*, 5, 642; 1937) on the infra-red spectrum is therefore full of interest. They find that Raman-active frequencies are not present in their spectrum and the linearity and symmetry of the molecule are now convincingly proved. The modes of vibration of such a model consist of 4 non-degenerate (2 Raman-active, 2 infra-red active) and 3 doubly degenerate (only one of which is Raman-active) frequencies. By assuming the type of molecular force field, values of the frequencies can be calculated, and it is found that one of the infra-red active degenerate fundamental frequencies lies beyond the limits of their spectrograph at about 50 μ (200 cm.⁻¹). The other degenerate infra-red fundamental (ν₂) cannot at present be assigned with certainty. From a consideration of the allowed binary and ternary com-

bination tones, there is strong indication that its value is 550 cm.⁻¹, although another possible value at 900 cm.⁻¹ cannot be completely excluded. It is interesting to note that all the observed bands can be satisfactorily interpreted on the basis of ν₁ = 550 cm.⁻¹, but further and more detailed experimental data on the infra-red spectrum, especially between 2 μ and 7 μ, between 11 μ and 18 μ, and around 50 μ, must be forthcoming before the final assignments can be made.

Atomic Weight of Phosphorus

ASTON has shown that phosphorus is a pure element, in the sense that it is composed of one type of atom only, of mass number 31. It has a negative peaking-fraction amounting to -5×10^{-4} . Hence the atomic weight of phosphorus should be less than 31, especially as the factor for converting physics atomic weights to chemical atomic weights on the scale O = 16 (1.00022) also acts in the same direction. Yet the internationally accepted value for the atomic weight of phosphorus is 31.02 (O = 16). The value calculated by Aston from mass-spectrograph data is 30.978. Hönigschmid (*Naturwissenschaften*, 25, 670 1937) has recently carried out a careful chemical determination of the atomic weight of phosphorus using phosphorus oxychloride, POCl₃. The ratio POCl₃:3Ag was determined by a nephelometric method, and the value obtained for the atomic weight was 30.978, in exact agreement with Aston's result.

Effect of Surface Treatment on Magnetic Permeability

IN a letter in NATURE of May 29, Dr. T. F. Wall gave particulars of results obtained in an investigation on the permeability of nickel wire as affected by coating of 0.003 inch of electro-deposited copper. These showed that, as compared with the bare wire, a value about 60 per cent higher could be obtained under the conditions described. The results of further tests on similar lines are now available (*Engineer*, Aug. 13), and bear out the idea which gave rise to the experiments. The dissymmetry of the molecular forces at and near the surface of the bare wire suggested to Dr. Wall a corresponding dissymmetry of the magnetic forces, and his idea was that by coating the surface with a thin skin of non-magnetic metal this condition might, to some extent, be eliminated and that interesting information might be forthcoming as to changes in magnetic properties. The later tests have been made on wire of bright draw Armco iron with coatings of copper, nickel, and aluminium. While the uncoated wire gave a maximum permeability of 3,500, the figures reached with the coated wires were: copper coating 3,600, nickel 4,050, and aluminium 4,300. The effects are thus not as striking as in the first tests, but from the very marked increase obtained when nickel is coated with copper—two metals standing next to each other in the atomic number series—it is inferred that iron with a coating of manganese—two similarly placed metals—may be expected to show an equally pronounced increase. This is now under investigation by the methods described and with the aid of X-ray spectrograms of the boundary surface of the wire and the applied skin, and it is anticipated that the results some light may be thrown on the behavior of manganese in the Heusler series of alloys and its influence in Hadfield's non-magnetic manganese steel.

Origin of Oil

THE United States Geological Survey and the American Petroleum Institute have, during the course of studies of source beds, amassed a wealth of data which may prove invaluable in the elucidation of the vexed problem of the origin of petroleum. Dr. P. D. Traub has made full use of this data, and in a recent paper (U.S. Department of the Interior, Prof. Paper 186—H) he explains inferences he has drawn, and suggests that they are worthy of the consideration of geologists interested in the problem.

Geological conditions under which petroleum is found point to its derivation chiefly from the organic matter of fine-grained marine sediments. The source of this organic matter is directly traceable to planktonic organisms in the overlying water. During their life, prior to burial in sediments, these plankton undergo successive chemical changes, and a study of these provides a valuable clue as to the constitution of the organic matter of sediments.

The main source of original organic matter is floating plant life which serves as food to the animal life of the sea. On being taken in as food, part of the plankton is assimilated in the tissues of the consuming organism, part is excreted as waste, and the rest is used to generate energy. That part which generates energy is destroyed during the process. The part which is excreted may again serve as food to some organisms, but it becomes successively less and less digestible. Ultimately there remains a complex residue of substances resistant to decomposition, and, broadly speaking, this forms the organic constituents of sediments. After burial, this residue is associated with little if any free oxygen and, therefore, is unlikely to undergo much further alteration.

The average composition of marine plankton is approximately 24 per cent protein, 3 per cent fat, 73 per cent carbohydrates and other non-nitrogenous substances. The composition of the organic constituents of recent sediments is of the order of 40 per cent protein, 1 per cent fat and less than 60 per cent carbohydrates and other compounds. In ancient consolidated sediments, proportions are about 27

per cent protein, 1 per cent fat, and more than 60 per cent other compounds.

It is improbable that any substance present in organic constituents of sediments only in quantities of 1 per cent or less is a major source of oil. Cellulose is discredited on this count, since it is ordinarily found in recent sediments in amounts of 1 per cent or less. Other carbohydrates such as hemicellulose, starches and sugars, are found in equally small quantities and are accordingly discounted.

Proteins, since they form approximately 40 per cent of the organic matter of recent sediments and 27 per cent of that of lithified sediments, are possible sources of oil. The proteins in sediments, however, differ considerably from proteins of the original plankton whence they are derived. Simple proteins are present in recent sediments in such small quantities as to preclude their consideration as source materials.

Fats, though believed by many to be the chief sources of petroleum, are possibly not so, partly because they are present in insufficient quantity, and partly because they are unsaturated in character while the fats of petroleum are saturated.

In any event, cellulose, carbohydrates, simple proteins and fats together only form about 5 per cent of the organic constituents of sediments, and it is more probable that the remaining 95 per cent, or part of it, is responsible for the formation of petroleum. This is in point of fact an unassimilable residue composed of complex compounds deficient in oxygen. The tendency of buried organic constituents to come to chemical equilibrium might cause the generation of liquid hydrocarbons. These in turn might dissolve organic substances, and the resulting organic constituents in solution might react upon one another in order to reach a state of equilibrium. Repeated readjustments of this character might possibly result in the formation of petroleum.

To substantiate this hypothesis, however, detailed investigations of the chemical nature of the organic constituents of sediments are essential. Conclusions may then be reached as to the particular type of organic material likely to be transformed into oil by chemical reactions of the type envisaged.

Studies of Metals and Alloys

OF the papers read or taken as read at the Autumn Meeting of the Institute of Metals at Sheffield in September 6-9, the following short abstracts of some of the more generally interesting will give an indication of the widely varying fields of research considered.

In view of the engineering importance of alloys, both ferrous and non-ferrous, which consist of two phases of appreciably different hardnesses and of inclusions in metals generally, a paper by Hermann Jnekel, on the deformation of the macrostructure of some two-phase alloys by cold-rolling, is welcome. Although this is but the first stage in the con-

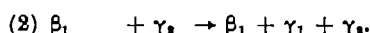
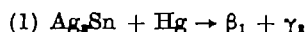
sideration of the subject, the paper gives much interesting data, and cannot fail to arouse the interest of metallographers generally.

Inverse segregation, that is, the segregation of components in an alloy in the reverse direction to that which would normally be expected, is a matter of both academic and practical importance. N. B. Vaughan contributes a general review of the present position, together with an extensive bibliography which will be widely appreciated.

The transformation which occurs at a temperature of about 470° C. in the β -brass and which has been known now for some forty years, is dealt with

in a paper by C. Sykes and H. Wilkinson. The work of Bragg and Williams which attributed the transformation to a change from disorder to order in the lattice is now generally accepted. The present paper provides data which confirm this view, and represents a most valuable contribution to our knowledge of this and similar changes in other metallic alloys.

The academic interest and the practical importance of the volume changes which occur during the hardening of a dental amalgam provide ample justification for two papers by Dr. Marie L. V. Gayler on the constitution of the alloys of silver, tin and mercury and on dental amalgams. The author concludes that the changes taking place on the setting of such an amalgam are to be attributed to complex reactions which probably do not proceed to completion and which may be briefly summed up as:



No explanation for the marked contraction or expansion which occurs is obtainable from X-ray analysis, but the former is ascribed to the formation of a solid solution of mercury in Ag_3Sn .

In view of the enormous amount of galvanized iron and steel now being used, a critical paper by L. Kenworthy on the methods of testing zinc coatings will arouse wide interest. The value of such protective coatings on iron and steel depends on the average weight, the uniformity, structure and porosity, and under these four headings the various methods which are actually in use, or which have been proposed, are described, together with their respective advantages and limitations, and, in certain cases, with suggested modifications.

The determination of alumina in metallic aluminium is a matter of very great difficulty, and a paper by G. B. Brooks and A. G. Waddington makes a substantial contribution in this difficult field of metallurgical analysis. A method is described which has proved superior to any yet proposed for determining alumina in granulated aluminium dross. The complete separation of the metal by volatilization as the chloride in pure hydrogen chloride and subsequent conversion to oxide allows the metallic content to be accurately determined.

It was observed by Hopkinson in 1905 that stresses greatly exceeding the normally accepted values of the tensile strength could be applied to iron and copper wire for very short intervals of time without rupture, and this is now generally believed to hold for all the more common engineering materials. D. W. Ginns describes apparatus in which samples of metals have been broken in 0.005 sec., the yield point being attained in 0.001 sec. It is shown that when compared with ordinary tensile test values the yield point is increased very considerably, at times by more than 100 per cent, that the maximum stress is raised, but to a smaller extent, while the ductility remains more or less unchanged. It is a curious feature of many of these ultra-rapid tests that the yield point and maximum stress coincided even in metals of high ductility. As a sample of the type of results obtained, the following may be quoted for a steel containing 0.15 per cent carbon. The tensile strength broken at ordinary rates was about 32 tons per square inch, which was raised to 37 tons in the high-speed tests. The corresponding values for the yield point were 22.3 tons per square inch and 37 tons per square inch.

F. C. T.

The California Sardine and its Fishery

THE California sardine (*Sardinops caerulea*) is caught by small motor-boats using purse-seines and round-haul nets with large bunts, called 'lamparas'. The fishery takes place in autumn and winter. The California State Fisheries Laboratory has recently added two more papers to the series of studies of this fishery.

The first paper ("Interseasonal and Intra-seasonal Changes in the Size of the California Sardine (*Sardinops caerulea*)"). By Frances N. Clark. Contribution No. 150 from the California State Fisheries Laboratory) deals with the results of the biometrical investigations which have been carried on by the staff of the State Fisheries Laboratory during the last sixteen years. The autumn fishery is of adolescent fish which will spawn for the first time in the following spring, and of the three preceding year groups. In the winter fishery these young fishes continue to be caught, but the bulk of the catch is made up of fishes in their fifth to tenth spawning seasons.

Unusually successful year classes occur at irregular intervals: the study of their effect upon the length frequency polygons of the autumn fishery indicates that the adolescent fishes form a higher proportion of the catches in the southern part of the area (San

Pedro-San Diego) than farther north off Monterey and San Francisco. These large year classes may be detected in the winter fisheries for six or more seasons. The author points out that the autumn fishery drawn upon three or four year groups only, as against the eight or ten year groups present during the winter fishing. From the fact that the large year groups of 1929-30 and 1933-34 lost their dominance in the catches more rapidly than the year groups of 1919-20, 1922-23 and 1925-26, the conclusion is drawn that there is a considerable over-fishing of the young fish, and that a serious reduction of the sardine population must be the result.

The seasonal changes in size which occur suggest that the young fishes are to be found off the southern coast of California, and that as they grow older they tend to move farther north after each spring spawning, so that the oldest fishes inhabit the more northerly part of the range. These old fishes move southward to the spawning grounds.

The fishing grounds of the Californian sardine boats are briefly reviewed in a separate paper ("Fishing Localities for the California Sardine, *Sardinops caerulea*, 1928-1936"). By Frances N. Clark. Contribution No. 158 from the California State Fisheries

Laboratory). In Central California practically no catches are made outside the 100-fathom line. Off Monterey, where the continental shelf is narrow, 81 per cent of the catch of sardines is taken within five miles of the coast. The shelf is wider off San Francisco,

and correspondingly more catches are made at greater distances from the shore. In southern California, where the 100-fathom line is close to the shore, the fish appear to be concentrated along the steep slope, which drops rapidly to 500 fathoms.

Lubrication and Lubricants*

INDUSTRIAL APPLICATIONS

The third group of papers is concerned with industrial applications of lubricants. Catterall and Maitland survey the use of grease in a number of diverse applications, and several papers reveal the extent to which this form of lubricant is being used. Although, as mentioned by Cooper, lubrication by an oil mist would be ideal for ball, roller and needle bearings, they are most commonly lubricated with grease, because grease remains in the housing and affords protection against dust and moisture, which would lead to abrasion and pitting of the accurate surfaces. Cooper, Richardson and Kjerrman all emphasize the undesirability of overfilling the housings, on account of churning, and the care required in choosing greases, advocating an actual running test. Hancock deals with the friction of ball and roller bearings.

Water-grease emulsions are used in drawing steel tubes (Catterall and Maitland). In the similar operation of cold pressing sheet steel, high pressures are encountered, and Arrowsmith reviews the desirable qualities of the lubricant, film strength, appropriate friction, ease of spreading and of removal, etc.; a fatty oil emulsion containing chalk powder is generally used. High pressures also occur in wire-drawing, and Goodacre states that the lubricant used in dry drawing is a dry sodium soap, in conjunction with some calcium hydroxide remaining after neutralizing the acid used in cleaning. In wet drawing one of the essentials is the formation of a very thin coat of copper or tin on the surface of the metal; the bath usually contains a fatty lubricant and soap, and must contain sulphuric acid. Thompson considers that the friction in the die is of the boundary type, and investigates a number of soaps and liquid lubricants at various temperatures.

Miller contributes a useful review of extreme pressure lubricants as regards composition and the behaviour in various testing machines, and the problems presented by the need for stability, absence of corrosion, etc.; he refers to future trends and the need for more research, emphasizing the important effect this work on additions to lubricants is having on lubrication generally. Evans gives results of tests in the Almen machine on various oils and greases, and of a number of pure organic compounds in small proportion in mineral oil. Clayton describes the superior behaviour of extreme pressure oils over other gear oils in the 4-ball apparatus, not only in breakdown load and wear, but also in the time to recovery from seizure.

Parker writes on the lubrication of bearings of light mechanisms in which the oils sometimes cannot be renewed during the life of the mechanism. High oiliness has thus been regarded as important, and dolphin and porpoise jaw oils have been used; on

account of the oxidation and gumming of these oils, however, mineral oils are now being tried. Stott and Shotton agree that the pivot and cupped-jewel bearing can run well for a time without lubricant, but that oil is necessary for prolonged running at low friction, one of the important functions of the oil being to carry in suspension the iron oxide formed at the contact under the extremely high local pressures.

Hogan, also Nixon and Jackson, describe the difficult problem of lubricating wire ropes; two functions are required of the lubricant: (1) to prevent corrosion; (2) to reduce the friction and prevent seizure of the wires, which make contact with each other at high pressure. Merritt gives much useful information on gear tooth failures and on factors governing the choice of lubricants for gears; Tuplin describes the different methods of applying the lubricant. Blok, in a notable paper, shows, by Bowden's method, the high temperatures reached by gear tooth surfaces under high-pressure running conditions.

PROPERTIES AND TESTING

The fourth group of papers concerns properties and testing and is of especial interest. In connexion with boundary lubrication, Adam and Kyropoulos review surface phenomena and the function of the adsorbed boundary layer in protecting the metals from cohesive contact. Kyropoulos favours internal molecular mobility rather than elasticity as the explanation of the efficacy of long molecules; also he reasons that the lattice forces of the adsorbing surface ultimately control the lateral packing of the molecules of the boundary layer, thus accounting for the surviving influence of the surface at distances exceeding the range of the original surface forces.

Finch and Zahoorbux describe their work on electron diffraction to show orientation of surface films. Trillat studies adsorption by measuring the rate of change of oil-water interfacial tension by a modification of du Nouy's method. Using oleic acid-B.P. paraffin mixtures to provide a scale, the activity of commercial oils can be expressed in equivalent oleic acid content. Examination of an oil before and after passing it over metal balls, through filter paper, etc., shows the adsorption of active molecules at the surfaces. Miss Nottage reports results of static friction tests with fatty acid and wax additions to oils, revealing the effect of atmosphere and adsorbing surface. Fogg describes kinetic friction tests with an oscillating bearing machine; he considers that true boundary friction is obtained below 3 cycles per minute.

Surface finish in relation to the boundary layer is mentioned in a number of papers. Bowden refers to the high temperatures found at sliding contacts; with Leben he shows that sliding is a discontinuous

*Continued from page 816.

process, and that when slip occurs there is a momentary jump in temperature. Blok works out the temperature rise for sliding contacts for a number of ideal cases. Neely describes simultaneous friction and wear measurements and shows that the wear-reducing value of addition agents may be quite different in degree and sometimes in direction from the friction-reducing value. Brownson, Southcombe, Wells and Waters, Clayton and van der Minne report breakdown loads and wear under relatively severe conditions, and provide a fund of information relating to 'oiliness' and extreme pressure effects which can only be partially co-ordinated; it appears that the good qualities of extreme pressure oils can only be brought out at high pressure and speed, leading to high temperature.

In the papers dealing with viscosity, that by Groff explains the use of a chart for the graphical solution of a number of viscosity-temperature problems. Geniesse describes the kinematic viscosity measuring equipment which has been adopted by the American Society for Testing Materials, and the new viscosity-temperature chart. Barr describes viscometer bath arrangements for high temperatures, and suggests a new empirical formula for expressing viscosity-temperature relationship. Suge gives an account of his methods and results of measurement of viscosity up to high temperature and pressure; he finds that the product of surface tension and coefficient of compressibility is a constant, and measures the thermal conductivity of oils. Bradford and Vandegrift quote Dow's results on the effect of pressure on the viscosity of mineral oils.

Coming now to papers dealing with oxidation tests of oils, Andrews finds that the rate of separation of water-in-oil emulsion is a good guide to the condition of a turbine oil in service. Moerbeek is critical of the

many oxidation tests for internal combustion engine oils on account of the disagreement between their results and the lack of correlation with engine behaviour; he is pessimistic as to their ultimate capability of predicting the behaviour of oils in engines. Mardles and Ramsbottom provide extensive results on the oxidation of oils with varying temperatures, time and method of oxidation. Hanson and Egerton, finding that gumming increases when engine knocking occurs and that nitrogen oxides are formed particularly under these conditions, have investigated the connexion between the two; they find that nitrogen oxides, even in small proportion, have a marked catalytic effect on oxidation, and suggest that this may be one of the factors leading to lack of correlation between laboratory and engine tests. Moutte, Dixmier and Lion find that they get improved correlation by first oxidizing the oil at low temperature and then subjecting it to high temperature. Evans and Kelman have found that soaps such as tin oleate can inhibit the catalytic effect of iron on oxidation, and by engine tests have chosen optimum proportions of tin and chromium oleates for an engine oil.

The time has certainly not yet arrived when the principles of lubrication can be said to be satisfactorily established on a scientific basis: clearly, much additional and carefully co-ordinated research of a really critical nature must be carried out. Nevertheless, progress has been made and certain underlying physico-chemical concepts are emerging. The papers contributed to this general discussion form an admirable review of the present position, and their detailed study is recommended to all interested in the theory and practice of lubrication and lubricants.

H. J. G.

Recent Advances in Horticulture

MANY useful reviews are contained within the pages of vol. 5 of the Horticultural Education Association's yearbook for 1937 "Scientific Horticulture" (Pp. 196 + xxxii, 3s. 6d. net, from the Hon. Editor, S. E. Agric. Coll., Wye, Kent), which constitute a welcome channel for the distribution of knowledge from the research worker to the teacher of horticulture. "Some Recent American Work on the Copper Fungicides" is described by Mr. R. W. Marsh; Prof. Stoughton contributes "A Review of the Problem of Bud Dormancy". Dr. O. N. Purvis discusses recent Dutch research on the temperature requirements of hyacinths, and Dr. Meirion Thomas has a paper on "Plant Hormones and Their Possible Importance in Horticulture". Dr. F. Kidd and Dr. G. West show that apples destined for long-period gas storage should be picked within a fortnight of the 'climacteric phase'. This is the time when growth in size of the apple ceases in autumn, and is indicated in practice when the fruit can just be detached by gently twisting it on its stalk. The late Dr. W. Maldwyn Davies describes the results of his experiments on factors which affect the distribution of virus-transmitting aphids, particularly *Myzus persicae*. Winged individuals of this species fly readily when the temperature reaches 65° F. Increasing humidity deters the movement of winged aphids, and flight ceases

completely when the wind velocity rises above four miles per hour. Dr. T. Whitehead has correlated this knowledge with a survey of districts in North Wales which are suitable for the growth of virus-free seed potatoes.

Messrs. B. S. Furneaux and W. G. Kent have investigated a malady of fruit trees known as the 'death'. This is due to the suffocation of roots by rise of the water-table after planting in a dry period, whilst wind-rocking of newly planted trees is often a contributory cause. Research work in progress at the John Innes Horticultural Institution is reviewed by Mr. W. J. C. Lawrence, and at the St. Ives Research Station by Mr. R. B. Dawson, who also contributes a paper on the routine management of lawns. Dr. W. G. Ogg discusses the reclamation of peat land and the utilization of peat as a mulch, as a potting medium, and as a source of organic matter for garden soils. Prof. G. W. Robinson discusses more general problems of horticultural soils.

Papers dealing with practical topics also appear in the volume.

CHESHUNT RESEARCH STATION

The twenty-second annual report, for 1936, of the Experimental and Research Station sponsored by the Nursery and Market Garden Industries' Development

Society, Limited, at Turner's Hill, Chesshunt, Herts, shows that much work is being directed towards the improvement in quality of tomatoes. The director, Dr. W. F. Bewley, and Mr. J. Harnett, have investigated the condition of tomatoes upon arrival at the wholesale markets in many parts of England, and much information has been made available for growers. Manurial and crop-management trials have been continued, and a method for restricting the root systems of tomato plants within clay pots gives earlier ripening and enhanced quality. Soil heating, applied after the two bottom trusses have set, gives a greater yield than the use of continuous ground warmth from planting time.

The Station now possesses a mushroom house, where an attempt is being made to understand the cultural requirements of this plant, and where the incidence of pests, and the appearance of undesired fungi, can be studied and controlled. A truffle fungus, *Pseudobalanus microspora*, has been described as a new invader of mushroom beds. Several new fungal diseases of flowering plants have been described.

An interesting method of testing for the presence of spotted wilt virus in chrysanthemum plants has been evolved. This virus is scarcely tolerant of oxidation, and it is difficult to inoculate such hosts as tobacco or tomato with it. A dilute solution of sodium sulphite, acting as a reducing agent, allows such inoculations to be performed with ease. The occurrence of the eelworm *Anguillulina dipsaci* upon the tomato has been recorded, and the marking of tomato fruits with circular rings is shown to be the result of drops of water containing *Botrytis* spores.

LONG ASHTON RESEARCH STATION

The annual report of the Agricultural and Horticultural Research Station at Long Ashton, Bristol, for 1936, sets forth the results of a number of investigations which are especially practical in their outlook. A new section deals with soil surveys; Dr. T. Wallace has described the soils in the Vale of Evesham, in their relation to fruit and vegetable crops, and Dr. D. A. Osmond has studied the more intensive problem of the Station's pedology. Mr. G. T. Spinks reports work in progress on apple breeding, and variability of apple trees on seedling and on clone rootstocks.

Drs. T. Swarbrick and W. E. Berry have carried out yield trials with various black currant varieties in relation to the system of pruning adopted. They give the interesting result that hard pruning reduces the crop significantly in every case. The same two workers have also inquired into the incidence and spread of the virus disease of black currants known as 'reversion'. They indicate a correlation between the appearance of big bud, caused by a gall mite, and the virus, though big buds have never been observed before the symptoms of reversion, on the same bush. This raises the possibility that the gall mites may be present upon a bush for some time, in numbers sufficient to transmit reversion, but insufficient to produce a gall.

Dr. H. G. H. Kearns, Mr. R. W. Marsh, Dr. H. Martin, and Mr. E. Umpleby have a number of papers upon the control of pests and diseases by spraying. A third progress report on the use of combined washes is given, and sulphite lye has been used as an emulsifier. Dr. C. L. Walton shows that a type of pearnip canker is caused by the eelworm *Anguillulina dipsaci*, which can also induce similar

symptoms on onions, and in collaboration with Messrs. L. Ogilvie and C. J. Hickman, a study of the effect of nitrogenous fertilizers on potato 'sickness' has been made. The eelworm, *Heterodera Schachtii*, which causes the trouble, evidently interferes with the nitrogenous metabolism of the potato, and the yield of tubers on 'sick' land can be increased by the application of nitrogenous manures.

Mr. P. T. H. Pickford reviews the cider-making trials during the year, and Mr. Vernon L. S. Charley contributes two papers upon principles involved in the manufacture of fruit juice syrups. This work is of importance in providing a new and steady market for various fruits, and should help materially in the economic management of the extremely variable yield of home-produced fruit. A study of the dormant buds of the cricket-bat willow, as they affect the wood, has been made by Mr. H. P. Hutchinson, who also inquires into the effect of lateral branches upon the production of sets in this species of willow.

CULTURE OF AMARYLLIDS

The American Amaryllis Society has decided upon the title *Herbertia* for its third, and all subsequent year-books. This is to honour the pioneer work of William Herbert, whose published work on the Amaryllidaceae appeared in 1837. Vol. 3 (Pp. 151, from the editor, Dr. Hamilton P. Traub, Mira Flores, Orlando, Florida, U.S.A., 1936) is dedicated to Arthington Worsley, whose contributions to the culture of amaryllids are acknowledged in a short appreciation by Lord Aberconway, president of the Royal Horticultural Society of England. The botanist will find much of interest in the volume, particularly in the sections dealing with the physiology of reproduction and with genetics and breeding. Little is yet known about causes which influence the balance between flowering and vegetative propagation in bulbs. A paper on "The Propagation of *Zephyranthes rosea* by Under- and Over-Feeding" by Dr. Hamilton P. Traub and A. E. Hughes, provides a welcome introduction to the effect of soil nutrients upon propagation by bulbils. I. W. Heaton describes the propagation of amaryllids by destruction of the terminal bud, and Wyndham Hayward gives a method for propagating *Lycoris* by basal incisions. Dr. Traub has a further paper on "Growth Responses Following Stem Cuttage of Amaryllids".

The most widely interesting contributions in the section on genetics and breeding are, perhaps, those which relate to the storage of pollen. It has only been possible in the past to cross-pollinate such varieties as overlapped each other in their times of flowering. It is now possible to store pollen of many species for a considerable time. Miss Norma E. Pfeiffer has shown that the best conditions for storage are provided by a temperature of 10° C. with a relative humidity of 35-60 per cent. Dr. Traub shows how such a humidity can be preserved in an enclosed space by means of saturated solutions of various salts. Dr. A. B. Stout has an article on the evaluation of horticultural clones of day lilies, and there are also papers upon specific genetic problems relating to the Amaryllidaceae by S. P. Lancaster, G. W. Gibson, R. T. van Trees, and Wyndham Hayward.

The section on colour description includes three papers on colour photography, and the colour charts of Fischer and the Royal Horticultural Society are discussed.

Science News a Century Ago

Captain Back's Voyage in H.M.S. *Terror*

At the opening meeting of the session of the Royal Geographical Society on November 13, 1837, many interested in Arctic exploration assembled to hear Captain (afterwards Admiral Sir) George Back (1796-1878) give an account of his voyage in the *Terror*, made at the instance of the Society with the object of furthering knowledge of the North-West. Leaving England in June 1836, he passed through the Hudson Strait and shortly afterwards in exceptional circumstances was beset in the ice off Southampton Island. Speaking of his experiences off the Island he said: "The frost-smoke that allured us vanished as we drew near, and the dark lanes of water from which it originated closed firmly, to the utter impossibility of proceeding one yard farther. Left, therefore, to the influence of events, we were borne backwards and forwards, according to the eccentric movements of the ice, crowding sail when the least crack showed a probability of an opening, or with the aid of saws, axes and ice anchors, working a few paces, until the most closely packed ice finally arrested our progress twelve miles from Cape Bylot, when only fifteen more would have ensured a safe wintering place in Duke of York's Bay."

The ship remained fixed in the ice from September 1836 until June 1837, when owing to the damage done to her it was necessary to return home. On the way home she leaked so much as to need incessant pumping, and to secure the ship, said Back, "we were obliged to strap her together with the stream chain cable. . . ." The *Terror* arrived back in Lough Swilly on September 3, 1837.

The Royal Society's New Barometer

On November 16, 1837, Francis Bailey read a communication to the Royal Society, entitled "Description of a new Barometer recently fixed up in the Apartments of the Royal Society; with remarks on the mode hitherto pursued at various periods, and an account of that which is now adopted, for correcting the observed height of the mercury in the Society's Barometers". In the course of his paper, Bailey referred to the height of the Society's barometer above the mean level of the sea, about which there appears to have been some uncertainty. Thus prior to 1823 the cistern of the barometer is said to have been 81 ft. above the level of low-water spring tides at Somerset House, but without any information how this was connected with the sea. From 1823 until 1825 inclusive, it was said to have been 100 ft. above the same level, and from 1826 until 1836 inclusive the height is said to have been 83 ft. 2½ in. above a fixed mark on Waterloo Bridge or above the mean level of the sea (presumed about 95 ft.). The discordance between the 81 ft. and the 100 ft. was accounted for in as much as the old barometer prior to 1823 was fixed in the Council room while the Daniell barometer of 1822 was fixed in the closet adjoining the library on the floor above the Council room. With respect to the mark on Waterloo Bridge, the reference level was the surface of the granite pedestal at the base of the columns at the north abutment of the bridge and on the eastern side, a reference point "more durable, and more convenient than any mark that could have been inscribed by hands".

Taylor's Scientific Memoirs

On November 18, 1837, the *Mechanics Magazine* under the above heading said: "The first volume of this collection of translations from the foreign scientific periodicals is now completed, and we are sorry to find the editor and proprietor has still to complain of a want of adequate patronage. He has suspended the continuation of the work for the present, to give an opportunity for men of science to come forward in its support, before he commits himself by commencing the second volume. As the great utility of such a publication is too manifest to admit a doubt . . . it is to be hoped that Mr. Taylor's appeal will not be in vain. Richard Taylor (1781-1858) was a printer and naturalist and a member of various scientific societies. He was the publisher of the *Annals of Philosophy* founded in 1813, which was incorporated in 1827 with Tilloch's *Philosophical Magazine* founded in 1797.

Cholera in Africa

THE *Lancet* of November 18, 1837, contains the following information: "The cholera has just broken out in the *Dey's Hospital* at Algiers. On the 14th of October seventeen cases and nine deaths were reported. At Bona, where the epidemic has been prevailing for some time, the number of cases on the 17th of October had amounted to 318, the deaths to 180. One of the most curious points in the history of the Asiatic Cholera is, perhaps, the steady proportion of deaths to cases which may be observed to have occurred in all parts of the world and in all climates. This fact proves how very little as yet has been done in the treatment of the disease!"

University Events

CAMBRIDGE.—The Vice-Chancellor has announced that the University has received from Mr. J. W. O. Hamilton, of Chesterfield House, 98 Great Tower Street, London, E.C.3, an album entitled "The Commercial Development of Radio-telegraphy, Telephony and Broadcasting", and a cheque for £500 to found a prize for the encouragement of radio research in the University. Mr. Hamilton wishes the prize to be associated with the names of James Clerk Maxwell and Sir Ambrose Fleming.

It is proposed that Prof. F. Debenham and J. A. Steers, of St. Catharine's College, be appointed to represent the University at the International Congress of Geography in Amsterdam on July 18-28, 1938.

LONDON.—The degree of Doctor of Literature *honoris causa* was conferred on H.M. the Queen in the presence of H.M. the King on November 10.

The following doctorates have recently been conferred: D.Sc. in chemistry on Mr. A. N. Dey (Imperial College—Royal College of Science); D.Sc. in statistics on Mr. M. S. Bartlett.

OXFORD.—The honorary degree of D.Litt. will be conferred on November 20 on Dr. R. R. Marett, rector of Exeter College since 1928 and reader in social anthropology since 1910.

K. A. H. Murray, of the Agricultural Economics Research Institute, has been elected fellow, and bursar of Lincoln College.

Societies and Academies

Edinburgh

Royal Society, October 25.

J. W. S. MARR: Antarctic surveys: The work of the "Discovery" investigations (Bruce Memorial Prize lecture, 1936). The Discovery Committee, in spite of the heavy commitments of a comprehensive oceanographical programme, has not overlooked the urgent need for reliable charts of the little-known Antarctic lands, and of the widely scattered, remote and frequently inaccessible island groups that are the dependencies of the Falkland Islands. Among other things it was this aspect of the Committee's researches that Dr. W. S. Bruce himself had so strongly supported in an interview at the Colonial Office nearly twenty years ago. In the twelve years the Discovery investigations have been in existence, much has been done to further existing knowledge of these distant coasts. The cartography of this region is emerging slowly from a state of uncertainty and confusion, and will, it is hoped, in time reach one which may prove useful to future scientific or commercial enterprise.

Paris

Academy of Sciences, September 27 (C.R., 205, 529-548).

CHARLES JACOB: Obituary notice of Albert Heim.
LOUIS LAPICQUE: Isochronism as a condition of intercellular transmission of stimulation.

PAUL LÉVY: New contribution to the arithmetic of products of Poisson's law.

RODOLPHE HENRI GERMAY: The existence of functions associated with the solutions of completely integrable systems of total differential equations with linear coefficients.

SANTIAGO ANTUNEZ DE MAYOLO: The composition of the electron and the energy of fixation.

PIERRE DUPIN and LOUIS SACHÉ: The measurement at a distance of the electrical state of the surface of insulating bodies.

MILLE SUZANNE VEIL: The presence of iodine dissolved in aqueous solutions of potassium iodide, and the electrical properties of the medium.

HENRI MOURMU, MICHEL MAGAT and GEORGES WITTOFF: The stereochemical structure of phosphorus pentachloride. In an earlier paper, the authors have suggested that phosphorus pentachloride exists in two forms, the solid state possessing an unsymmetrical structure, the liquid form a symmetrical structure. These considerations are applied to explain anomalies of electrical conductivity and dielectric constant described by various authors, and also certain differences in chemical reactivity.

Amsterdam

Royal Academy (Proc., 40, No. 7, Sept. 1937).

J. CLAY: The energy and penetrating power of cosmic rays. A survey of the evidence for the energy and corpuscular nature of cosmic rays.

F. M. JÄGER, J. TH. BERG and P. TH. BERG: Optical rotation and rotatory dispersion in solution and in the crystalline state.

P. E. VERKADE, J. VAN DER LEE, MISS J. C. DE JUAUT and E. DE ROY VAN ZUYDREWIJN: New methods for the synthesis of glycerides (2).

MISS W. A. LUB: The optical spectrum of actinium. New lines due to actinium.

MISS J. G. EYMERS and H. P. BOTTILLIER: Proto-plasmic movement in the oat coleoptile as related to oxygen pressure and age.

A. KAWAGUCHI: The relation between a metric, linear connexion and a non-metric one in a general metric space.

P. TH. BERG and J. TH. BERG: The crystal form of some complex salts of triaminopropane with trivalent cobalt and rhodium.

A. W. H. VAN HERK: The chemical processes in the spadix of *Saurumatum*.

G. C. HIRSCH: Outlines of a theory of the Golgi bodies. (1) The Golgi bodies in space.

L. H. BRETSCHNEIDER and J. J. DUYVENS DE WIT: The hormone chain: active urine substance → ovary → ovipositor in *Rhodous amarus*.

P. JULIEN: (1) Distribution of the blood groups in some peoples of Liberia and Sierra Leone. (2) Studies in blood group correlations in some peoples of Liberia and Sierra Leone.

Cracow

Polish Academy of Science and Letters, July 1.

W. JACZYNA: The thermodynamic scale below 1° K. Data concerning the thermodynamic scale below 1° K. are doubtful for two reasons, the inexactitude of the thermomagnetic equation and the irreversibility of the adiabatic demagnetization.

T. BANACHIEWICZ: The numerical solution of a system of linear equations.

B. KAMIEŃSKI: Thermodynamical considerations on dielectric potential and surface tension.

B. NIKLEWSKI and MILA J. WOJNICKA: The morphological phenomena produced as the result of chemotropic irritation of the roots.

H. GROSSFELD: Osmotic pressure and intravital coloration.

H. GROSSFELD: A method applied in researches on the permeability of animal tissue cells.

Rome

National Academy of the Lincei (*Atti*, 25, 353-412; 1937).

A. DE MIRA FERNANDES: Expressions for the curvature of a surface.

G. PALAMÁ: The transformation of Gauss and the Hermite polynomials.

T. TURRI: An observation on the classification of curves of the second kind.

G. COLONNETTI: The elastic equilibrium of systems in which non-elastic deformations also occur (1).

G. PERETTI: Plastic sources.

O. TOLOTTI: Generalization of Dirac's equations for the space of general relativity.

L. CAVALLARO: Absorption bands in polar substances at very high radio frequencies (1).

A. MANGINI: Aromatic nitroderivatives (13). Some substituted α -naphthylamines.

G. DAL PIAZ: Geological structure of the Anstrides (5). Some further work on the Austrian alpine system of the Eastern Alps.

A. CAVINATO: Morenosite from Val Malenco.

G. BOZZINI: Observations on the parasitism of *Sclerotinia libertiana sclerotiorum* Fuck associated with other fungi.

A. SALVATORI: Further contribution to the study of post-operation hypochloremia.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 15

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—H. St. J. B. Philby: "The Land of Sheba" (Asia Lecture).

Tuesday, November 16

CHADWICK PUBLIC LECTURE (at Mansion House, 26 Portland Place, W.1), at 5.15.—Dr. Bernard Myers: "The Promotion of Health in the Empire Citizen".*

GRINSHAM COLLEGE, BASINGHALL STREET, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Nebulae as External Galaxies" (succeeding lectures on November 17, 18 and 19).*

Wednesday, November 17

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—J. E. Barnards, F.R.S., and F. V. Welch: "The Principles of Fluorescence Microscopy".

Thursday, November 18

LONDON MATHEMATICAL SOCIETY, at 5 (at the Royal Astronomical Society, Burlington House, W.1).—Annual General Meeting.

Prof. G. B. Jeffery, F.R.S.: "Mathematical Studies in the Modern Universities".

CHEMICAL SOCIETY, at 8.—Dr. J. M. Robertson: "Bond Character and Interatomic Distance".

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS—(at Mansion House, 26 Portland Place, W.1), at 8.—Annual General Meeting.

Dr. Marie Stopes: "The Year's Work, and Behind the Scenes in the Present Crisis".

Friday, November 19

ROYAL INSTITUTION, at 9.—Sir William Bragg, O.M., F.R.S.: "Clay".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN ELECTRICITY ENGINEERING in the Wolverhampton and Staffordshire Technical College.—The Director of Education, North Street, Wolverhampton (November 18).

LECTURER IN ENGINEERING in South-East Essex Technical College, Dagenham.—The Clerk to the Governors (November 15).

ASSISTANT ENGINEER in the Roads Department of the Ministry of Transport.—The Establishment Officer, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (November 17).

SCIENTIFIC OFFICER in the Air Ministry Scientific Research Pool.—The Secretary, Air Ministry (S.E.d. Room 406), Admiralty House, Kingsway, W.C.2 (November 20).

TECHNICAL OFFICER in the Directorate of Armament Development of the Air Ministry.—The Secretary, Air Ministry (S.E.d. Room 406), Admiralty House, Kingsway, W.C.2 (November 20).

JUNIOR SCIENTIFIC OFFICERS in the Electricity, Radio and Aerodynamics Departments of the National Physical Laboratory, Teddington, Middlesex.—The Director (November 22).

PHYSICIAN at the Liverpool Radium Institute, 1 Myrtle Street, Liverpool.—The Secretary (November 20).

PROFESSOR OF PHYSICS in University College, Aberystwyth.—The Principal (November 20).

PROFESSOR OF CHEMISTRY in the University of Cape Town.—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (December 15).

DEWAR RESEARCH FELLOW IN CRYSTALLOGRAPHY in the University of Edinburgh.—The Secretary (December 15).

GEOROLOGIST to the Rubber Research Scheme (Ceylon).—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7 (December 31).

JUTE SPECIALIST to the Indian Central Jute Committee.—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (December 31).

STRUCTURAL ENGINEERING ASSISTANTS in the Directorate of Fortifications and Works of the War Office.—The Under-Secretary of State (0.5), The War Office, London, S.W.1 (Quote Appts./56).

SENIOR AND JUNIOR RESEARCH ASSISTANTS in the Courtland Institute of Biochemistry, Middlesex Hospital, W.1.—(The Secretary).

SENIOR LECTURER IN GENERAL AND INORGANIC CHEMISTRY in the University of Melbourne.—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1.

SENIOR LECTURER IN ANATOMY in the University of Melbourne.—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Leaflet No. 23: Pruning in Young Plantations. Pp. 12. (London: Forestry Commission.) [2510]

Technical Publications of the International Tin Research and Development Council. Series A, No. 63: The Corrosion of Tin in nearly Neutral Solutions. By Dr. T. P. Hoar. Pp. 16. Free. Series A, No. 64: Surface Tension and Viscosity Phenomena in Tinplate Manufacture. By Dr. Bruce Chalmers. Pp. 10. Free. (London: International Tin Research and Development Council.) [2510]

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1936. Pp. 294. (Harpenden: Rothamsted Experimental Station.) 2s. 6d. [2510]

Institution of Gas Engineers. Publication No. 162: The Low-Temperature Carbonisation of Scottish Cannel. By Dr. J. G. King and James Jamieson. Pp. 16. Publication No. 165: Third Report of the Research Executive Committee, 1936-37. Pp. 24. Publication No. 167: Forty-first Report of the Joint Research Committee of the Institution and Leeds University.—The Investigation of the Use of Oxygen and High Pressure in Gasification, Part 2: Synthesis of Gaseous Hydrocarbons at High Pressure. Pp. 48. (London: Institution of Gas Engineers.) [2510]

Hull Museum Publications. No. 191: The *Sirius*, the first Steamer to Cross the Atlantic. By Thomas Sheppard. Pp. 15. No. 193: A Roman and Saxon Site at Elmwell, East Yorks., 1935-1936. By Anthony L. Coogreve. Pp. 23. No. 194: Excavations at the Roman Town at Brough, N. Yorkshire, 1935. By Philip Corder and the Rev. Thomas Romans. Pp. 69+3 plates. (Hull: Hull Museum.) [2510]

Decennial Index of *The Analyst*, the Journal of the Society of Public Analysts and other Analytical Chemists. Vols. 51-60 (1926-1935). Compiled by M. B. Elliott. Pp. 467. (Cambridge: W. Heffer and Sons, Ltd.) 25s. net. [2510]

ULAWB Monographs and Reports, No. 4B: Instructions for dealing with Rabbits. Compiled by Capt. C. W. Hume. Second edition (revised). Pp. 16. (London: University of London Animal Welfare Society.) [2510]

Other Countries

Instituto Nacional de Tecnologia. Opcas do Brasil: Rochas de Jabot, Trapo, e Jutahydas. Pelos José Luis Rangel e Hays R. Schneider. Pp. 42+3 plates. Nota sobre os Fosfatos de Tranhur (Baurita e laterita phosphoreas). Por S. Fróes Abreu. Pp. 28+4 plates. Rochas oleaginas do Brasil e seu aproveitamento. Pelo S. Fróes Abreu. Pp. 162+10 plates. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [2510]

Memoirs of the Geological Survey of India. Paleontological Index New Series, Vol. 22, Memoir No. 6: Cambrian Trilobites from Iraq (Persia). By W. B. B. King. Pp. iv+22+2 plates. (Calcutta: Geological Survey of India.) 1.14 rupees; 2s. 3d. [2510]

Zweihundertjähriger Jahresbericht über die Tätigkeit der Deutschen Seewarte, 1936. Pp. 40. (Hamburg: Deutsche Seewarte.) [2510]

Forestry Pamphlet No. 5: Forestry and the Oil Industry. Pp. 4 (Port-of-Spain: Government Printing Office.) 13 cents. [2510]

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 155: Some Effects of Ignition Timing and Rate of Burning on the Thermodynamical Performances of High-Speed Compression-Ignition Engines. By Seichi Awano. Pp. 20. (Tōkyō: Kōgyō Tokei Kabushiki Kaisha.) 55 sen. [2510]

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1936. Pp. 24. (Zomba: Government Printer.) 2s. 6d. [2510]

M.F. Department of Scientific and Industrial Research. Appl. Observatory, Apia, Western Samoa: Annual Report for 1934. Pp. 121. (Wellington: Government Printer.) 5s. [2510]

Ostia. Vol. 4: *Icones Scientifiae et Medicae*. By Arnold C. Klebs. Pp. 350. (Bruges: St. Catharina Press, Ltd.) [2510]

Smithsonian Institution: Bureau of American Ethnology. Bulletin 116: Ancient Caves of the Great Salt Lake Region. By Julian H. Steward. Pp. xiv+181+9 plates. (Washington, D.C.: Government Printing Office.) [2510]

Maryland Geological Survey. Vol. 18. Pp. 295+45 plates. (Baltimore, Md.: Johns Hopkins Press.) [2510]

Smithsonian Institution: United States National Museum. Bulletin 169: The Fort Union of the Grassy Mountain Field, Montana, and its Mammalian Fauna. By George Gaylord Simpson. Pp. x+287+1 plates. (Washington, D.C.: Government Printing Office.) 4 cents. [2510]

Tanganyika Territory: Department of Agriculture. Annual Report 1936. Pp. 100. 4s. Pamphlet No. 16: The Bael Experimental Station Report for the Year 1936. Pp. 12. 6d. Pamphlet No. 17: Report from the General Experimental Farms, 1936. Pp. 40. 6d. (Dar es Salaam: Government Printer.) [2510]

National Research Council of Canada. Bulletin No. 18: Chemical Weed Killers; a Review. By W. H. Cook and A. C. Halford. Pp. 111. (Ottawa: National Research Council of Canada.) 2 cents. [2510]

Catalogues, etc.

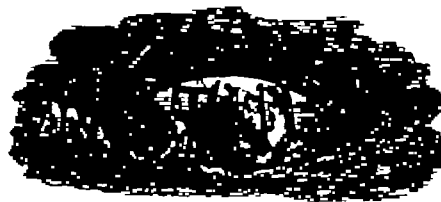
Apparatus for the Measurement of Dielectric Constants (Dipol Measurements). (Dipol 25.) Pp. 6. (Delft: P. J. Kipp and Zoonen London: W. Edwards and Co.)

Voyages and Travels, Americans, Important Historical Works Early Scientific Books, etc. (Catalogue No. 617.) Pp. 72. (London: Francis Edwards, Ltd.)

Vermes. (Catalogue No. 93.) Pp. 68. (Den Haag: Antiquariaat W. Junk.)

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SATURDAY, NOVEMBER 20, 1937

Vol. 140

Social Aspects of Nutritional Science

THOUGH there is still a tendency among certain people to deplore the passing of the 'good old days', it has to be acknowledged that during the past century and a half the lot of the poorer sections of the populations of western Europe has been enormously improved. In the past, war, famine and pestilence have decimated many countries; to-day, in Europe, famine is the exception and many types of pestilence have been already almost forgotten, although the widespread occurrence of infectious diseases, especially influenza in pandemic form, yet offers many problems for preventive medicine. The advance in public health and well-being, strikingly shown by the fall in the death-rate and the extension in the expectation of life of the individual, was made possible by the advances in sanitation and medical knowledge, and the improvement in the social conditions of the lower-income groups was due to the rapid growth of wealth, which resulted mainly from the advances in scientific knowledge and its application. The awakening of the social conscience of the community has frequently played no mean part in these advances.

In spite, however, of the improvement in the health of the people, it is only comparatively recently that it has been realized what an important part nutrition plays in maintaining health: with increasing wealth, diet has become more abundant and more varied, but the improvements in the past have been largely the result of the unconscious and instinctive groping of men for a better and more abundant life. To-day, medical science can state, within limits, what is a good and what is a bad diet: therefore, it is possible from dietary studies to determine whether people are eating the right kinds of food in sufficient quantities.

Further, our knowledge of the results of consuming ill-balanced diets has increased to the extent of enabling us to say, in many cases, from a clinical examination, whether malnutrition is present and what particular element in the diet is lacking, even apart from the obvious occurrence of what are now known as the frank 'deficiency diseases', such as scurvy, rickets or beriberi.

Perusal of the recent report of the League of Nations on nutrition, reviewed elsewhere in this issue, shows, however, that in spite of the general improvement in the social conditions of the poorer sections of the communities of western Europe in recent decades, much malnutrition still exists, even in the richer countries. The evidence is both clinical and economic: dietary and income surveys have shown that among the lowest-income groups it is simply impossible for the members to obtain a proper diet, since the family income is insufficient! Nutrition policy, therefore, must be directed both to educating people in the elements of correct dietetics, and also, which is even more important, to enabling *everyone* to make full use of our present knowledge, by bringing the foodstuffs essential to health and physical development within reach of all sections of the community. No campaign for improving physical fitness can succeed when nutrition is at fault.

What, then, does improved nutrition imply? Usually an increased consumption of animal protein, milk, eggs, 'fat' fish, green vegetables and fresh fruits, with a decreased consumption of cereals: in other words, a decrease in the consumption of the purely energy-bearing foods, and an increase in that of the so-called "protective" foods, which are in general the more expensive. Dietary surveys have shown that with increasing

income, more of the protective foods are consumed; the problem is therefore largely economic—how to increase the incomes of the more poorly paid sections of the community, or, alternatively, how to reduce the price of the protective foods, which comes to the same thing. One objection, that the shift in consumption will cause distress among many agriculturists, is shown in the League of Nations report to be of no weight. For many years agriculture has been adapting itself to just such a shift in consumption, which has occurred with the general increase in wealth of many countries; moreover, cereals formerly produced for human consumption can also be used as animal feed when the demand for meat and milk increases.

It is impossible to-day for Governments to divest themselves of responsibility for the nutrition of their peoples; nutrition should be considered to-day the most important of all the social services.

Education in the correct principles of nutrition and avoidance of policies which may prevent the full use of adequate diets should be the foremost considerations of legislators as steps in the improvement of the well-being and health of their peoples. It must be emphasized that the problem is indeed complex; thus a simple reduction in the price of food may benefit the urban consumer but bring ruin and malnutrition to the agricultural producer.

The League's report on nutrition should be in the hands of all who have the welfare of the people at heart, especially those entrusted with the direction of policy. If Governments can achieve for their peoples adequate levels of food consumption, further progress, in no way less spectacular than that achieved during the nineteenth century, can be made in increasing the quantity and raising the quality of human life.

Logic and Empiricism

Actes du Congrès International de Philosophie scientifique, Sorbonne, Paris, 1935

1: Philosophie scientifique et empirisme logique. Pp. 81. 12 francs. 2: Unité de la science. Pp. 77. 12 francs. 3: Langage et pseudo-problèmes. Pp. 60. 10 francs. 4: Induction et probabilité. Pp. 65. 10 francs. 5: Logique et expérience. Pp. 80. 12 francs. 6: Philosophie des mathématiques. Pp. 85. 12 francs. 7: Logique. Pp. 73. 10 francs. 8: Histoire de la logique et de la philosophie scientifique. Pp. 92. 12 francs. (Actualités scientifiques et industrielles, 388-395.) (Paris: Hermann et Cie., 1936.)

SCIENTIFIC philosophy may be in a state of flux in its details, but there is one guiding principle which seems to give at least a unity of purpose to the numerous schools of thought which have made logic their chief interest. This principle requires that the reconstruction of our knowledge should be made on the basis of experience alone, free from anthropomorphic additions, and by means of a unified scientific language shaped out of logical syntax. Let it be said at once that few thinkers would dispute the fundamental importance of this principle, provided that it is interpreted in a liberal spirit. It seems, however, that the more vocal logicians of to-day deliberately restrict experience to sense-data alone,

thus leaving out those no less important aspects of experience which refer to moral, æsthetic, mystical and religious values. Without arguing the point as to whether it is possible or not to achieve a complete synthesis of our knowledge with these initial restrictions on the meaning and acceptance of experience, it can be admitted that this narrow interpretation of the guiding principle of scientific philosophy has aroused the enthusiasm of all those important thinkers who have adopted Russell's motto that logic is the great liberator of the mind. The Paris Congress of Scientific Philosophy is the first result of their intellectual crusade though some of its meetings were tempered by the presence of more traditional thinkers.

Unity of purpose, however, is not incompatible with difference of interests; and it is not one of the least remarkable aspects of the vitality of logic that it has developed in so many directions. The variety of the papers under review bear witness to this statement. Thus, the first fascicule devoted to "Philosophie scientifique et empirisme logique", contains a series of declarations of faith in logical empiricism by some leaders of the movement such as Russell, Frank, Reichenbach, Carnap, Neurath, Enriques, Morris, Wiesner, Chwistek, Kotarbinaki, Ajdukiewicz and Prof. Louis Rougier, who organized the Congress so ably and supervised the publication of the papers.

Most of them are inclined to think that speculative metaphysics does not even deserve the honour of a discussion, and they busy themselves with the organization of a "scientific empiricism which by doing justice to the three dimensions of meaning is able to unite the attitudes of formalism, pragmatism and traditional empiricism, and at the same time to give the promise of resolving the inadequacies which have beset previous forms of empiricism" (C. W. Morris, 1, 56). The elimination of idealism from mathematics as well as from other sciences is suggested by the use of the super-general science of 'semantics' (Chwistek, 1, 79).

The conditions of unifying the sciences and of illustrating their unity by means of an International Encyclopædia, are discussed in the second fascicule, "Unité de la science", in which, besides the able papers of representatives of the Vienna Circle, there is an important contribution by Lecomte du Noüy on the unity of the method of the physical and biological sciences, and an excellent discussion of the notion of 'type' by J. G. Hempel and P. Oppenheim. With regard to the International Encyclopædia, as originally conceived by O. Neurath, its purpose will be to show the 'structure' rather than the totality of our knowledge; and because of its purpose, it will have to make use of 'graphical representation' as an essential element of unification of our knowledge. The main conception and general plan of this International Encyclopædia have been approved by the Congress, which passed a resolution expressing its willingness to co-operate in the execution of the scheme, and appointed a special committee to discuss ways and means of unifying logical symbols. Semantics and linguistics are the subjects of the third fascicule, "Langage et pseudo-problèmes", which contains papers by Tarski, Padoa, Chevalley, Rougier, Vouillemin, Matiasse, Feigl and others. The accusation levelled by Rougier against Aristotelian logic, that it helps to create pseudo-problems rather than solve them, is more dogmatic than convincing. A direct reply to this charge is given in a paper by the present writer on the significance of logical symbols.

Two essential problems of logical theory are discussed in the fourth fascicule, "Induction et probabilité", by Reichenbach, Carnap, Schlick, Zawirski, Hosiasson and Finetti. The arguments, however, are rather one-sided, as they refer to Reichenbach's well-known doctrine of probability, and to the assimilation of probability with a plurivalent logic proposed by the Polish school. Though the debate of this dual problem would have gained if it were less restricted, the papers in this fascicule clarify many aspects of the esoteric teachings of logical empiricism.

The fifth fascicule, "Logique et expérience",

contains papers on definition and experience by Ajdukiewicz, Benjamin and Renaud, on the formalization of experience by Petiau, Destouches, Métadier, Habermann and Chwistek, and on protocol-judgments by Braithwaite, Rasmussen and Grelling. Most of the arguments refer to physical experiments rather than to physical experience under the influence of different types of causes and conditions. Owing to the paramount importance of experience in logical empiricism, it was legitimate to expect a fuller treatment of sense-data and of their integration in a unified system of knowledge.

The sixth and seventh fascicules deal respectively with "Philosophie des mathématiques" and with "Logique". This seems to point to a real division between mathematics and logic, a conception heretical to the Russellian tradition, but none the less true and widely accepted. It inspires most of the papers on mathematics and reality (Gonseth and Lautman), on the theory of groups (Juvet, Bouligand, Destouches), or the intuitionist logic (Mania, Jaskowski, Reymond, Becker and Schrecker), on logical syntax (Tarski, Helmer, Sperantia and Lindenbaum) and on mathematical logic (Bachman, Padoa, Bergmann and others). These papers carry further the process of clarification of mathematical logic which was initiated when flaws were discovered in the awe-inspiring and monumental "Principia Mathematica".

The historical aspect of the problems raised by logical empiricism is the subject of the eighth and last fascicule, "Histoire de la logique et de la philosophie scientifique". One will not find in it any elaborate considerations about the historical development of logic as a whole. With the exception of an essay by Jasnowski on the limitations of Greek mathematics, all the other papers (Scholz, Reymond, Bachmann, Padoa, Tegen, Ayer, Hollitscher, Zervos, Jørgensen, Frank and Heinemann) refer to the development of logical empiricism in the various countries of Europe, and to some particular aspects of the development of mathematical logic. As such they are very valuable. Ayer's paper on the analytic movement in British philosophy is particularly interesting, inasmuch as it explains some fundamental differences between this movement and the Continental developments of logical empiricism.

The importance of some of the technical results obtained by those who favour logical empiricism explains why this school of thought continues to attract much interest and controversy; and though logical empiricism has now lost the aggressiveness it showed at its earlier stages, it has still great vitality and real influence, which cannot be neglected in assessing the philosophical climate of our generation.

T. GREENWOOD.

A Survey of Organic Chemistry

Lehrbuch der Chemie

Von Prof. Walter Hückel. Teil 2: Organische Chemie. Pp. xvi + 602. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 18 gold marks.

THE author of a compact text-book of organic chemistry lays himself open to criticism because his selection of subject-matter can never meet with complete approval of other teachers and writers on the subject. Stressing fundamental principles and including only such descriptions of compounds as he deems necessary for the purpose of illustration, his work will probably be judged as lacking in subject-matter, a fact of which the author is fully conscious, realizing that, in its forty volumes, the present edition of Beilstein's "Handbuch" is still incomplete and when finished will only deal with the subject-matter of organic chemistry up to 1919. The literature of organic chemistry must be much greater than that of any other experimental science, and this literature takes little or no account of the vast amount of information obtained through detailed investigations by large industrial organizations. The rapid growth of this literature makes the writing of new text-books of organic chemistry increasingly difficult, and the justification of their publication should lie in the up-to-date treatment of classical organic chemistry and the careful choice of subject-matter to illustrate the general principles.

Prof. Hückel is not only an investigator but is also the author of the well-written "Theoretical Outlines of Organic Chemistry", of which the second edition appeared in 1934. To many British readers the present work will seem more old-fashioned than they would expect from him. On the other hand, the order of the subject-matter is different from that in many text-books, and few authors would discuss the alkaloids before the systematic treatment of stereochemistry and aromatic compounds.

Prof. Hückel has restricted the subject-matter of systematic organic chemistry to meet the first requirements of the general student and the large class of those who are required to possess a knowledge of organic chemistry as a medical science. He has omitted, for example, a number of the so-called classical syntheses, including those of quinine, isoquinoline and indole. From a biological point of view, it can be maintained that these are key substances the study of which the author might have included in a book to be used

by biology students even if other subjects had to be dealt with in less detail. Even urea, the synthesis of which marks the beginning of systematic organic chemistry and which might well form the starting-point of a modern course of lectures in the subject, has to be given a far too condensed treatment so as to provide space for much more 'spectacular' and highly complicated subjects.

The survey of organic chemistry given by Prof. Hückel is much more comprehensive than that usually given in a text-book of this type. There would appear to be justification for the inclusion of the good but necessarily brief accounts of the carotenes, vitamins and the hormones, including the sex hormones; but it may be doubted whether the student has gained sufficient knowledge from the previous hurried treatment of the simple and fundamental compounds to appreciate fully the complexities of this advanced work. The additional disadvantage lies in the fact that perhaps many readers will not realize that this is far from being a finished chapter in organic chemistry. Undoubtedly, the average student will find this book inspiring because the subject-matter is dealt with so broadly, although he may not realize at this stage that there are defects in the treatment of what he may have come to regard as the dry bones of the subject.

One unusual and interesting feature in this kind of book is the inclusion of short biographical notices in appropriately placed footnotes. It is perhaps natural that the great majority of these are of German chemists, and of British modern investigators Prof. Robert Robinson is the only one so distinguished. Without detracting from the work of organic chemists in other countries, it is rather remarkable that in this modern text-book there is no mention of the classical work of Sir William Pope or of Sir Arthur Harden in connexion with the development of our knowledge of stereochemistry and fermentation respectively. Omissions are not confined to the work of non-German investigators. The account of the reactions of aromatic diazo compounds is very brief and there is no mention of the well-known (Bart) reaction which now constitutes the method for the preparation of aromatic arsenical compound of various types of the highest importance as chemotherapeutical agents.

There are a few typographical errors, and the wrong formula for thyroxine may be one of these. It is much more serious as indicating a certain

lack of care in the compilation of the book that the crystal drawings of the enantiomorphous sodium ammonium tartrates reproduced by the author and evidently copied from older text-books have little relation to the crystalline forms of these

substances and may be described as representing crystal monstrosities. It is unfortunate that the author of a new text-book should be so uncritical as to reproduce what has long been known to be an error in older books. CHARLES S. GIBSON.

Religion and Medicine of a West African People

Religion and Medicine of Gã People

By M. J. Field. Pp. xi + 214 + 16 plates. (London : Oxford University Press, 1937.) 17s. 6d. net.

THERE is a charming feminine inconsistency between Miss Field's announcement that she refrained from studying anything that anyone else had ever written concerning the subject upon which her own researches were to be directed—her only lapse in this respect being the "perfunctory" perusal "eight years ago" of a work dealing with a neighbouring tribe—and her acknowledgement of advice and criticism from various experts in her particular subject.

The author may, however, have had in mind the example of certain anthropological students, who, having sat with reverence at the feet of some great master, the originator of a new school of thought, are so influenced by his teaching that they, perhaps unconsciously, find further proofs to back up—or to bolster up—those pet predilections of a beloved teacher. Modern youth, however, of both sexes, is now inclined to display independence, and the functionists, diffusionists and what-nots, need not be surprised to discover rebels in the ranks of former pupils. It is well that it should be so. There is no science where an open mind and freedom from preconceived ideas are more essential than in a study of mankind's primitive institutions.

The title of this eminently sympathetic and thorough piece of field work perhaps disarms one otherwise obvious criticism.

It deals—and only purports to deal—with "religion and medicine"; in anthropological parlance, the latter term is often synonymous with the former. Yet there will be many, besides the writer of this notice, who would have wished to know more of the origin of this interesting West African people. Their curious affinity in customs, in language, and most of all in their folk-lore, with their northern neighbours, the Twi-speaking tribes, is very marked. Miss Field states, for example, that the religious songs at a certain ceremony were in the forgotten "Obutu dialect", and adds that these were often "mere gibberish to both singers and hearers". In a footnote, however, she states that her informants insisted that this "gibberish"

was Twi, but she adds that could not be so, for it would mean that the particular custom was a late, not an early, cult. "Fleeting glimmers" such as this—to use Miss Field's own expression—make us all the more anxious to probe still further into the question how far the Gã have been influenced by their northern neighbours.

The book plunges straight away into an account of Gã gods and their servants. In the first paragraph is the arresting statement that the whole idea of the *fetish* is foreign to Gã worship. "The typical Gã high-priests," the author writes, "have no fetishes and are not fetish priests". There is, of course, now, every reason to believe that among the Twi and Ashanti, the indigenous cults were equally free from the influence of the *suman*. These Gã people of the lagoons and Atlantic free-board appear, in spite of centuries of contact with Europeans, to have retained, unchanged, certain primitive institutions which have been lost or become obscured among the inland tribes. This has perhaps been due to the greater wealth and rise of native kingdoms and warlike confederacies among the latter, which postulate external influences, in their case, from the north, that is, from the great inland kingdoms of Ghana and Melle.

Miss Field also refers to the survival of priest-kings, still faintly discernible in the Ashanti *Aase-wura* (master of the earth) and functioning more clearly in the Ashanti hinterland in the person of the *Tendana*. "Gã governments," she writes, "were originally absolute theocracies, and the only rulers were the priests". Scores of similar analogies rise before the reader who is familiar with the Twi-speaking and other Gold Coast peoples. It is to be hoped that the author will one day bring her scholarship to bear on the problems thus suggested.

This book is a model of what sympathy and painstaking research can achieve. It is, indeed, on books of the kind that the whole science of anthropology is being reconstructed. Those scientific investigators who cannot themselves embark on field work can wholly rely upon, and safely draw correct deductions from, such a work.

R. S. RATTRAY.

An Irish Pilgrimage

The Way that I Went:

an Irishman in Ireland. By Robert Lloyd Praeger. Pp. xiv + 394 + 39 plates. (Dublin: Hodges, Figgis and Co., Ltd.; London: Methuen and Co., Ltd., 1937.) 21s. net.

THE way that the author went was all over Ireland, often to little-known areas, especially when obtaining data for "Irish Topographical Botany", a book for the achievement of which students of distribution will remain permanently indebted to him. Of the present work, Dr. Praeger writes, "this is not a guide book—Heaven forbid." Yet it partakes in no small degree of both the virtues and defects of that type of literature. As in the conventional guide book, the only connecting theme is that of location, and this produces a certain inconsequence which renders the book easy to dip into at any point but less suited for continuous reading. Unlike the conventional guide book, the text is more concerned with the works of Nature than the works of man, and the reader who loves the countryside can here share the author's simple pleasures. The work is, in fact, a *pot pourri*, albeit an unusual and charming one, of facts and reminiscences concerning, *inter alia*, the topography, geology and natural history of Ireland.

Whether the author is writing of how the pied wagtails have learnt to appreciate the night-life of Dublin, of the sole Irish stations for the rock rose on the Carboniferous Limestone at Ballintra and

the cloudberry on the bogs of the Sperrin, of cliff scenery or the story of the rocks, all are presented with a personal touch that gains materially from the many parts that the author has himself played in the investigation of Ireland's wealth of natural interest.

Dr. Praeger pays a well-merited tribute to the value of natural history societies in general, and particularly to his personal debt to the Belfast Naturalists Field Club, which he joined at eleven years of age. His emphasis on the value of intensive studies of limited areas, which has proved so valuable elsewhere, is enforced by the data obtained during the Clare Island survey, which added no fewer than 2,000 species of organisms to the Irish lists and 109 animals and 11 plants which were new to science.

The work is clearly intended for the general reader, in deference to whom 'popular names' for animals and plants are mainly used, sometimes at the risk of ambiguity. Occasionally unexplained technical expressions are employed which may form a stumbling-block to a few, but there is little doubt that the intelligent traveller in Ireland will find in these pages much to open his eyes to the interest of his environment. The book is illustrated with a number of excellent photographic reproductions and text figures. It is unfortunate that one of the latter, purporting to represent "diatoms from Lough Neagh," should consist almost exclusively of figures of desmids. E. J. S.

Directive Evolution

The Evolution of the Australian Merino

By E. W. Cox. Pp. xxii + 160 + 31 plates. (Sydney and London: Angus and Robertson, Ltd., 1936.) 21s.

TO the student of evolution this history of the Australian merino will be of great interest, for it not only gives a narrative of the ways in which the breed was formed, but also seeks to analyse the factors responsible for its successful development.

After tracing the history from Spain, through England, France, Austria, Germany and United States to Australia, detailed accounts are given of the development of the main flocks and lines of blood in the various Australian States. In the later chapters dealing with the ways and means

of the evolution, geneticists will find much of interest.

The history of the Australian merino forms perhaps one of the best examples of the evolution of an animal directed by man towards a certain purpose—the production of large amounts of good quality wool. What directive evolution means can be gathered from the advice given to the prospective flock master, who "must visualize the type he wishes to attain and the wool it is to grow. That 'dream-sheep' must be kept before his mind at all times."

As an example of what has been achieved by this method, the average cut in 1800 was 4 lb. for a ewe and 7 lb. for a ram, while to-day almost

any of the great studs average more than 15 lb. for a ewe and more than 20 lb. for a ram—wool, too, of better quality.

Photographs of the champion rams each year from 1895 until 1936 show clearly the changes which have taken place in the body form of the Australian merino. Progress in the development of the body and in the constitution has been marked. The hardest improvement to obtain appears to have been to increase the length of the staple without loss of the other properties, but this has been done by the gradual process of selection. The success of the outstanding Peppin stock is attributed to the founder's idea of letting the sheep develop to suit the food and climate of the country. The failure of the Vermont stock from America, after their size had led to a craze for their importation, is attributed to a lack of suitability to environmental conditions.

It is concluded that breeders should preserve and utilize by inbreeding the outstanding qualities of every excellent animal: inbreeding is the most powerful tool available to the breeder. Inbreeding of a good strain makes it possible to produce superior animals more quickly than by any system of selecting and mating unrelated animals. The behaviour of strains when submitted to inbreeding is the surest test of their worth.

As to probable future developments, the author foresees breeding in much smaller flocks, and with this the danger of the loss of uniformity which is the feature where one man has directive control over large numbers of animals. A knowledge, too, is needed of the chemical nature of the food best suited to wool growth, for the best sheep are produced on the medium grass and salt bush country and not on the rich fattening areas.

J. H.

Science and Free Will

Free Will or Determinism

By Dr. M. Davidson. Pp. xv + 203. (London: Watts and Co., 1937.) 10s. 6d. net.

IN recent years experimental work in physics has led to theoretical conceptions which suggest that the movements of atoms and electrons are just as indeterminate as human action. Yet it is doubtful if Prof. Max Planck's quantum theory will rule out determinism for those who prefer, for logical or other reasons, to hold to that view. It has not made Dr. M. Davidson or Prof. H. Levy relinquish a strictly mechanistic view of Nature. Prof. Levy, for example, argues that those who maintain that recent physical research has exposed a fundamental indeterminacy in Nature must explain away the determinism that has been established on the large scale. On the other hand, Sir Arthur Eddington asserts that "Classical physics foists a determinate scheme on us by a trick; it smuggles the unknown future into the present, trusting that we shall not press an inquiry as to whether it has become any more knowable in that way". Perhaps the truth is that if one believes in free will for other reasons—the experience of volition, for example—one is thankful for the quantum theory as a crack in the fabric of the mechanistic view of Nature. Judicious leverage may, one hopes, make it wider. Hence the anxiety in some quarters to fill it with cement.

Perhaps the best line of attack on the mechanists

is not to look for cracks in their system, but to ask whether a strictly mechanistic view has not its difficulties too, though they can be easily ignored because they lie on the surface. Is it not now coming to be recognized that the method of science is, after all, realist, not nominalist (to use the scholastic terminology)? Does science not proceed on the theory that reason and logic have a reality of their own, even apart from particulars? In a word, is not science idealist (to use modern terminology)?

In his chapter on the mechanistic view of life, Dr. Davidson seems to end up on a note of some dubiety. For while he says that Loeb and his school have pushed the problem back a long way, he adds that it still remains unsolved, though it does seem that "some day the final word on vital phenomena may be spoken by the physicist". Then he observes that, "In the present state of our knowledge we can only endorse the words of Dr. Benjamin Moore: 'In the processes of cell reproduction and division there is a type of energy at work never found elsewhere than in living organisms'." But the late Dr. Moore's doctrine of a vital force was, from the mechanistic point of view, a heresy.

Dr. Davidson has provided a useful summary of arguments in favour of holding fast by the deterministic view, though he cannot be said to have contributed anything new to the solution of the problem.

J. C. H.

Science and Common Sense:

an Aristotelian Excursion. By W. R. Thompson. Pp. vii+234. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

DR. THOMPSON is a biologist of distinction whose published work is characterized by depth and originality. In this book he has departed from his usual field of observation and experiment and set himself the task of examining certain aspects of present-day scientific thought. He contends that some of the paradoxical statements made in connexion with physical theory would, in other circumstances, be regarded as contrary to logic and common sense. Biologists, he says, show signs of being imbued with this same mental attitude owing to the influence of mathematical physics.

Dr. Thompson's views are developed in some eight chapters, and perhaps the most significant are those concerned with the use and abuse of mathematics and of philosophy. The concluding chapter examines certain concepts of evolution. While the doctrine of evolution is a long way from being played out, it seems to have lost much of its interest, workers to-day tending to pursue matters more capable of experimental verification. Attempts to extract from the world as it now is have not yielded the true history of its past. Without the help of philosophy, the legitimacy of the principle of evolution would be impossible to uphold. The rejection of philosophical methods and principles would ultimately turn scientific work into a mere cinematographic record of events. With reference to mathematics and biology, the author stresses that the growing tendency to restate biological problems mathematically is beginning to produce "a kind of sublimation of biological facts into mathematical figments" which are commonly believed to be their equivalents. This practice, he observes, leads to quite fallacious notions about living things.

We commend Dr. Thompson's book as a critical and suggestive analysis: it aims at showing up in proper perspective some tendencies of modern scientific thought.

Zero to Eighty:

being my Lifetime Doings, Reflections and Inventions, also my Journey around the Moon. By Akkad Pseudoman (Dr. E. F. Northrup). Pp. xii+283+15 plates. (Princeton, N.J.: Scientific Publishing Co., 1937.) 3 dollars.

It may not be generally known that there is a British Interplanetary Society and an American Rocket Society, the members of which are heralding the dawn of interplanetary travel. In his volume "Rockets through Space", published last year, Mr. P. E. Cleator, president of the former, has given an account of the unsuccessful attempts which have been made to make a rocket leave the earth and visit other planets. Dr. E. F. Northrup, in "Zero to Eighty", is very much more likely to convince us that such methods will ever succeed, for he is at great pains to give us scientific chapter and verse for every event in his imaginary journey around the moon and back.

The story is told as an autobiography—the life inventions and reflections of a man of science, Dr Akkad Pseudoman, living from A.D. 1920 until 2000—and is claimed to present a reasonable scientific solution to the problem of escaping from the earth's gravitational attraction and navigating projectile-ships in celestial space. Dr. Northrup's projectile acquires its huge velocity by eddy-current thrust in a long coil of special design which is excited by three-phase current. It is steered by means of rockets.

Akkad Pseudoman has all manner of adventures. He has a Russian assistant, who is claimed by the Soviet Government when all his plans are ready and who organizes a rival flight. He is kidnapped and is rescued as a result of his wife's knowledge of chemistry. He makes a fortune and is able to found a School of Associative Science where science-philosophers are trained.

Dr. Northrup's book does not, it is true, provide the general reader with such delectable fare as does Jules Verne in "From the Earth to the Moon, and a Trip Round It"; but the scientific reader cannot fail to be interested in the technical argument, which is expounded with striking lucidity.

River Flow Records

By Capt. W. N. McClean. Series A: River Garry. Sheet No. 1. 1s. 6d. Sheet B: River Moriston. Sheet No. 1. 1s. 6d. Series C: River Ness. Sheets 1-14. In portfolio. 15s. (London: River Flow Records, 1937.)

THE hydrological activities of the private organization known as River Flow Records (director, Capt. W. N. McClean, Parliament Mansions, S.W.1) have been in evidence for some time, and the publications under notice represent the data accumulated over a period of several years in the basin of the River Ness, Inverness-shire. Records of the River Garry, one of the tributaries of the Ness, were instituted so far back as December 1912, and then, after a prolonged interval, were resumed in 1929 on the establishment of a water-level recorder at Invergarry, with fresh measurements of flow. The survey of the River Moriston, another tributary affluent, was instituted in 1929, following the rejection of the West Highland Water Power Scheme. In both cases, from July 1929 until March 1931, the records were issued quarterly in tabular form. In the present publication, they, and the complete set of records for the River Ness, are given in graphical form, based on the wider range of flow-gauging made since 1931.

It is obvious that these readings must be of great service to all who are concerned with the hydrology of the Ness Basin, as, indeed, to water engineers generally, and it is to be hoped that the organization will receive substantial public support from the purchase and circulation of these admirable charts, embodying, as they do, the results of prolonged and careful observation, carried out on scientific lines and rendered available in a compact and easily accessible form by the commendable enterprise of the undertaking.

B. O.

Air Ministry

Meteorological Office. *British Rainfall, 1936: the seventy-sixth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1936 as recorded by over 5,500 Observers in Great Britain and Ireland. (M.O. 415.)* Pp. xix+292. London: H.M. Stationery Office, 1937. 15s. net.

THE seventy-sixth volume of this valuable report on the year's rainfall contains the usual general table of returns from about 5,500 stations in the British Isles. In addition there are sections dealing with such special subjects as droughts, wet spells, duration of rainfall, heavy falls, monthly and seasonal rainfall, evaporation and percolation. From the foreword we learn that the revised system of classification of heavy falls in short periods, described last year in a special article by Mr. E. G. Bilham, has now been introduced. The main effect of the new scheme is to exclude many falls lasting only a few minutes from the 'noteworthy' category. It is also interesting to learn that the arrangements for charting rainfall month by month have now been so greatly improved that the charts prepared for the Monthly Weather Report are accepted, without substantial revision, for publication later in "British Rainfall".

Although the rainfall of 1936 exceeded the normal by nine per cent over England and Wales, there was a marked deficiency in Scotland, amounting to twenty per cent in the Western Highlands. In a special article by Dr. J. Glasspoole, details are given of the unprecedented deficiency of rain in western Scotland during the period November 1935 to June 1936. There is also a valuable article by Mr. L. C. W. Bonacina on the snowfall of the decade 1926-35.

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement. Lief. 6 (Band 2, Specialer Teil: Haupt-Teil 13-15). Pp. 783-942. (Den Haag: Dr. W. Junk, 1936.) 10 florins.

THE sixth part of this important supplement deals with the proteinases, in particular with tryptase, pepsinase, chymase (rennet) and also papainase: it follows the plan already indicated. Frequent use of the supplement confirms the opinions already expressed as to its utility and the clarity with which the great amount of information is presented. Sections dealing with the occurrence and distribution of these enzymes may be particularly cited for their completeness and value to the physiological chemist. Naturally, exact directions are given for the preparation of the crystalline enzymes, and one could have wished for some photographs of these crystals in order to bring home to the sceptics their beauty and the magnitude of the achievement.

Prof. Oppenheimer indicates that the completion of the supplement will occupy another year and a half, and he pleads for reprints of papers on enzymes to be sent to him so as to hasten and facilitate this reference to new work, a request which we recommend also to our readers. The address is: Berlin, W.15, Kurfürstendamm 61. E. F. A.

British Museum (Natural History)

Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2: Cretaceous. By Thomas Henry Withers. Pp. xiv+534+50 plates. (London: British Museum (Natural History), 1935.) 30s.

WHEN the first volume of this Catalogue was published in 1928, the earliest cirriped known was *Eolepas* from the Rhetic. A much earlier form has since been discovered in the middle Carboniferous of the Dones and Kusnetz Basins, U.S.S.R. This is a Lepadomorph barnacle, and it shows that the Cirripedia must already have been in existence for a long period, but gives no evidence of the origin of the group. Among many interesting points in phylogeny the author brings forward evidence to show that the three sub-orders of the sessile Cirripedes (the Brachylepadomorpha, the Verrucomorpha and the Balanomorpha) have been derived independently from a pedunculate stock. The Cirripedes show a great development in the Chalk, where nearly a hundred species and varieties are known, but there is an unaccountable imperfection of the record in the Lower Cretaceous deposits, in which only six species have been found; this makes it difficult to connect some of the Jurassic forms with those of the Cretaceous.

The introductory chapters deal with the history of research, phylogeny, ontogeny, distribution, etc. The main part of the work is a systematic account of all the known genera and species of Cretaceous Cirripedes. The reconstructions of some of the more important forms add greatly to the interest of this comprehensive work.

Design:

A Treatise on the Discovery of Form. By Percy E. Nobbs. Pp. ix+412. (London: Oxford University Press, 1937.) 30s. net.

THIS interesting work fills a gap in æsthetic theory, in so far as the discussion of the subject is developed by a practitioner from fact to principle. Many problems of mechanical, of psychological and of philosophical interest are involved in what seems to be the simple art of design. Illuminating suggestions are offered by the author for the solution of such problems, though he is careful not to commit himself to any particular school of thought. Gestures which seem to be innate for the artist, such as the use of scale and proportion, the materialization of ornament, the appreciation of colour and the realization of form, involve a series of elements which the author brings out and discusses with clarity and conviction.

It is in the third part of the book that the mutual process of discovering pure form is described by the consideration of a series of progressively complicated problems of accommodation. It is thus shown that the discovery of pure form is expression, but not art, and that the loss of purity in the form may be compensated for by its artistic elaboration, or by the incorporation with it of extraneous subject-matter by way of adornment. An excellent selection of illustrations gives an added emphasis to the æsthetic views put forward. T. G.

Nutrition and Health

TWO years ago the League of Nations set up a Mixed Committee on the Problem of Nutrition, consisting of agricultural, economic and health experts, and including representatives of the Advisory Committee on Social Questions, the International Labour Organisation and the International Institute of Agriculture. An interim report was published more than a year ago, in four volumes: the report proper, a report on the physiological bases of nutrition, and volumes entitled "Nutrition in Various Countries" and "Statistics of Food Production, Consumption and Prices", the latter being compiled by the International Institute of Agriculture, Rome. The interim report was devoted primarily to explaining the new conceptions which, in the opinion of scientific investigators, should govern human nutrition, to showing the effects of disregarding these rules, and to framing recommendations which might form the guiding principles of national nutrition policies. The economic and agricultural aspects of the problem, briefly referred to in the interim report, were reserved for further treatment, and the final report, which has now been published*, is primarily concerned with them.

The report is divided into three parts: the first, which has three chapters, describes the activities of the Mixed Committee and of other international bodies working on the problem of nutrition, outlines the general trend of progress in nutrition and public health during the past century, and finally summarizes the contents and conclusions, reproducing also the recommendations published in the interim report. The second part is devoted exclusively to the health aspect of nutrition, and reproduces, with such minor modifications as recent research has made necessary, the section of the interim report dealing with nutrition and health. The third part, which constitutes the bulk of the report, deals with the economic and agricultural aspects of the nutrition problem: in its seven chapters the recent tendencies in food-consumption habits and in agricultural production are traced, the problem of food prices and the role of income in determining nutritional levels are analysed, and the part which education can play in determining food habits is considered: finally, a chapter is devoted to showing that in spite of the gradual improvement in nutrition which has taken

place in recent decades, malnutrition still exist in all countries, even in those with the highest general plane of living. The report is mainly concerned with conditions in Europe and countries with a Western civilization, since the Committee found that it would not be possible, in the time at its disposal, to obtain adequate documentation of conditions in the Far East; the Health Organisation is, however, taking measures to promote a full consideration of the problem of nutrition in this part of the world.

The advance in our knowledge of the principles of correct nutrition makes it possible to lay down with some precision what is an adequate diet in different circumstances. The report divides food-stuffs into two classes: (1) the protective foods such as milk, glandular animal tissues, eggs, 'fat' fish, green vegetables and fresh fruit, which provide minerals, vitamins and 'good' (or animal) protein; and (2) the energy-bearing foods, such as fats, cereals and sugar. The basic figure for the energy requirement of the average adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work, is fixed at 2,400 calories net (that is, after deducting waste in cooking and at table) per day. It is suggested that 1,400 calories should be obtained from protective foods, and the use of highly milled cereals and an excessive amount of sugar in the diet is deprecated: special attention is directed to the value of the potato as a food rich in calories and in starch, which is particularly suited as a substitute for sugar and cereals in the modern European diet. Among the protective foods special emphasis is laid on the need for milk in the human dietary and on the value of fish liver oils as supplements for their content in vitamins A and D.

The report directs attention to the improvement in nutrition and public health during the past century, owing to the improvements in economic welfare and sanitation and to the advances in medical knowledge, and presents statistics to show that in all Western countries the average diet of the population has become increasingly diversified during recent decades, with a definite tendency, stronger in some countries than in others, but everywhere present, for the consumption of protective foods to increase, and for that of the purely energy-bearing foods, such as cereals and potatoes, to decrease. The changing content of the diet is not an accident: it corresponds to a genuine change both in physiological requirements and in the power to satisfy them.

* Nutrition. Final Report of the Mixed Committee of the League of Nations on the Relation of Nutrition to Health, Agriculture and Economic Policy. (Official No.: A. 13, 1937, II, A.) Pp. 327. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1937.) 7s. 6d.

The principal cause is the reduction in the expenditure of muscular energy, brought about by the increased mechanization of industry and agriculture and the reduction of the hours of work, and by the rise in the proportion of the population engaged in commerce, clerical work and other quasi-sedentary occupations. Simultaneously, mechanization has increased output per head and raised the purchasing power of all classes of the population. Nor must the improvements in the methods of production and distribution of agricultural products—for example, by the widespread use of refrigeration—be left out of account.

Although the diet of most Western countries has improved very considerably during the past twenty or thirty years, and consumption habits are tending to change along the right lines, yet the report adduces evidence that, even in those countries where the improvement in dietary habits has been most marked, the diet of a substantial proportion of the population remains deficient in essential nutritive elements. Reference is made to evidences of malnutrition, when the dietary needs of different classes of the population are considered, such as expectant and nursing mothers, infants, children and adolescents, as well as adults; whilst a special chapter at the end of the report gives statistical evidence for the statement that malnutrition still exists in countries of the most diverse social structure and stage of economic development. Such malnutrition need not result in the appearance of frank 'deficiency diseases' among the population; in fact, the report emphasizes that, although preventive action against such diseases as scurvy, rickets and beriberi is impressive, yet it is probably of less importance to the human race than the acquisition and application of such knowledge as will also improve the general condition and well-being of every man, woman and child, through the better choice, provision and utilization of foodstuffs.

Almost half the report is devoted to the effects of changing habits of food consumption upon agriculture and the economic aspects of the question of improving nutrition, including the relationship between food prices and consumption and factors affecting the former. It is pointed out that agriculture has had no difficulty in meeting the changes in food consumption which have occurred during the past few decades, and that the adjustments necessary in the future should not be impossible, although certain difficulties exist; moreover, the change in dietary habits to which the report looks forward will be steady and gradual. Although it is likely that the demand for the protective foods will rise, yet it is considered that a considerable increase in the consumption of foods of high energy value will be required to bring the

calorie content of the diet of certain sections of the population of a very large number of countries up to standards of adequacy. The increase in the demand for energy-bearing foods will more than counterbalance the decrease which accompanies an increased demand for protective foods. Also, as in the classical case of Denmark, a shift from exportation of cereals to dairying and animal husbandry need not mean a reduction in cereal cultivation; in fact, the output of cereals was increased owing to their demand for animal feed.

The obstacles in the way of adaptation of production to the new consumption trends are shown to be natural conditions, the conservatism of producers, commercial policy and penury of capital, as well as the perishable nature of many of the protective foods; wise and sympathetic consideration will overcome many of them. It is pointed out also that the contribution of agriculture to improved nutrition has not been merely adaptive only. The application of science to agriculture has produced a technical revolution parallel to, though less spectacular than, the industrial revolution. Mechanical processes have replaced hand-labour and the application of biological and chemical science has resulted in the improvement of both plants and animals or animal products used for food. Thus the breeding in Canada of Marquis wheat, which ripens early, has added 100 million acres to the potential wheat belt of Canada alone, by extending it northwards, and the annual milk yield per cow in most countries has been enormously increased. Even if, during the next five years, no further new discoveries were made but intensive national efforts were concentrated on securing the application of existing knowledge, the results on agricultural prosperity and nutritional standards would be enormous.

Turning now to the influence of food prices upon consumption, the report points out that the relationship varies in the case of different foodstuffs. Thus the demand for butter is elastic, consumption increasing markedly in recent years in countries where the price has been relatively low; in Great Britain during the years 1923-33, whatever the price prevailing, a rise or fall in the price of butter of 1d. per lb. decreased or increased demand by 39,000 cwt.; and a rise or fall in the price of cheese of 1d. per lb. similarly decreased or increased demand by 133,000 cwt. The 'elasticity', therefore (that is, relation of proportionate change in demand to proportionate change in price) was greater when consumption was low (and prices high) than when consumption was high (and prices low). In the case of milk, the response of consumption to changes in price has been found to be fairly low; and the same is also true of cereals. The demand for bread is inelastic, since the first

desire of the consumer is to satisfy his hunger ; and even though bread prices are kept high, bread generally still remains the cheapest way of doing this. Paying more for the bread he eats is equivalent to a reduction in the real income of the consumer, with the result that his purchases of the higher-priced protective foods are restricted, with consequent deterioration of the diet.

Evidence is adduced, in the chapter on the relation of income to nutrition, that usually the sources of 'good' protein and foods rich in minerals and vitamins are more expensive than the purely energy-bearing foods. This applies particularly to fruit, vegetables, meat, fish and eggs ; while dairy products—also 'highly' protective—occupy an intermediate position. These foods, though expensive as sources of calories, are relatively cheap as sources of minerals and vitamins ; their expense, however, militates against their consumption by the poorer sections of any community. With rising income, calories are purchased from more varied and expensive sources, which are usually more nutritive ; thus a steady increase in the percentage of both proteins and calories derived from animal sources has been found to accompany a rising income per consumption unit. The evidence for the existence of malnutrition in many countries is supplemented by studies of the cost of adequate diets, which

disclose the fact that the incomes of the poorer sections of the population are actually insufficient to provide their members with a minimum adequate diet.

Finally, the report gives consideration to method of improving nutrition ; it insists, in the first place that the problem must be recognized as one of primary national importance. It recommends the establishment in each country of National Nutrition Committees, containing scientific investigators, economists, agricultural experts, consumers' representatives, teachers and administrators, which would initiate investigations into the facts of nutrition, educate the consumers and make recommendations for improving the national diet. The report recommends the extension of social legislation for the protection and improvement of the health of the people, and directs attention to the value of school meals and to methods for increasing the consumption of milk. Policy must also be directed towards helping the orderly expansion of agriculture and its adaptation to the changing demand at the same time, attention must be given to improvement of transport and distribution, with the view of reducing the margin between the price received by the producer and that paid by the consumer. Adequate nutrition must be one of the factors considered by each country in determining its economic policy.

Investigation of the Upper Air

AT the Nottingham meeting of the British Association a discussion on the upper air which was held on the morning of September 6 was preceded by a demonstration of the ascent of a sounding balloon, organized by Prof. D. Brunt. The demonstration attracted the attention of large numbers of members of the Association, as well as of the general public. The balloon carried a Dines meteorograph, recording pressure, temperature and humidity at all stages of the ascent. The instrument was attached to the balloon by a Baker release, which consists of a small aneroid box with a catch capable of being set so that it is released from the balloon at any desired height. In the demonstration the catch was set to liberate the instruments at a height of about 12 kilometres.

The instruments were in fact released from a height of 12.3 km., and were found 4 miles east of Grantham and returned to Kew Observatory in good condition. The record of the meteorograph showed that the balloon had probably entered the stratosphere at a height of 12 km., where the

temperature was -55°C . The temperature fell steadily through the whole range of height attained except in a layer from $\frac{1}{2}$ to 1 km. above the ground where it increased by about 1°C . The record of humidity, which was probably only reliable in the lower half of the ascent, showed no features of particular interest. The general features of the temperature record agreed with those shown by the aeroplane ascent at Mildenhall on the same morning.

In the subsequent discussion in Section A Prof. D. Brunt explained the division of the atmosphere into troposphere and stratosphere, and explained why frequent measurements of temperature and humidity in the free air are of importance to the forecaster. The method demonstrated before the meeting has the disadvantage that days or even weeks may elapse before the record of the Dines meteorograph, or any other instrument sent up on a free balloon, is available for study. The alternative method of upper air observation which is in general use is

meteorological services is that of observing from an aeroplane. This method is expensive and is restricted to those days when it is possible for an aeroplane to fly. In consequence, efforts are now being made to develop wireless methods.

Mr. L. H. G. Dines, of Kew Observatory, described the meteorograph in greater detail, and showed a number of specimen records obtained by its use. On account of the lightness of the instrument, it can be sent up with any other instruments used for the investigation of conditions in the upper air.

Prof. K. O. Lange, of Blue Hill Observatory, Harvard University, described a wireless transmitter which has been developed at Blue Hill, for use on balloons in conjunction with a receiver at the ground. The transmitter sends out waves of constant frequency, and the aim of the designer of the instrument is to replace the measures of the meteorological elements by time intervals. The meteorological instruments are an aneroid, a bimetallic thermometer and a hygrometer. Each of these instruments is equipped with a pen arm, and these pen arms, together with a fixed pen, slide over a small cylinder on which is wound a fine platinum wire in the form of a helix. The helix and the pens are wired to the transmitter, and the cylinder on which the helix is wound is rotated by a clockwork which makes two revolutions per minute. The contacts of the fixed pen with the helix bring the transmitter into action at regular intervals of $\frac{1}{2}$ minute, while the pens attached to the meteorological instruments bring the transmitter into action at times which are determined by the readings of these instruments. The signals being recorded on the drum of a chronograph, the lags between the records given by the moveable pens and the fixed pen are readily estimated and converted into the readings of the corresponding meteorological element.

The instrument shown by Prof. Lange is extremely compact, being contained in a small wooden box, the external dimensions of which do not exceed 8 in. $\times$ 4 in. $\times$ 3 in. This method is now being adopted at some of the upper air stations in the United States, instead of the aeroplane ascents which have hitherto provided the data required for weather forecasting. It is likely that the same or similar instruments will be in general use in many parts of the world within a few years, in view of the saving of money, combined with the enormously increased frequency of observations, which will be obtained when this method supplants the aeroplane. The use of such instruments will open up the possibility of obtaining observations of the conditions in the central part of depressions and in other conditions when it is impossible for an aeroplane to make an ascent, as in rain or fog.

Prof. F. A. Paneth, in continuing the discussion, explained the methods by which he and Mr. Dines had obtained samples of air at high levels in the atmosphere, and showed some of the results of analysing these samples. The most interesting result so far obtained is the apparent increase in the proportion of helium present in air at levels of 25 km. and upward, indicating a tendency for the component gases of the atmosphere to separate out according to their molecular weights at such levels in the atmosphere. Further observations will be required before this can be accepted as conclusively proved. Prof. Paneth emphasized the importance of analysing samples of air from high levels for their water-vapour content. In view of the fact that nearly all the radiation and absorption of long-wave radiation in the atmosphere are produced by water vapour, it is of the greatest interest to meteorologists to know how much water vapour actually is present at high levels in the atmosphere. D. B.

The Percy Sladen Expedition to Lake Titicaca*

By H. C. Gilson, Leader of the Expedition

SINCE April 14, the day after the arrival of the main body at Puno, the Expedition has been established in a hacienda (Camjata) on the peninsula of Capachica, which bounds the north side of Puno Bay (see Fig. 1). The first fortnight was spent settling in, arranging laboratory

accommodation, and transporting all our numerous cases of apparatus and equipment out from Puno, a four-hour trip by motor launch. During this time a good deal of miscellaneous collecting was done in the ponds and streams of the peninsula, but it was not until the beginning of May that work on the lake could be started in earnest. Since then routine hydrographical and chemical observations

* See also the article by Prof. J. Stanley Gardiner in NATURE of Feb. 27, 1937, p. 353.

are a diatom and a colonial green alga resembling *Dictyosphaerium*. The latter is abundant at all depths down to 50 metres; the diatom is found alive down to 15 metres, but below this there are only dead shells. The less common forms show an interesting vertical distribution. Thus from 10 to 20 metres *Lagerheimia* sp. (Chlorococcales) and *Thlamydomonas* sp. occur; from 20 to 30 metres *Oocystis* sp. (Chlorococcales) is found and *Peridinium* sp. in small numbers; from 30 to 40 metres the *Peridinium* is common with *Staurastrum* sp. (Desmidiaceae); from 40 to 50 metres there is little alive except the *Dictyosphaerium* and *Peridinium*.

Round the shores the rooted vegetation varies considerably with depth, exposure and type of bottom. In all sheltered places where the depth is between 1 and 4 metres, such as the major part of Puno Bay, there is a thick growth of "tortora" (*Scirpus riparius*). Underneath this and elsewhere is a mixed smaller vegetation which shows a marked zonation with depth. Thus in moderate shelter from 0.2 to 0.5 metre *Zannichellia* sp. is dominant; from 0.5 to 8 metres there is a mixed vegetation of *Potamogeton*, *Elodea* and *Myriophyllum*; from 8 to 13.5 metres *Chara* sp. is dominant; from 13.5 to 17 metres this is replaced by a moss. With greater exposure the zones tend to be shifted downwards, perhaps owing to the harder bottom and consequently clearer water found there.

The fauna of the lake is rich in individuals, but species are not numerous. No Isopoda, Neuroptera, Plecoptera, Hydrometridae or Gerridae have been found.

In the "tortora" swamp occur *Notonecta* and the water beetles *Agabus* and *Trophisternus*. The same species of these genera are also present in ponds near the lake. In the belt of low-growing weeds which fringes the shores down to a depth of about 10 metres, the most abundant animals are several species of *Hyalella* (Amphipoda) and *Littoridina* (Mollusca). Besides these, *Turbellaria*, *Oligochaeta*, *Platyphius* (a ramshorn snail), *Ancylus* (a freshwater limpet), *Pisidium*, *Sphaerium*, leeches, water mites, Corixidae and the larvae of caddis flies, Chironomidae and dryopid beetles are usually found. A green sponge is common, growing on plant stems. A similar fauna is present in the shallow lagoons near the north end of the lake.

On bare stony bottoms *Hyalella* is dominant, as many as 1,500 having been counted to the square foot. Below the 10-metre line the bottom is usually muddy and contains *Platyphius* and *Hyalella* (different species from those in the weed), *Pisidium*, leeches, chironomid larvae and sponges.

There are in the lake a number of species of

Orestias (a Cyprinoid fish), a large catfish, and an aquatic frog (*Cyclorhamphus*). The catfish is also found in the larger rivers which run into the lake, and in these it is fished commercially.

In the smaller streams near the lake and the headwaters of the rivers are numerous beetles, larvae of dragonflies and mayflies, *Planorbis*, *Sphaerium* and *Hyalella*. The same species of *Planorbis* has been found near Cuzco in the Amazon basin; and the same, or a closely related, species of *Hyalella* as far down as Quillobamba

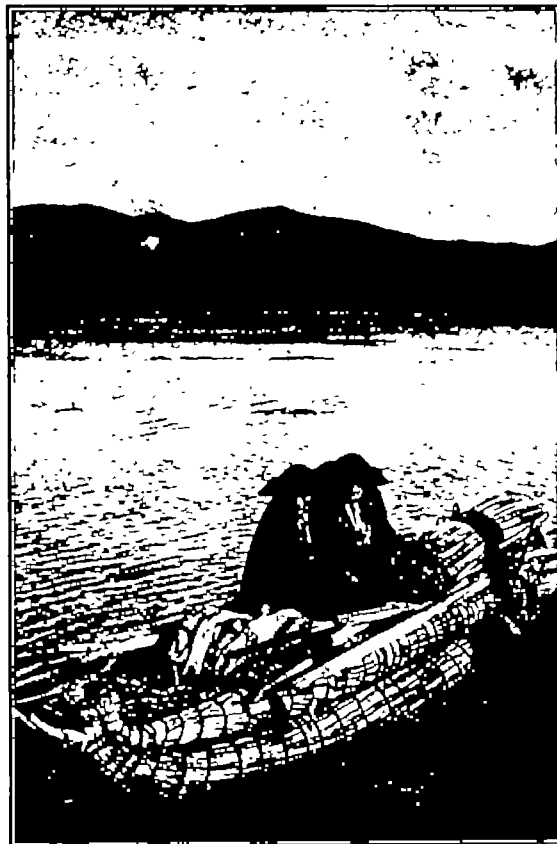


Fig. 3.

NATIVE BOAT WITH WOMEN WEARING A TYPE OF HAT COMMON IN COUNTRY DISTRICTS NEAR LAKE TITICACA.

(3,800 feet) in the Amazon basin, as well as at San Antonio (15,500 feet) in the Pacific drainage area. In some of the temporary ponds near our base a species of *Esteria* (Conchostraca) was abundant until they dried up.

Besides the field work, the results of which are very briefly summarized above, a good deal of laboratory work has also been done. Hinton has worked out the life-histories of nearly all the important insects, besides making extensive collections of the terrestrial insect fauna. Collections have also been made of many of the birds and their parasites.

I am much indebted to all my colleagues for their wholehearted co-operation in all the work of the Expedition and for much of the information contained in this article. We are also indebted to Señor Carlos Landaeta B. for allowing us to

use the Hacienda Camjata as our base, and to the officials of the Peruvian Corporation in Puno and Arequipa for arranging our food supplies and helping us in innumerable other ways. We gratefully acknowledge the help thus afforded the Expedition

Obituary Notices

Prof. Frank Morley

FRANK MORLEY, professor emeritus of mathematics at Johns Hopkins University, died at Baltimore on October 17. He was born in 1860 at Woodbridge in Suffolk, and was educated at Woodbridge School until he went into residence at Cambridge in 1879, having won an open scholarship at King's College. His university career was sorely hampered by illness. He did not graduate until 1884, a year later than the normal date, eighth in the list when G. B. Mathews was senior wrangler and A. N. Whitehead fifth. Ill-health beyond all doubt had prevented him from doing himself justice, but the disappointment was keen. In middle life he was loth to speak of his student days, yet the friendships then formed with Lower Dickinson and others were lasting. It is saddening to contrast the conditions of sixty years ago with the encouragement and the opportunities that are offered to a clever boy to-day.

For three years after leaving Cambridge, Morley was a master at Bath College. Then, by the good offices of Dr. Rendel Harris, Morley (whose parents were Quakers) became professor at the Quaker College of Haverford, Pa. From then onwards his home was in America. The hardships of his earlier years were behind him; his health no longer caused him anxiety, though he was always cautious; he married, feeling that his position was assured, and lived in Haverford for twelve years, years of great happiness, during which his powers and his reputation steadily increased. His closest mathematical associations were with two Cambridge professors at the neighbouring college of Bryn Mawr, Charlotte Scott from Girton College, one of the foremost of the younger geometers, and James Harkness of Trinity College, who collaborated with him in his first book, a treatise on the theory of functions published in 1893, and reissued six years later in a shortened and much improved form as an introduction to that subject.

In 1900, Frank Morley accepted the professorship of mathematics at Johns Hopkins University, Baltimore; this he held until he reached the age of retirement nearly thirty years later. His election to this famous chair, always associated in Britain with the name of J. J. Sylvester, was an honour that could scarcely be surpassed. Other honours were bestowed upon him as the years passed by; they will not be catalogued here. He filled his high office and performed its duties with dignity and distinction.

At Johns Hopkins the work was more onerous and the responsibilities were greater than at Haverford; it is not unreasonable to feel regret that Morley's output of original papers was thereby lessened, for it is in these that his most characteristic work is to be found. As a boy and a young man Morley had shown exceptional promise as a chess player; throughout his life he could grasp the possibilities of a position at chess or of a hand at cards with astonishing ease and certainty. He had something of the same power in discussing a geometrical configuration, for he proved, not once but many times, that he could penetrate more deeply into its inner significance than the rest of us.

There can be no doubt that the life Prof. Morley loved best was the quiet life of the student, a simple home life with friends near at hand. His elevation to the prominence of the professorship at Johns Hopkins University was a well-deserved honour, but whether it added to his happiness is doubtful. He never allowed himself to lose touch with England; it was his habit to come in alternate years, but after his retirement in 1928 he came every year; always if possible making a stay at both Woodbridge and Cambridge. A few years ago he was stricken with a serious illness while at sea on the way to England and never wholly recovered his strength. This year he had a heart attack at sea while returning to America, and died peacefully soon after reaching his home at Baltimore.

Prof. Morley leaves a widow and three sons, all of whom were Rhodes scholars at Oxford.

HERBERT W. RICHMOND.

Prof. H. Jacobi

THE death is reported of Prof. Hermann Jacobi emeritus professor of Sanskrit in the University of Bonn, which took place at Bonn on October 20 at the age of eighty-seven years.

Jacobi's early researches relating to Indian culture and religion dealt with the then little understood cult of Jainism. When quite a young man he accompanied Dr. Buhler, who was a member of the Bombay Educational Service, to Jaisalmer and other centres of Jain learning. He then made a profound study of the cult; and in consequence it was he who was mainly instrumental in securing the recognition in Europe and America of Jainism as an important religious system quite independent of Buddhism, of

which it was then supposed erroneously to be a mere offshoot. His translation of the Jain Sutras appeared in the Sacred Books of the East edited by Max Müller; and in 1879 he published an edition of the Kalpa Sutra, the recognized manual of the community, with an English introduction. He also edited three important Prakrit texts, which appeared at intervals between 1883 and 1923 in the "Bibliotheca Indica". He was the first to give Apabhramsa texts, which mark the transition from Prakrit to modern languages. His collection of Jain tales (1930) is in general use as a text-book. In 1913 Jacobi revisited India to lecture before the University of Calcutta on Indian rhetoric. His reception by Jain pandits on that occasion not only threw open to him material usually not accessible to foreigners, but also manifested the high esteem in which he was held in the Jain community.

Jacobi's contributions to Sanskrit learning were no less important and covered a wide field, including the study of the Indian doctrine of poetics, the Ramayana and Mahabharata, to which he is the most authoritative guide, and Indian chronology, a subject in which his studies in the *Indian Antiquary* of 1888 and *Epigraphica Indica* of 1892, with further articles published two years later, are the fundamental calculations for all later work. In comparative philology he developed important theories as regards the characteristics of certain Asiatic languages as compared with the Indo-European group. He was also an authority of the first rank on Indian philosophy, an important study being "The Origin of Buddhism from the Sankhya Yoga" (1896).

Jacobi's eminence as an Oriental scholar was recognized on the occasion of his seventy-fifth birthday, on February 11, 1925, when he was the recipient of a volume of contributions from forty-seven prominent Orientalists, among whom Britain was represented by Sir George Grierson, Dr. F. W. Thomas and Prof. R. L. Turner.

Mr. A. B. Brewster

We regret to record the death of Mr. A. B. Brewster, formerly Governor's Commissioner of Colo, North and East Fiji, which took place at Bath on October 13 at the age of eighty-two years.

Adolph Brewster Brewster was born in Melbourne and educated in England. On his return to Australia, with his father in 1870 he took up a land grant in Fiji from the Polynesian Company, which had acquired a large concession of land around Suva from King Cakobau (Thakombau). On the failure of his venture in cotton and sugar planting, he entered the Fijian Civil Service in 1884, and served until his retirement in 1910.

Later, as Governor's Commissioner of the mountain provinces of Vitilevu, Brewster acquired an intimate and sympathetic knowledge of the wild mountaineers and their customs, of which he gave a vivid and detailed account in his book "The Hill Tribes of Fiji". He was also the author of "King of the Cannibal Islands", which appeared recently. It was through

a letter written by him to *The Times* that the war club presented to Queen Victoria by King Cakobau was returned to Fiji in 1932 to serve as the mace of the Legislative Council. A further service to Fijian studies, for which posterity will be grateful, was the compilation of a manuscript record of a native version of the organization of Fijian society, which was undertaken at his request by a native clerk, preserving a tradition which otherwise would have died out.

Mrs. F. L. Griffith

We regret to record the death of Mrs. Griffith, widow of the late Francis L. Griffith, professor of Egyptology in the University of Oxford, which took place at Oxford on October 21 at the age of sixty-four years. Mrs. Griffith became interested in Egyptology after a visit to Egypt in 1906, and studied under Prof. Griffith, whom she married in 1909. From that time onward she was closely associated with her husband in his archaeological and linguistic studies, and accompanied him on his expeditions of archaeological investigation in Egypt, Nubia and the Sudan in 1910-13, 1923, 1929 and 1930. After his death in 1934, she devoted herself to superintending and herself working at the numerous undertakings which he had planned, but had left uncompleted. She had already published two volumes of the "Demotic Graffiti in the Dodecanese", of which the seventy plates were prepared by herself. She also actively supported by the expenditure of time and money the further excavations at Firkas and Kawa in the Sudan in connexion with the Oxford Excavations in Nubia, a trust which had been founded by her husband in 1910.

Mr. HERBERT WILLIAM ENGLAND, who died at the age of fifty-five years on October 30, had for nearly forty years been in charge of the departmental library of the Zoological Department of the British Museum (Natural History). Mr. England possessed an unrivalled knowledge of zoological literature and will be greatly missed by the many zoologists at whose disposal his knowledge and his ability in tracing obscure references were freely placed. He entered the Museum service as a boy attendant in February 1898 and attained the rank of higher grade technical assistant in 1932. Among his colleagues his kindly, helpful and generous character was well known, and the high regard in which he was held in the Museum is illustrated by the fact that he was one of the three recipients among the Museum staff of the King's Coronation Medal.

We regret to announce the following deaths:

Sir Joseph Isherwood, Bt., who devised the longitudinal framing method for the construction of cargo boats and tankers, on October 24, aged sixty-seven years.

Prof. J. B. Sanderens, *correspondant* of the Section of Chemistry of the Paris Academy of Sciences and honorary fellow of the Chemical Society, aged eighty-one years.

News and Views

Nobel Prize for Physics

THE formulation of de Broglie's wave-particle theory in 1924 and its experimental verification in 1927 by Dr. C. J. Davisson at New York and Prof. G. P. Thomson at Aberdeen mark an outstanding epoch in the history of physics. With the award of the Nobel Prize for Physics for 1937 to Dr. Davisson and Prof. Thomson just announced, all three are now in the select ranks of Nobel prize winners. The scattering of an electron beam was first studied by Campbell Swinton so far back as 1899, and had it not been for the fact that he used a polycrystalline instead of a single crystal reflecting surface, he might well have discovered the wave-like interaction of electrons with matter. The results of the many further observations on the scattering of electrons were all found to be in accordance with classical or quantum mechanics until, in 1921, Davisson and Kunsman recorded directions of preferential scattering of an electron beam from a polycrystalline surface which, however, they explained in terms of pure particle mechanics. Although L. de Broglie had formulated his theory associating wave systems with moving particles in 1924, it appears to have been rather the stimulus of an accidental observation which led C. J. Davisson and L. H. Germer to study the scattering of slow electrons from the surface of a single nickel crystal, and in March 1927 they gave a preliminary summary of their results. This was followed in December of the same year by a more complete account, which established for the first time the wave properties of moving electrons, in agreement with de Broglie's theory.

MEANWHILE, in Aberdeen, G. P. Thomson and the late A. Reid, unaware of Davisson and Germer's experiments, had been studying the scattering of fast electrons by thin films, and in May 1927 they published an account of the diffraction of cathode rays by a thin film of celluloid, illustrated by a photographic record of the distribution of the scattered electrons. It is interesting to note that here again, although he was acquainted with de Broglie's theory, it was not so much this as certain anomalous results relating to the scattering of electrons in helium observed by Dymond, and Thomson's own experiments on the scattering of positive rays in gases, which afforded the main stimulus to the carrying out of his experiments. Shortly afterwards, Thomson published the results of further experiments on the diffraction of fast electrons by thin metal films which quantitatively confirmed de Broglie's relationship. Since 1928, Davisson and Thomson have, with their respective collaborators, greatly extended their epoch-making researches, and to Thomson is due the merit of having early recognized the outstanding possibilities in the study of surface problems of electron diffraction by fast electrons with photographic

recording of the scattering angles. To-day the electric diffraction camera ranks with the microscope, the spectrograph and X-rays as an indispensable unit in the well-equipped chemical or physical laboratory.

Nobel Prize for Chemistry

Prof. W. N. Haworth, of Birmingham, and Prof. Paul Karrer, of Zurich, have been awarded jointly the Nobel Prize for Chemistry for 1937. Prof. Haworth is Director of the Chemistry Laboratories of the University of Birmingham, now provided with the most modern chemistry department in Great Britain through a generous benefactor who has recognized the value and possibilities of Prof. Haworth's investigations. He is a Davy medallist of the Royal Society and Longstaff medallist of the Chemical Society. For many years his name has been associated with outstanding results obtained in his laboratories in the elucidation by chemical and physical methods of the constitution of substances of biochemical importance, particularly the sugars and polysaccharides and, more recently, as the notice of the award indicates, with the synthesis and determination of the constitution of the antiscorbutic vitamin C to which he assigned the name of ascorbic acid. With this later work, other names are also associated, particularly those of Prof. A. Szent-Györgyi, who has received the Nobel Prize for Medicine, and Prof. E. L. Hirst, of Bristol, who has long been associated with Prof. Haworth. Prof. Haworth's name will remain outstanding in classical organic chemistry. The success of his work is due in no small measure to his great ability in organizing and leading a team of loyal collaborators, which call forth qualities as necessary in modern chemical investigations as those required for carrying out the investigations themselves. Of this loyal collaboration Prof. Haworth has never ceased to express his appreciation whenever he has had occasion to describe the results of investigations in laboratories of which he has had charge.

Prof. Paul Karrer has published many papers on vitamins A and B and related compounds; he also confirmed the constitution ascribed to ascorbic acid by Szent-Györgyi. Karrer is perhaps best known for his investigations on the carotinoids, of which β -carotene acts as the chief precursor of vitamin A in the animal body, although α - and γ -carotene and cryptoxanthine can also act as pro-vitamins to a certain extent. More recently he has turned his attention to vitamin B₂ and the chemistry of the flavins, one of which, lactoflavin, is a part of the complex originally described as vitamin B₆, and also a part of the yellow oxidizing enzyme, in which, as the phosphate, it appears to be combined with the colloidal carrier of the enzyme. Finally, in one of his most recent papers, he and Solomon describe the

isolation of some new sterols from the unsaponifiable matter of wheat-germ oil by fractionation by adsorption on a column of aluminium oxide; the fraction of unsaponifiable matter used was assumed to contain vitamin E.

Prof. Charles Fabry, For.Mem.R.S.

ARTHE fifty years devoted to teaching and research, Prof. Charles Fabry is retiring from the chair he has held in the Sorbonne, Paris. In his scientific career, Prof. Ch. Fabry has been pre-eminent for his work in optics. His interferometric work, with his determination (with Pérot and Benoit) of the length of the standard metre in wave-lengths of the monochromatic radiation of cadmium, has long been classical. His studies on the spectrum of the iron arc, his pioneer work on the mercury arc lamp, and on the application of interferometry to spectroscopic research must also be recalled. To a somewhat later period belong his researches in photometry and astrophysics. The microphotometer he designed with Prof. H. Buisson, and his studies on photographic density also represent pioneer work in a field which has since seen a wide development along the lines he predicted. During recent years, Prof. Fabry's interest has turned towards meteorological optics. Under his direction, researches on the composition of the upper atmosphere and its ozone content are being carried on by a group of his pupils. Soon after the Great War, Prof. Fabry founded in Paris the Institut d'Optique, of which he is still director. The activity of this institution has been devoted to industrial optics as well as to scientific investigation, to teaching and to the designing of optical parts as well as to research. The *Revue d'Optique*, also founded by Prof. Fabry, is published by the Institut d'Optique.

PROF. FABRY is also a brilliant writer and a lecturer of no ordinary skill. His text-books on electricity, thermodynamics, photometry, written in an exceptionally lucid style, are classics in the French universities. As a lecturer he was, at the Sorbonne, unrivalled; generations of students have listened to his witty and genial lectures and marvelled at the clarity and directness of his exposition. He is also well known in English-speaking scientific circles and is a foreign member of the Royal Society. He has delivered the Guthrie Lecture and Thomas Young Oration before the Physical Society; he is an honorary member of many scientific bodies, and recently has been elected president of the International Council of Scientific Unions. The scientific jubilee of Prof. Fabry will be celebrated by a meeting to be held at the Sorbonne some time between November 23 and December 5, and the committee dealing with the arrangements has also approved the design of a Fabry Jubilee Medal, a 'replica' of which can be obtained from the Secretary and Treasurer of the Committee, Prof. G. A. Boutry, Conservatoire des Arts et Métiers, 292 rue St.-Martin, Paris (3ème). It is also hoped to be able to publish in volume form some of Prof. Fabry's works, selected from his classical memoirs and from his unprinted researches.

Dr. Eric Ashby

DR. ERIC ASHBY, reader in botany in the University of Bristol since 1935, has been appointed to the chair of botany in the University of Sydney, Australia, in succession to Prof. T. G. B. Osborn. After leaving the City of London School, Dr. Ashby entered the Imperial College of Science in 1923, graduating in 1925. From this time dates the origin of his original investigations, which have been pursued steadily along two main lines: a quantitative study of the effects of the environmental factors and their interactions on the growth of *Lemna*, and the analysis of hybrid vigour. Papers on both these topics have appeared in the *Annals of Botany*. In 1929 he secured a Commonwealth fellowship and widened his scientific outlook by two years work in the United States. Shortly after his return he was awarded the D.Sc. of the University of London. Dr. Ashby has played a prominent part in the development of a quantitative ecology and has surveyed this subject in botanical reviews. His highly individual view on the nature of heterosis has aroused general interest if not general approbation. His point of view is succinctly expressed in a contribution to the Royal Society on the theory of heterosis. Dr. Ashby has served botanical science in various capacities on the councils of the Linnean and Ecological Societies, and as the joint secretary of the Society of Experimental Biologists. His great talents and enterprise have gained due recognition in securing at the early age of thirty-three years an appointment of such distinction.

Geological Society: Foreign Fellows and Correspondents

AT its meeting on November 3, the Geological Society of London elected as Foreign Fellows, Dr. W. A. J. M. van Waterschoot van der Gracht, Dr. W. J. Jongmans, Dr. A. Renier, and Dr. F. E. Wright, and as Foreign Correspondents, Prof. N. L. Bowen, Prof. R. M. Field, Baron F. von Huene, and Prof. H. Stille. Dr. W. A. J. M. van Waterschoot van der Gracht, of Heerlen, has made important contributions to our knowledge of the underground geology of the Netherlands, and has also published papers on economic geology, including coal and petroleum. More recently he has devoted attention to tectonic geology with special reference to North America. His review of the theory of continental drift formed the introduction to a symposium on that subject which was published by the American Association of Petroleum Geologists. He was director of the Rijksopsporing van Delfstoffen until 1917, and has been a Fellow of the Geological Society of London since 1898. Dr. W. J. Jongmans, director of the Geological Bureau of the Netherlands at Heerlen, has added much to the knowledge of Carboniferous stratigraphy. His publications on Carboniferous plants are well known, particularly those dealing with the genus *Calamites*. He is editor of the botanical section of *Fossilium Catalogus*, and was responsible for the volumes in that series dealing with the Equisetales and Lycopodiales. Dr. A. Renier, director of the Geological Survey of Belgium, has

also made numerous contributions to the stratigraphy and palaeontology of the Carboniferous rocks, particularly of Belgium. His published works deal with, among other subjects, fossil plants, coal resources and tectonics. Dr. F. E. Wright of the Geophysical Laboratory, Carnegie Institution, Washington, has investigated the optical properties of minerals, including variations due to changes of temperature. He has also written on the petrological microscope and the surface features of the moon.

COMING to the new Foreign Correspondents, Prof. N. L. Bowen, of Chicago, formerly a member of the staff of the Geophysical Laboratory, Washington, is an authority on the crystallization of magmas and the evolution of igneous rocks. His work is widely known, and has had considerable influence in Great Britain. Prof. R. M. Field, of Princeton University, has carried out researches upon marine sediments, particularly of the West Indies, and has described the geology of the Bahamas. He has also compared the Ordovician succession in Great Britain and America. Baron F. von Huene, professor in the University of Tübingen, is well known for his studies of fossil reptiles, particularly those of the Trias and Lias. He has described forms from Central Europe, South Africa, North and South America, India, and Great Britain. His larger works include monographs on the dinosaurs and ichthyosaurs. Prof. H. Stille, of Berlin, is the author of numerous papers on the geology of Westphalia, Hanover and other parts of Germany, many of them dealing with the Cretaceous system. He has also made a special study of tectonic geology, both in its broader aspects and in relation to particular areas, such as the western Mediterranean.

The Royal Veterinary College and Hospital

THEIR MAJESTIES THE KING AND QUEEN opened on November 9 the new buildings of the Royal Veterinary College, Great College Street, Camden Town, London, N.W.1. A brochure issued to commemorate this event gives a brief history of the College, and an account of its reconstruction, with a description of the new buildings and of the work that will be carried on in them. The brochure is sumptuously produced, and is illustrated with a portrait of Charles Vial de St. Bel, the first principal (1791-93), as frontispiece, three views of the old College buildings, and a plan of the reconstructed College with views of some of its chief features. The old College has been demolished, and the new College block is rectangular in shape, with projecting wings facing Great College Street, the various departments being grouped around two internal courts separated by a central assembly hall. The Beaumont Hospital for Sick Animals and the Canine Hospital are situated to the west, and the Pathological Museum and Pathological Research Institute to the east, of the main block. Behind the Canine block are a reception stable, harness room, garage and workshop. Along the north-east boundary is the Ride in which horses are tested for soundness, horse-boxes, stores and

quarters for attendants. The post-mortem building with cold store, preparation room and laboratories adjoins the Ride. Future extensions planned when funds permit are the Large Animals' Hospital and a field station.

Society of Glass Technology: Twenty-first Anniversary

THE Society of Glass Technology began a two day anniversary meeting on November 9 to celebrate its Coming of Age. The proceedings opened with a luncheon that was attended by the vice-chancellor of the University of Sheffield and Mrs. Pickard Cambridge, Mrs. F. Wood, Lord Cozens-Hardy, Mr. Geoffrey Pilkington, Mr. W. L. Chance and many other prominent glass manufacturers. In addition, the Society had as its guests four foreign delegates from the Continent, namely, Prof. A. J. de Artigas (Spain), Prof. G. Keppeler (Germany), Dr. B. Long (France) and Dr. H. Maurach (Germany). Of the eighteen original members who still retain their connexion with the Society, thirteen attended. The toast of the Society was proposed by Dr. A. W. Pickard-Cambridge who spoke of the good effect of such scientific societies internationally and said he looked forward to a time when the University could do more toward developing the artistic side. He concluded by thanking the Society for its generosity in promising to contribute £2,500 towards the Elmfield Fund. The toast was supported by Prof. Keppeler (representing the Deutsche Glastechnische Gesellschaft) and Mr. S. B. Bagley, president of the Glass Manufacturers Federation.

In the evening the presidential address to the Society was given by Prof. W. E. S. Turner, who reviewed the progress in the glass industry during the past twenty-one years. He showed how the development of machine methods, for which we have largely to thank America, has resulted everywhere in the displacement of skilled labour, so that the craftsman has been fighting a losing battle. On the following day a number of technical papers were read. The morning session was opened by the reading of congratulatory messages from members and friends from Germany, Belgium, Denmark, Italy, United States, Canada, and Africa, after which the status of honorary fellow of the Society was conferred upon Dr. H. Maurach of the Deutsche Glastechnische Gesellschaft (Germany) and Dr. Ross C. Purdy of the American Ceramic Society. Dr. Maurach, who with Prof. G. Keppeler represented the German Society then presented a congratulatory address, after he and a number of ordinary fellows had signed the roll. The address was contained in a magnificently engraved cylinder of glass mounted in silver at the ends the work of Prof. von Riff of Stuttgart, and was enclosed in a casket.

New Buildings for Glass Research at Sheffield

ON Tuesday, November 9, a ceremony having an element of novelty took place in connexion with the new buildings at present being erected for the Department of Glass Technology of the University of Sheffield. This was the laying of a foundation

block made of glass, weighing approximately four hundredweight. Mr. Geoffrey Pilkington, of Messrs. Pilkington Bros. Ltd., who cast the block, performed the ceremony in the presence of a distinguished gathering of civic and university authorities and prominent glass manufacturers. He said that he thought he must be the first to lay such a block, and referred to the considerable technical difficulties involved in its manufacture. Immediately previous to the laying of the block, Prof. W. F. S. Turner placed a glass casket containing appropriate records in a cavity in a wall of the building. He said, however, that as the Glass Research Delegacy was quite sure that the list of donors to the Building Fund enclosed was not yet complete, it was not proposed to seal either the casket or the cavity as yet. The pro-chancellor of the University, Lieut.-Colonel Sir Henry Stephenson, sketched the development of the Department from its birth in 1916, and Mr. Bagley, chairman of the Glass Delegacy, announced that of the sum required for the operations, only a further £7,000 now remains to be raised.

FOLLOWING the laying of the foundation 'stone' for the new buildings, the Wood Memorial Library was declared open by Mr. Bagley who, after a prayer of dedication from the Bishop of Sheffield, spoke in moving terms of the work of the late Mr. Frank Wood for the Department of Glass Technology, through the Glass Research Delegacy, of which he was chairman from 1923 until his death in 1934. A beautiful memorial window in stained glass executed by Messrs. James Powell and Sons to the design of Mr. J. Hogan, was then unveiled by Mr. Haslam Wood, son of Mr. Frank Wood. A portrait of Mr. Wood in the centre is supported on the left by scenes illustrating glass manufacture and on the right by others showing research and control. Above are the shields of the Universities of Leeds, London and Sheffield, with a glass furnace below them.

Sir Aurel Stein in Southern Persia

SIR AUREL STEIN described his latest and final journey of archaeological reconnaissance in southern Persia before the Royal Asiatic Society and the Royal Central Asian Society on November 11. In recording his farewell to Iran, Sir Aurel mentioned that in five years he had covered close on five thousand miles on camel, horse and foot—a considerable achievement for any explorer, in view of the difficulties of climate, country and the dangers of tribal interference, but for a veteran past his eightieth year a feat of remarkable endurance. This last expedition, taking up its work where the expedition of exploration in Fars had come to an end in 1934, started from Shiraz in November 1935 and lasted until the autumn of 1936. Its itinerary included the plateau of Ardakhan, the Bakhtiari Mountains, Susa, the Saimarah River, to which four months was devoted, the little explored Pish-i-koh portion of Luristan, Kermanshah, the high mountain valleys of Persian Kurdistan, where an attempt to reach the border was unsuccessful, and the province of Urumiyeh,

where in the country between Zagros and the salt Lake Urumiyeh, prehistoric remains in the form of mounds, both great and small, far exceeded in numbers any encountered in previous stages of the journey. Here burials in abundance belonging to the second millennium B.C. were found; but difficulties of labour, of which the supply was permanently depleted during the Great War, prevented any extensive investigation. The expedition came to an end at an interesting point, when the reconnaissance was being carried out in the valleys leading down from Kermanshah to the Mesopotamian plains. Orders from Teheran, due to the possibility of difficulties with the tribes, and the incipient illness of the leader, prevented the completion of the programme as planned. Sir Aurel, however, has no ground for dissatisfaction in what had been accomplished. A notable tale of archaeological discoveries of every period from prehistoric to early Mohammedan has been added to his laurels.

Archaeological Exploration in Arabia

MR. H. ST. JOHN PHILBY opened up an attractive vista for archaeological exploration in an account of his recent journey through Arabia before the Royal Geographical Society on November 15, when he suggested that the Sheban country might be the original homeland of the Phenicians whose place of origin has not yet been determined. In the summer and autumn of last year Mr. Philby traversed Arabia from north to south, from the Mediterranean to the Indian Ocean, a journey of which there is no previous record, although he himself considers that it may have been a route followed at times in the days of the old spice trade. To the archaeologist, the most interesting part of Mr. Philby's lecture dealt with his visit to the ancient Himyaritic capital of Shabwa, where, however, he found no evidence to support Pliny's statement, if the identification of that writer's Sabota with Shabwa be accepted, that it had contained sixty temples. The remains of one outstanding temple of supreme magnificence was found, with two ruin heaps within the walls, which one day may be found to contain temples. At the same time there is a possibility, in Mr. Philby's view, that Pliny may have been referring to the whole district of the 'two Shebas', which might well have possessed sixty temples in the days of its prosperity. In the heart of the desert two necropolises were discovered, forty miles away from the nearest wells to-day. Here there were thousands of circular tombs built up of untrimmed slabs of local limestone. The largest tomb was ten feet high and twenty-five feet in diameter. All the tombs had been rifled of their contents and in no instance was evidence of human burial discovered. Judging from the inscriptions, these tombs date from Himyaritic times or earlier. Similarities with cemeteries at Bahrain and in the central Arabian provinces point to Phenician affinities; while certain signs among the inscriptions and rock engravings seem to stand half-way between pictographs and letters, recalling the reputed relation of the Phenicians with the origins of the alphabet.

Problems of Soil Erosion

For his Friday evening discourse at the Royal Institution, on November 12, Sir Daniel Hall took as his subject "Soil Erosion: the Growth of the Desert in Africa and Elsewhere". Soil, far from being stable, is easily set in motion by wind or rain if the cover of vegetation and the binding supplied by its roots and humus are unduly disturbed. Deforestation about the headwaters of the streams, followed by grazing by goats which prevent natural regeneration, has brought about the denudation of the hillsides in Levantine countries, has turned the river valleys into malarious swamps and choked the harbours at their mouths. Of recent years the duststorms that have swept across the United States represent the removal of the fertile soil from farming land west of the Mississippi, in many cases to such an extent as to cause the abandonment of the farms. It is not so much agriculture that is to blame, as the continuation of a wasteful system of farming and the breaking up of the sod on soils only fit for regulated grazing. Such wind destruction extends into Canada and has become serious in parts of Saskatchewan and Alberta.

In Africa the problems of erosion by washing are becoming insistent. The native forms of agriculture are wasteful and depend upon moving on to fresh land every few years. With the growth of population that has followed the Pax Britannica, land is becoming insufficient for shifting cultivation, giving rise to land hunger and political unrest. Still more destructive is the custom, among the Bantu tribes in particular, of maintaining excessive numbers of cattle, sheep and goats, which are not used for food. Live-stock has increased far beyond the capacity of the grazing grounds, and, with overstocking, erosion sets in. So far from affording opportunities for colonization, much of the best land in East Africa is rapidly wasting and leaving its inhabitants under a growing threat of famine. Sir Daniel exhibited photographs of the remedial measures that are being adopted, but it will be necessary to interfere somewhat drastically with tribal customs before the natives can be taught to practise a system of agriculture that will maintain the fertility of the land and allow of continuous production. Considerable expenditure is probably required in order to implement British trusteeship for the inhabitants of Africa who are now destroying their means of existence.

Kashmir Earthquake of November 14

AN earthquake of some strength occurred on the afternoon of November 14 in north-western India, especially in the province of Kashmir. That it attained semi-destructive intensity (degree I of the Milne scale) is clear from the slight damage that occurred at Srinagar, Abbottabad, and other places. The earthquake is of interest chiefly from its association with more violent shocks in the same province. Within little more than a century, two earthquakes of Milne's highest order of intensity (III) visited Kashmir, one in 1828, the other in 1885. Another, of intensity II, occurred on December 4, 1885, in the district around Chamba (about 150 miles south-

east of Srinagar), and two others, of about the same intensity as the recent shock, in that near Srinagar on August 28, 1916, and January 20, 1931. Of these earthquakes, by far the most interesting is that of May 30, 1885, studied by Mr. E. J. Jones, of the Geological Survey of India, whose brief report is published in the *Records of the Survey* (18, 221-227). In the small meizoseismal area of this earthquake, containing about 47 square miles, the destruction of villages was complete and about 3,000 persons were killed. The next isoseismal includes Srinagar near its east end, and within it large portions of the towns and villages were thrown down. Abbottabad lies a short distance to the west of this isoseismal. Thus, it would seem that the origin of the recent shock may have been connected somewhat closely with that of its much stronger predecessor in 1885.

Benefaction to Edinburgh Astronomical Association

THE Edinburgh Astronomical Association will shortly be in possession of about £25,000 under the will of the late Mr. J. H. Lorimer, the well-known artist. Mr. Lorimer had been a member of the Association since 1924, when the first general meeting of the Association was called. He served for a time as a member of council some years ago and later was elected vice-president. He was much interested in astronomy and in the Association, and regularly attended the Association's meetings. The Association has always had plans for development, but has been hampered in the past by the small income available. Now that this is to be much increased, the council is considering which in particular of the many possible schemes will best use the money for the benefit of astronomy. As yet the only decision made is to extend the Association's library. The objects behind further decisions are likely to be: to advance the science of astronomy and promote astronomical research, to circulate information on astronomical matters by publication and generally to encourage astronomical study and to increase popular interest in the science. Negotiations are being conducted with the view of using the Edinburgh City Observatory for research and education. This Observatory has not been in use since the death of the City Astronomer, Mr. J. McD. Field, in April of this year.

Physical Fitness of University Students

THE University authorities at Leeds have introduced a scheme of medical examination and advice which should be of considerable assistance to students in the maintenance of their health while they are at the University. The scheme is on an entirely voluntary basis, but there is reason to think that it will be used extensively. A certain number of medical practitioners, resident in different parts of Leeds, are co-operating with the University for this purpose. A student who registers under the scheme (paying a nominal fee of half a crown) is entitled to go to one of these doctors, at his own choice, for examination and advice. The scheme is not intended to provide medical treatment for students, but rather to help them to avoid the necessity for treatment. In the past, members of the staff have always been ready

to advise and help students when any questions have arisen in regard to their health; the new scheme, however, by providing a simple form of machinery, will encourage students, whatever their present condition of health, to satisfy themselves of their physical fitness or be advised in good time of the measures they should take to become fit. Consideration is also being given by the authorities to the possibility of extending the facilities for physical training at the University. The students are naturally watching with keen interest these developments, which are taking place in consultation with the Union Committee.

Agricultural Marketing Policy

UNDER this head, Mr. A. N. Duckham, research officer to the Bacon Development Board, made a weighty contribution to the discussion on "State Intervention in Agriculture", which was held in Section M at the British Association meeting in Nottingham. In his view, recent marketing legislation is the offspring of the researches and inventions associated with the names of Liebig, Mendel, Faraday, Pasteur and others, and of the necessity for rectifying the imbalance between agriculture and manufacturing industries. The protective measures adopted by the marketing boards have helped to save British agriculture from chaos by reducing, through price stabilization, the speculative nature and insecurity of 40-50 per cent of home production, and by prompting improvements in agricultural business methods. Other beneficent activities of the boards have been the laying down of minimum quality standards, the standardizing of trade practices, and the institution of good market-intelligence services. Equally important have been the provisions made for controlling competition, for example, by limiting the number of sugar-beet factories, creameries, bacon factories, potato merchants and cattle markets. The savings effected by cutting out surplus capacity and operating the remainder at full load should, it is stated, reduce the price spread between farmer and consumer; and farmers should benefit by the practice of collective bargaining, which is one of the main objects of the Marketing Acts. A noteworthy feature of current policy is the statutory attempt to influence demand by 'consumption steering', that is, by means of differential prices and subsidies to consumers, by education, habit-changing and direct publicity. So far very little has been done in this direction, but, in the author's view, the success of current marketing policy will be largely governed by steering consumption more vigorously towards the produce of British soil. Planning and State intervention have come to stay, and their prospective effect will be to ensure stability of quality, supply and price.

Development of the Glasshouse Industry

A SERIES of papers delivered before Section M (Agriculture) of the British Association at Nottingham on September 6 dealt with the history and present-day practice of the growth of crops under glass. Mr. H. V. Taylor first indicated trends in the technique of plant forcing, from the early use of the cloche,

through the employment of frames and greenhouses, to the modern Dutch lights and 'aeroplans' tomato houses. Dr. W. F. Bewley spoke upon "Science in Relation to the Glasshouse Industry". He showed how the increase in intensity of crop forcing, and the growth of produce out of its normal season, brings new problems of disease and of nutrition. Many examples of how these troubles have been overcome by the Cheshunt Research Station were given. Some of the investigations, as the work of Lloyd on control of the tomato moth caterpillar, and that of Speyer upon the control of white fly, are now classical, and the newer research maintains the high standard. A most welcome link with practice was provided by Mr. F. A. Secrett's paper on "The Production of Early Vegetables and Salads under Glass". The need for vegetables quickly grown on good soil, as a contribution to national health, was stressed. A suitable light soil, adequately manured, and a site with security of tenure and adequate water supply, are the first essentials. Heavy capital costs and labour charges are incurred, but Mr. Secrett's practical demonstration of commercial success is even more eloquent than his illuminating paper.

Fire-Immune Cable

A FACTORY, opened by Lord Ridley on October 12, for making fire-resisting cable called 'Pyrotanax', marks a new development which promises to be of far-reaching importance to the electrical industry. The insulating cover utilizes a new insulating material, magnesium oxide, the heat-resisting and other physical properties of which have been proved in connexion with boiling-plate elements, which are made of resistance wire embedded in the oxide. 'Pyrotanax' cable has a copper conductor, magnesia insulation, and copper sheath. The new technique enables continuous runs of this cable up to 300 yards to be produced. A piece of cable in series with a burning lamp can be hammered to the thickness of a sixpence without affecting the light. It is therefore mechanically robust. For all practical purposes the cable is immune from fire and would not contribute anything to a possible conflagration. Notable use has been made of 'Pyrotanax' cable in France. The Louvre, the *Normandie*, the *Galerie Lafayette* and the French railways use it. In Great Britain it has been adopted for the new lighting equipment of the Tate Gallery and for several industrial installations. The 'Pyrotanax' factory is practically 'all-electric' throughout, electric furnaces being used for all the annealing stages and for the dehydration of the magnesium oxide insulation. The rating of these furnaces is 250 kilowatts, and their temperature is controlled by a Cambridge thermostatic instrument. The factory is situated at Hedgely Road, Hebburn-on-Tyne. A full illustrated account appeared in the *Electrical Times* of October 21.

Electrical Accidents and their Causes

IN a pamphlet issued by the Home Office (London: H.M. Stationery Office, 1937, 6d.) and written by H. W. Swann, H.M. Inspector of Factories, a report of electrical accidents for the year 1936 is given. The

report deals not only with accidents that have actually occurred but also with the large-scale methods for preventing danger and damage which have been discussed with the electrical industry. The total number of fatal accidents reported, 112, is satisfactorily small, and comparing it with previous years it indicates no marked variation from a steady mean. The variations in the numbers reflect the periods of industrial activity and depression. It is noted that there has been an increase in the number of accidents to male persons less than twenty-one years of age during the last five years. A feature of the electrical accidents is the large percentage (55 per cent) in which the injury was due to burns alone. Joining of metal by arc welding is rapidly becoming popular. Practically all the welding accidents (57) are cases of conjunctivitis (eye-flash) and none of them was fatal. Stress is very properly laid on the provision of suitable goggles for workers liable to be exposed to radiations from the arcs.

Vehicle Tests on Motor Roads

HIGHWAY engineers are interested in tests recently made by the German road authorities on the comparative efficiencies of motor roads and ordinary roads. An abstract of a paper on the subject is given in *Roads and Road Construction* of August. The results of the driving efficiencies obtained in two approximately parallel roads joining Bruchsal to Bad Nauheim, a distance of about 91 miles, are given. One of these was an *autobahn* road and the other a State road specially constructed for long-distance journeys which had been greatly improved during the last four years. The latter road was comparable in layout and surface condition with a Class I road in Great Britain. The tests were made with an ordinary high-powered car. On the State road, the journey took $2\frac{1}{2}$ hours at an average speed of 44 miles per hour. On the motor road it took $1\frac{1}{2}$ hours at an average speed of 74 m.p.h.; on the State road the average speed was only 56 per cent of the maximum speed of the car; on the motor road it was 92 per cent. On a second journey undertaken on the motor road at the same average speed as that attained on the ordinary road, the petrol consumption dropped from 5.5 to 3.1 gallons. Considering that on the ordinary road 351 cars were met and 158 overtaken, exclusive of bicycles and pedestrians, the feeling of safety is much greater on the motor road as there are no oncoming cars to avoid. The tests were made with a 3.21 Mercedes car. It is concluded that on the motor road you always arrive quicker at your destination than is possible on the ordinary road and consume less fuel. On this road also the safety is greater and the stress to which the driver and car are subjected is much less. Further experimental results are to be carried out on speed trials with other cars.

Kelvin and the Atomic Theory

IN his tribute to Lord Rutherford in *NATURE* of October 6, Prof. A. S. Eve states that Lord Kelvin died in unbelief of Rutherford's atomic theory. Mr. C. Turnbull, 21 Percy Park, Tynemouth, North-

umberland, has pointed out that this is incorrect. In his presidential address to the Physical Society (January 1936), Lord Rayleigh (p. 221) states that Kelvin argued emphatically with Rutherford and himself against the atomic origin of the energy. Rayleigh asked him to make a bet of five shillings that within three (or six) months he would admit that Rutherford was right. Within the allotted period Kelvin came round, and at the British Association he made a public pronouncement in favour of the internal origin of the energy of radium. He also produced the five shillings in settlement of the bet.

Announcements

THE Right Hon. Lord Riverdale has been appointed chairman of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research in succession to the late the Right Hon. Lord Rutherford of Nelson. Sir William H. Bragg has been appointed a member of the Advisory Council.

THE following have been elected as officers of the Cambridge Philosophical Society for 1937-38: *President*: Sir F. Gowland Hopkins. *Vice-Presidents*: Dr. O. G. Darwin, Mr. F. P. White, Prof. J. Gray. *Treasurer*: Dr. J. D. Cockcroft. *Secretaries*: Mr. A. H. Wilson, Dr. O. M. B. Bulman, Mr. J. A. Ratcliffe. *New Members of the Council*: Dr. N. Feather, Dr. C. F. A. Pantin, Mr. E. N. Willmer.

At the anniversary meeting of the Mineralogical Society held on November 4, the following officers were elected: *President*: Dr. L. J. Spencer; *Vice-Presidents*: Prof. P. G. H. Boswell and Prof. C. E. Tilley; *Treasurer*: Mr. F. N. Ashcroft; *General Secretary*: Lieut.-Colonel W. Campbell Smith; *Foreign Secretary*: Prof. A. Hutcheson; *Editor of the Journal*, Dr. L. J. Spencer.

At 6.57 p.m. (G.M.T.) on November 16, Flying Officer Clouston and Mrs. Kirby-Green arrived at Capetown from London, having flown the distance in 45 hours 2 minutes. The route taken was through Cairo, Khartoum, Broken Hill and Johannesburg. They have thus beaten the record set up by Miss Amy Johnson by 33 hours 23 minutes.

FOR the first time in history, a medical man in the person of Dr. Roussy, dean of the Paris medical faculty and well known for his researches on the nervous system, endocrinology and cancer, has been elected rector of the University of Paris.

THE Francis B. Garvan Gold Medal established by the American Chemical Society to honour outstanding women chemists has been awarded to Dr. Emma R. Carr, head of the Mount Holyoke Department of Chemistry. Dr. E. Bright Wilson, jun., assistant professor at Harvard University, has received the one thousand dollar award from the Society for his experimental work in physical chemistry.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 897.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Kinetics of Polymerization

A RECENT paper¹ on the kinetics of gaseous polymerization reactions appears to lead to some doubts concerning the interpretation of experiments in the liquid phase. It is now found that gaseous styrene is stable at temperatures up to 400° C., a result which seems inconsistent with the published data on the rate of polymerization of liquid styrene. The results of Schulz and Husemann² can be expressed by means of a unimolecular constant, given by

$$k_1 = 1.1 \times 10^7 e^{-21,000/RT} \text{ sec.}^{-1},$$

while Sues, Pilch and Rudorfer³ find a bimolecular constant,

$$k_2 = 2.5 \times 10^6 e^{-21,000/RT} \text{ mol./l./sec.}$$

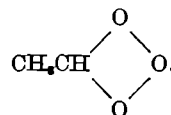
Further, Wassermann⁴ has shown that the rates of a number of diene additions are the same in the gas phase and in solution, so that we can with some confidence employ the expressions above to calculate the rate of the gaseous polymerization.

At sufficiently high temperatures, the reverse process of depolymerization will become sufficiently important to mask the forward reaction. According to Blyth and Hofmann⁵, polystyrene is depolymerized on heating above 300° C., and up to this temperature the above formula should therefore hold. The calculated half-lives for the reaction at 300° C. and atmospheric pressure are 6 sec. and 46 min., and it is clear that there is a very large discrepancy between these figures and the results of Kistiakowsky. It is suggested in explanation that the liquid phase results refer to a catalysed reaction, the catalyst being in all probability a peroxide which may initiate chains by the formation of a complex⁶.

Definite evidence has been obtained that this is the case for vinyl acetate, which Kistiakowsky also found to be stable up to 380° C. in the gas phase. Starkweather and Taylor⁷ found that the polymerization of liquid vinyl acetate at 101° C. could be represented by a first order constant, $k = 5.0 \times 10^{-3} \text{ min.}^{-1}$. Breitenbach and Raff⁸ were unable to obtain consistent results in glass vessels, and Breitenbach⁹ has attributed this difficulty to the presence of traces of moisture which react with the alkali of the glass to give sodium hydroxide. When the ester was dry, Breitenbach found that its rate of polymerization at 98° C. was only one hundredth of that found by Starkweather and Taylor. We have found that pure vinyl acetate does not polymerize measurably at 100° C., and believe the rates measured by the former authors to be due to the presence of peroxides.

Commercial vinyl acetate may contain a small amount of acetaldehyde¹⁰ which in the presence of air

forms a peroxide, probably of the formula



Samples of vinyl acetate capable of polymerizing at 100° C. always gave a peroxide test, and the rate and extent of polymerization were found to be associated with the amount of peroxide present. It is perhaps significant that this substance can be eliminated by distillation with an efficient fractionating column but is by no means completely removed by careful vacuum distillation. It is probable that the role of the sodium hydroxide produced when the ester is moist is to saponify some of the vinyl acetate yielding vinyl alcohol, which is tautomeric with acetaldehyde. We may note further that aldehyde-free vinyl acetate does not polymerize at 100° C. even in the presence of oxygen: samples were shaken with air or oxygen for two weeks but remained stable when afterwards heated to 100° C. Identical results were obtained from supplies of vinyl acetate from two sources.

The study of the initiation of polymerization by aldehydes and oxygen is being continued and fuller details will be published in due course.

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¹ Harkness, Kistiakowsky and Mears, *J. Chem. Phys.*, **5**, 682 (1937).

² Schulz and Husemann, *Z. phys. Chem.*, **36**, B, 194 (1937).

³ Sues, Pilch and Rudorfer, *Z. phys. Chem.*, **179**, A, 361 (1937).

⁴ Wassermann, *Farad. Soc.*, General Discussion, September, 1937.

⁵ Blyth and Hofmann, *Ann.*, **53**, 315 (1845).

⁶ Gee and Rideal, *Trans. Farad. Soc.*, **32**, 666 (1936).

⁷ Starkweather and Taylor, *J. Amer. Chem. Soc.*, **52**, 4708 (1930).

⁸ Breitenbach and Raff, *Ber.*, **66**, 1107 (1933).

⁹ Breitenbach, *Z. Elektrochem.*, **43**, 323 (1937).

¹⁰ Blakie and Crozier, *Ind. Eng. Chem.*, **26**, 1155 (1934).

Phase Transformation in Locusts in the Field

In 1921 Uvarov¹ enunciated the 'phase theory' to account for the swarming of locusts, a theory which postulated post-embryonic divergences in the pigmentation, structure and behaviour of members of the same species. This theory has since been proved by field observations and by experiment to be correct in a number of locust species, and in breeding experiments the changes were found to be due to the density of population of locusts².

The question which has so far remained unanswered, however, is how the individuals of a population of solitary locusts in the field, less numerous than gregarious locusts, and without the 'gregarious instinct' of the latter, could encounter one another with sufficient frequency to bring about the change of the phase *solitaria* through *congregans* to *gregaria*. My investigations of the behaviour of the solitary phase of *Schistocerca gregaria* Forsk., on the Red Sea coast of the Sudan during last winter, have thrown some light on the mechanism by which this transformation occurs in the field.

For various reasons, the solitary 'hoppers' of the 4th and 5th instars tend to concentrate into patches of dense but uneven vegetation, which is usually unweeded millet cultivation. One of the most



Fig. 1.

A 'BASKING-PLACE' OF SOLITARY LOCUSTS AMONG UNWEEDED MILLET CULTIVATION. A THERMOMETER WITH BULB EXPOSED TO THE SUN (APPEARING AS A WHITE LINE), AND A SMALL SCREEN SHADING ANOTHER THERMOMETER AND AN EDNEY PAPER HYGROMETER (TO THE LEFT OF THE FIRST THERMOMETER), ARE LYING ON THE BARE SAND OF THE 'BASKING-PLACE'.

interesting reasons for this is the existence of a visual attraction to the millet stands (probably perceived as dark objects), which I was able to demonstrate experimentally. Within the 'concentration zones' the absence of wind permits the sun's radiation, in conjunction with vegetation of very uneven height (Fig. 1), to produce a close 'patchwork' of different temperatures, humidities and light intensities. Small patches of bare ground, such as that shown in Fig. 1, constitute the warmest and driest situations available. Solitary hoppers are not as inactive as formerly supposed, and at certain times of day

they form loose basking groups on the bare patches. I was able to demonstrate that the formation of such groups must largely be attributed to the separate reactions of each individual to the temperature stimulus, as presented in the 'patchwork'. Without any gregarious instinct, the solitary hoppers are forced into association, simply because their numbers are large in relation to the number of bare patches available in the vicinity. This crowding of hoppers may have the same effects as breeding in densely populated cages, namely, changes in coloration, morphology and in the inter-reactions of individuals, so that the bare patches may be regarded as the birth-places of gregariousness, for without them the change of phase would probably be impossible, however numerous the locusts became.

It was also found that gregarious hoppers, whose cohesion in bands is maintained by some form of inter-attraction which is perhaps visual, were too active to remain together on the bare patches, so that the bands tended to break up in unweeded cultivation. Such vegetation is, therefore, on one hand indispensable to the production of phase *gregaria*, but on the other hand, fatal to the continued existence of this phase. The survival of the hopper bands and adult swarms of this phase is only made possible by their 'breaking out' of the environment which has engendered them.

Another interesting result, partly of field observations and partly of rough experiments, was that the direct relation between activity and temperature in temperature-adapted hoppers, is reversed in hoppers not adapted to temperature. Over a certain range, temperature-adapted hoppers are, of course, more active at higher than at lower temperatures, but the effect of sudden increase of body temperature is temporarily to depress activity, while sudden temperature decrease temporarily accelerates activity. This principle may have much wider applications.

A detailed account of these investigations will be published elsewhere.

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Bull. Entom. Res., 12, 135-163 (1921).

* Faure, *Bull. Entom. Res.*, 23, 293-406 (1932).

Nomenclature of the Seasons

ONE frequently hears it said that the swallow passes the winter in South Africa, though a moment's reflection shows that it is summer in South Africa when the swallow is there. There appear to be no words for times of year, longer than a calendar month, applying to the whole world. Again, when one is trying to analyse periodic phenomena among organisms in the tropics, one is continually hampered by the lack of words denoting the seasons; for spring, summer, autumn and winter are meaningless near the equator. One may speak of the rainy and dry season or seasons, but the periods are often ill-defined. If one extends the words for the temperate seasons into the tropics, one cannot escape such absurdities as saying that in south-west Ceylon the winter is the hottest season. Such considerations as these have driven me, despite an aversion from all unnecessary complications of nomenclature, to suggest a series of eight new words.

Each of the first four words is applicable (like a calendar month) to the whole world at the same date:

Boredune. March 22–June 21 (approximately): the time when the sun is in the northern hemisphere and going towards (δύνα) the north (βόρρα).

Borepheuge. June 22–September 21: the time when the sun is in the northern hemisphere and going away from (φεύγειν) the north.

Notodune. September 22–December 21: the time when the sun is in the southern hemisphere and going towards the south (νότος).

Notopheuge. December 22–March 21: the time when the sun is in the southern hemisphere and going away from the south.

These words make possible such succinct statements as the following. The swallow breeds in Europe in the boredune and borepheuge and passes most of the notodune and notopheuge in South Africa. Very few species of birds breed in the southern hemisphere and pass the boredune and borepheuge in a non-breeding condition in the northern hemisphere. The Gouldian finch of Australia exhibits an internal rhythm in reproduction: for it breeds about the notodune in its native haunts, and individuals imported into the northern hemisphere tend to continue to breed in the notodune.

There is also a need for words which apply to the whole of one hemisphere (north or south), that is, words which extend the concepts of spring, summer, autumn and winter right through the tropics to the equator.

Homodune. The season when the sun is in the same hemisphere (north or south) as the place spoken of and going towards the pole of that hemisphere (δύς same). This word, applicable everywhere, is the same as spring in temperate latitudes, if one allows the official sense to the word spring. The days are lengthening during the homodune.

Homopheuge. The season when the sun is in the same hemisphere as the place spoken of and going away from the pole of that hemisphere. In temperate latitudes this is the same as summer. The days are shortening during the homopheuge.

Heterodune. The season when the sun is in the opposite hemisphere to the place spoken of and going towards the pole of that hemisphere (ἐτερος, other). In temperate latitudes this is the same as autumn. The days are shortening during the heterodune.

Heteropheuge. The season when the sun is in the opposite hemisphere to the place spoken of and going away from the pole of that hemisphere. In temperate latitudes this is the same as winter. The days are lengthening during the heteropheuge.

The following are examples of the use of these four words in sentences which require considerable circumlocution without them. The blackbird starts laying about the beginning of the homodune in Britain and also in New Zealand, where the descendants of imported specimens have established themselves; in Ceylon it breeds about the beginning of the homodune and again about the end of the homopheuge. In Britain we have no species of bird with a special breeding season starting in the heterodune, but there are heterodune-breeders among tropical and southern hemisphere birds. Almost throughout their range most species of fruit-bats copulate in the heterodune, and there is thus a difference of about six months in their breeding seasons on the two sides of the equator. In the tropics the rainy season or seasons usually fall in the homodune and homopheuge: often there is a rainy season in each, separated by a short drier period.

I am greatly indebted to my friend, Mr. E. B. Ford, for translating my concepts into easily pronounced and intelligible words based on Greek. It may be remarked that the first 'o' of notodune and notopheuge is short.

It is hoped that students of migration and of seasonal phenomena in the tropics may consider the possibility of these eight new words being useful. The new knowledge of the relationship between light and reproduction may be thought to lend weight to a system of the seasons based on the apparent movement of the sun and therefore on the change in length of day.

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Non-Specificity of the Trio Follicles in the Merino

I HAVE the privilege of collating the valuable notes of the late Prof. J. E. Duerden, having been his colleague and friend for the past two years. Prof. Duerden's recent work on the embryology of the fleece has important implications of both a fundamental and an applied character, and it is felt that the following advance note, indicating some of the results he obtained, approaches in some measure the type of communication which Prof. Duerden himself contemplated writing at the time of his death.



Fig. 1.

Magnification $\times 120$.

Prof. Duerden's investigations were chiefly in the form of a comparative study of follicular arrangement in both fetal and post-natal stages of the Ovidæ, and also of many other mammals. He established the fact of the common and fundamental nature of the arrangement of the early follicles in trios, noted in some mammals by other workers, and also observed that these follicles produce coarse birth-coat fibres; he states in this connexion that "Production of the woolled fleece is by the loss of the coarse fibres grown by the trio follicles" and, I would add, of course, by the addition of finer fibres chiefly grown by later developing follicles.

With reference to this aspect of the developing fleece, Prof. Duerden has established the important point that a follicle which in the lamb produces a coarse, kempy birth-coat fibre may later produce a fine

non-medullated wool fibre. He has shown that this actually occurs in the South African Cape Merino lamb, and the photomicrograph (Fig. 1) reproduced here (magnification $\times 120$) constitutes evidence supporting his view. This is a photograph of a horizontal section of skin from a four months' old Cape Merino lamb: so many new follicles and fibres have become differentiated that the early trio arrangement is somewhat obscured. Large birth-coat follicles, however, are clearly shown which have already shed their coarse birth-coat fibres, and in these same large follicles can be seen recently keratinized fine non-medullated wool fibres. Here again a note of Prof. Duerden's may be aptly quoted: "Changes in the arrangement and character of the fibres occur during the life of the sheep, especially as between the birth-coat and the adult fleece. The foetal distinction in size between the trio and the later follicles may be accentuated, as in the Somali and wild sheep, or may be reduced, as in the Suffolk and Leicester, and the fleece become more uniform; the coarse trio fibres may be shed and replaced by fine fibres (that is, in the same follicles), as in the fine-woolled Merino."

Prof. Duerden's work also suggests the importance of the follicle bundle as a genetic morphological unit, and how its nature may influence such fleece characters as type of staple formation, degree of sample uniformity in fibre diameter, and fleece density.

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Androgenic Endocrine Activity in the Female Mammal

PARKES¹ recently made the very important statement that ovarian extracts may show androgenic activity when tested on the comb of the oapon. Since there was no androgenic activity in purified ovarian hormones, Parkes reasonably concluded that the androgenic activity of the extracts was probably due to the presence of substances of the androsterone-testosterone group.

Many observations demonstrate that androgenic activity can be induced experimentally in the female guinea pig by certain agents which act on the ovary without changing its microscopical aspect. The clitoris of the guinea pig offers a very convenient test for androgens; more than twenty years ago² I discovered its transformation into a penis-like organ under the influence of a testicular graft (in one of the experimental animals which Prof. Steinach generously put at my disposal). Sand³ independently found a similar phenomenon in the rat. Since then, the transformation of the clitoris of the guinea pig into a penis-like organ has been seen by other investigators working with testicular grafts or testicular hormones.

Now a penis-like organ can also occasionally be found in untreated female guinea pigs which are otherwise normal⁴. A similar condition can be produced experimentally by exposing the ovaries to X-rays or by injecting gonadotropic extracts (Steinach and Kun⁵). A typical penis-like organ may grow in less than three months after 'partial castration', that is, when the quantity of ovary is diminished to a minimum by resection (in six out of twenty animals operated upon when adult⁶).

Steinach and Kun emphasized the extensive luteinization of the ovary seen in their successful experiments, but the ovaries in our guinea pigs with a spontaneous penis-like organ, and likewise the androgenic ovarian fragments, showed no excessive luteinization. Similar results were obtained in a new series of twelve guinea pigs, out of which again six revealed the penis-like organ. These animals were operated on when 4-28 days old, one ovary being removed and the other reduced to a minute fragment. The transformation of the clitoris became manifest only about eleven to twelve months later. The ovarian fragments were examined 32-33 months after operation, and showed cystic follicles and sometimes luteal cysts, but only twice in a total of twelve positive cases was I able to state with certainty that hypertrophy had taken place of those tubular structures of the ovarian medulla which may be considered as a masculine rudiment. One of the most interesting features of our experiments is the fact that the experimentally induced androgenic activity does not depend upon microscopical ovarian changes suggestive of gonadal intersexuality. This indeed does not exclude the possibility suggested by Parkes of androgenic male hormones being produced in the ovary.

An ovarian graft in a castrated male guinea pig may exceptionally maintain the seminal vesicles and the prostate in a normal condition⁷. This was recently shown also for castrated mice with ovarian grafts⁸. In our case, in which the graft was not examined until 34 months after transplantation, there was an enormous development of epithelial tissue due to proliferation of the medullary ovarian tubules; but in view of our microscopical results with ovarian fragments, the condition of this graft may be considered as exceptional and not necessarily related to the androgenic activity.

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¹ Parkes, *NATURE*, 139, 965 (1937).

² Lipschütz, *Ann. Abnd. Wissenschaft. Wien*, No. 27 (1916); *Arch. Hist.-Mech.*, 44, 190 (1918).

³ Sand, *Pflügers Arch.*, 172, 1 (1918).

⁴ Lipschütz, *Brit. J. Exp. Biol.*, 4, 237 (1927).

⁵ Steinach und Kun, *Pflügers Arch.*, 237, 235 (1931).

⁶ Lipschütz, *C.R. Soc. Biol. (Paris)*, 112, 1273 (1933).

⁷ Lipschütz, *Pflügers Arch.*, 235, 35 (1933).

⁸ De Jongh und Korteweg, *Acta Bravia Neerland.*, 5, 120 (1935) Hill and Gardner, *Anal. Rec.*, 54, Supp. 21 (1936). Hill, *Endocrinology* 21, 456, 633 (1937).

Restropic Effects of Anterior Pituitary Extracts

SEVERAL authors have attributed endocrine functions to the reticulo-endothelial system (R.E.S.) and have employed, for various purposes, extracts prepared from its centres. But no link between endocrine glands and the R.E.S. has as yet been demonstrated. Recently, however, we have obtained evidence of pituitary control of the reticulo-endothelial system. The experiments were carried out on rabbits. A modification¹ of the Congo-Red method² was used in assessing the activity of the R.E.S. The rate at which the dye is eliminated from the circulation reflects the functional condition of the system, and the method which measures this rate thus yields an index of the activity of the R.E.S.

First the normal rate was determined in each animal. Injections of various pituitary extracts were then administered and the rate of elimination was again determined at regular intervals. Certain aqueous extracts produced a rapid rise in the activity of the system. The rise was noticeable 24 hours after the first injection but did not attain its maximum until some days later. Cessation of the injections resulted in a return to the normal level. Thus one rabbit showed an initial index (per cent of dye eliminated *within one hour) of 45.7. After three daily injections of 1 mgm. each the index rose to 76.9; 10 days after the last injection the index had fallen again to 48.5. The treatment was not followed by any signs of damage to the R.E.S. These effects were obtained with extracts that did not contain the growth factor and were free of, or contained traces only of, gonadotropic and thyreotropic hormone. The active substance is highly soluble in water and can be extracted even with distilled water. A highly potent extract was prepared from fresh anterior lobes (cattle pituitaries) in a Soxhlet worked under reduced pressure. Water was used as extractive and an alkaline reaction was maintained by repeated addition, to the gland material, of weak ammonia. The active substance is insoluble in acid 70 per cent alcohol but soluble in alcohol containing 3 per cent ammonia. It is precipitated by phosphotungstic acid, rapidly destroyed by boiling and unstable in solutions kept at room temperature.

Purified gonadotropic hormones prepared from the anterior lobe of cattle pituitaries, from human placenta or pregnancy urine, and from the blood of a menopausal subject failed to affect the R.E.S.-index significantly or even uniformly.

Strongly thyreotropic extracts, prepared from anterior lobe and containing a proportion of gonadotropic hormones, significantly and rapidly lowered the index. For example, 61 per cent of the dye was eliminated in an untreated rabbit within one hour after its injection. After three daily injections, the rate had fallen to 26 per cent. But the fall in the activity of the system persists for a few days only. A return to the norm takes place even when the injections are continued.

It thus seems likely that the anterior pituitary is involved in the regulation of the R.E.S. Presumably it influences, therefore, some aspects of immunity.

The influence of the gland may be complex since it yields at least two active derivatives. One type of extract increases the activity of the R.E.S.; in accordance with current terminology, we propose to refer to the active substance as the 'positively restropic factor'. Another type of extract, characterized by its thyreotropic activity, is negatively restropic; that is, it lowers the activity of the R.E.S. The positively restropic factor is manifestly not identical with the growth factor or the gonadotropic hormones. But it may be identical with one of the other anterior lobe hormones for which separate existence has been claimed.

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* Adler, H., and Reimann, F., *S. Exp. Med.*, **47**, 617 (1925).

* Stern, K., and Wilhelm, R., *S. Exp. Med.*, **47**, 364 (1925).

Interpretations of Atomic Constitution

THE correspondence columns of NATURE are usually devoted to contributions from specialists, and for a layman to enter into them may be regarded as an intrusion. There must be, however, many readers who, unable to be advanced workers in any particular branch of science, try to follow current thought, especially in physics. They form the bulk of those who read and enjoy the more popular expositions of science by fellows of the Royal Society and others actually engaged in scientific work, and many look forward to the arrival of NATURE.

Could one of such interpreters give an explanation of the difficulties some of us find in the present contemporary picture of atomic structures? We know it is only a rough picture. A billiard ball model of the atom is, we know, impossible. Recent bombardment experiments bear out, however, the general rough scheme of things. Heisenberg, with his indeterminacy, certainly introduces anxieties. On the other hand, in the answers do not allow a shift to wave mechanics: we would look upon that as an unfriendly 'action'. Could NATURE, however, get some explanation given us of such difficulties as the following:

(1) No doubt in popular works it is difficult to express things correctly, but I notice reference frequently to the charge on the electron or proton. Surely these two elements are the charge and nothing else, even if they do differ in mass by a factor of 2000, or is the ephemeral positron now looked upon as the charge on the proton?

If, to account for isotopes, we must introduce neutrons, no difficulties present themselves if a neutron can be looked upon as a proton married happily to an electron in domestic bliss with no charge. Just mass. But we are told (see Prof. Andrade's article in NATURE of September 8, 1934) that we must not look upon the neutron as having within itself an electron. The consequence seems to lead to philosophical difficulties; for now the neutron is just a lump of matter, and the theory that matter is electrically built up, fails. Is this point conceded, or if not, why not?

(2) The nucleus in heavy atoms presents the most serious difficulties. Here, we are told for each atom, live concentrated together a group of protons, corresponding in number to the electrons in their orbits, plus some neutrons to account for isotopes and other things. Yet the protons, being positively charged, must dislike proximity with the same vehemence as the electron. How is it assumed that they can remain packed together? Prof. Andrade, in his attractive book "The Atom", page 71, envisages a scale model with the nucleus the size of a plum, with electrons occupying orbits two thousand feet across. If the nucleus is made up of protons, as bombardment apparently proves it to be, and if each proton has, or is, a positive charge, then such a picture is mathematically an absurdity. What is the force holding them together?

If I am told that under certain conditions two similarly charged protons can be made to unite to form a super proton of mass 2 and charge 2, or even more, but always in units of protons plus a neutron or two—rather like similarly charged blobs of mercury, sitting on a glass plate, disliking proximity, but by force made to amalgamate; if I am told that this super proton, now called a nucleus, is held together by a new sort of atomic 'surface tension'

but can be broken up by bombardment; if I am told that in such breaking up it may shed a proton or two which will change the chemical properties of the atom and that energy will be released; that is a story which anyhow accounts for the facts, and for Prof. Andrade's 'plum', although not really explaining them, but the trouble is no one mentions the difficulty of protons just living together, maintaining their individuality.

The above idea may be fantastic, but let us have some story; at present we have none. There may be answers, easy ones, to these difficulties, which are asked in all sincerity of those who have worked so wonderfully in this new entrancing wonderland of physics, and for whom no one has greater admiration than myself.

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At one time it was the fashion to ask "What is electricity?" and to taunt, or condole with, the man of science, because, said the questioner, he had no answer to offer. The question I always considered unreasonable, since we must take some fundamental entity, which we cannot explain in terms of other substances, as the basis of our theories, and electricity is an aspect of our fundamentals. It is not a kind of liquid, or a kind of gas, but something quite different from both. There should never be any question of calling electricity a fluid, and then expecting to deduce its complete behaviour from the known property of fluids. What we have rightly done is, rather, to find out by experiment what its actual properties are, and what general laws will cover them. It then proves that for certain limited purposes electricity can be considered as a fluid, but the limitations should always be borne in mind.

Colonel Moore-Brabazon, moving with the times, puts certain questions as to our fundamental entities of to-day, the proton and the neutron, and wants their properties explained in anthropomorphic terms of likes and dislikes, and so on, or at any rate, in terms of the behaviour of massive bodies, which they resemble as little as electricity in bulk does a material fluid. The problem is not to explain atomic and nuclear electro-dynamics in terms of macroscopic charges and their properties, because we know that this cannot be done, but to find out with what particles we can form a consistent scheme of action for the experimenter, and with what properties we must endow these particles.

Workers on nuclear problems have decided that they must have, among other things, protons and neutrons. Now, if I understand Colonel Moore-Brabazon, he wants to know how the neutrons and the positively charged protons can be packed together, because if they have the properties of macroscopic charges the assemblage will be unstable. We know, however, that they have not these properties, and our task is to form a consistent scheme which shall cover these properties and shall also cover other aspects of atomic electrodynamics. We may have to assume certain entities to help us along temporarily in our difficulties, such as the unsatisfactory neutrino, but the unsatisfactoriness of the neutrino is not that it has properties inconsistent with the laws of classical

electricity, but that it has no properties at all, except those assumed *ad hoc*.

We can get over Colonel Moore-Brabazon's difficulty about "the charge on the proton" by calling it "the charge of the proton", to which nobody will object. Whether we talk of the neutron containing an electron is to some extent a matter of words, just as whether we talk of a rocket as containing the stars is a matter of words. What we want to know is under what conditions the neutron can be transformed into, or replaced by, a proton and an electron. To explain this behaviour we have to resort to sets of rules evolved by studying atomic and macroscopic phenomena and to accept the "non-reasonable" conception of the quantum theory, in its modern wave-mechanical form. Thus I can tell Colonel Moore-Brabazon that it is held in some quarters that the proton and the neutron represent two different quantum states of one entity: I can talk to him of Fermi and of Bose statistics, and allied rules to help us to decide as to the structure of the nucleus—as to whether, for example, it contains electrons. This would, however, be to introduce difficult detail that he might regard as an attempt to throw dust in his eyes. I prefer to say, quite generally, that some sort of special rules are required, and that, whatever these are, they are to be obtained by generalizing certain experimental results, and not by reasoning from the classical laws of electricity. In Rutherford's words "the atomic nucleus is a *world of its own* [my italics. E. N. da C. A.] in which a number of particles like protons and neutrons are confined in a minute volume and held together by very powerful unknown forces. Vigorous attempts are in progress to adapt existing [that is, quantum-mechanical] ideas to explain the structure of atomic nuclei, and some success has been obtained in a few simple cases".

If Colonel Moore-Brabazon is still unsatisfied I beg him to cast his eyes back to Newtonian days. Would he in those days have wanted strings tied to the planets to pull them towards the sun, on the ground that a body cannot act where it is not? He cannot pull my nose (though perhaps he may pull my leg) at a distance; how then can the sun pull the planets? In fact, the conception of action at a distance gave much trouble to very acute brains*. Jean Bernoulli, for example, never accepted it. However, quite apart from any speculations as to the nature of gravitational forces, such as Einstein's recent hypothesis, the laws of interplanetary force were worked out on the assumption that a body *could* act where it was not, with such satisfactory results that the hypothesis of universal gravitation now offers no trouble to anybody.

I cannot promise Colonel Moore-Brabazon that all men of science will share my views, but there they are, for what they are worth. Now, perhaps, in return, Colonel Moore-Brabazon will give me a logical statement of British foreign policy in the last ten years, which has puzzled me as much as the nuclear mechanics of the last ten years has puzzled him.

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* The reader who wishes to see how slowly Newton's ideas penetrated may consult M. Brunet's learned "L'Introduction des théories de Newton en France au XVIII^e siècle".

Internal Friction of Wires

WORKING with the transverse vibrations of wires of glass, steel, brass, aluminium and silver, Bannewitz and Rötger¹ have found that the internal friction has a maximum at a frequency f_0 characteristic of each wire. They have found, in fact, that the internal friction varies with frequency f approximately as

$$A \frac{f_0 f}{f_0^2 + f^2} \quad (1)$$

The purpose of this letter is to point out that the internal friction measured by Bannewitz and Rötger is a direct consequence of the entropy increase associated with the flow of heat from the compressed to the extended side of the wire. f_0 is interpreted as the reciprocal of the time of relaxation for the establishment of temperature equilibrium across the wire. The theory of this thermo-elastic internal friction has been discussed by me² for the case of a reed. An extension of the theory to wires is being published elsewhere. It is found that Q^{-1} for both reeds and wires (which is equal to the logarithmic decrement λ of Bannewitz and Rötger multiplied by $\log_e 10/\pi$) is given by (1), with

$$A = (E_S - E_T)/E_S,$$

where E_S and E_T are the adiabatic and isothermal Young's moduli, respectively. In the case of wires, f_0 is given by

$$f_0 = (q^2/2\pi)Da^{-2} = 0.539 Da^{-2},$$

where D is the thermal diffusion constant of the material, a the radius of the wire, and q the first root of the equation

$$(d/dx)J_1(x) = 0,$$

namely, 1.84.

Not only does the thermo-elastic effect give a satisfactory qualitative interpretation of the experiments of Bannewitz and Rötger, but also, as shown by the accompanying table, it gives good quantitative agreement.

Type of wire	Glass	Steel	Brass	Aluminium	Silver
2s in mm.	1.25	1.0	1.25	1.5	1.01
f_0 , observed	0.66	25	40	83	240
$0.539 Da^{-2}$	0.5-0.6	27	45	84	250
$\lambda \times 10^4$, observed	8.7	2.6	4.4	5.2	6.0
$(E_S - E_T)/E_S \times 10^4$		1.9	3.2	4.6	3.7

[†] A has been obtained by multiplying λ_{max} of Bannewitz and Rötger by $2(\log_e 10)/\pi = 1.46$.

It is of particular interest to note that the frequency, f_0 , at which the internal friction has a maximum is not a constant of the material, but varies inversely as the square of the radius of the wire.

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¹ Bannewitz, K., and Rötger, H., *Phys. Z.*, **37**, 578 (1936).

² Zener, C., *Phys. Rev.*, **53**, 230 (1937).

Capture of Slow Neutrons in Light Elements

By means of a small boron-lined ionization chamber we have studied the density distribution of neutrons around a source (Ra + Be) placed in a large container filled with a hydrogenous liquid¹. From the measured distribution the total number of neutrons present at any instant is obtained by integration. This figure does not depend on the scattering properties but only on the capture cross-sections of the

nuclei constituting the liquid. If a constant number of neutrons is emitted from the source, then the mean number present at any instant is inversely proportional to the total capture probability.

By using liquids containing the same constituents in different proportion we have been able to separate the capture effects due to the single constituents. First we compared benzene (C₆H₆) and liquid paraffin (CH_{1.87}, according to chemical analysis). The numbers of neutrons in these two liquids were found to be inversely proportional to the respective hydrogen densities; it follows that the capture cross-section of carbon must be much smaller than that of hydrogen. A similar result was found for oxygen, on comparing benzene and water. Through the kindness of a loan of 60 litres of heavy water of 10 per cent deuterium oxide content, from the Norsk Hydro-Elektrisk Kvalstofaktieselskab, Oslo, we were enabled to include deuterium in our experiments; also in this case no measurable capture was detected. In a 7.6 per cent solution of ammonium nitrate in water, however, the capturing action of the nitrogen could be easily observed and measured.

We have also made measurements with aqueous solutions of boric acid and lithium hydroxide. Since the capture cross-sections of boron and lithium have been determined from experiments with beams of thermal neutrons, our measurements can be used to obtain absolute capture cross-sections for all the light elements quoted above. The results are collected below.

Capture cross-sections σ_c for neutrons of velocity 2.2×10^5 cm./sec.

Element	H	D	O	N	O
$\sigma_c \times 10^{24}$ cm. ²	0.27 ± 0.02	< 0.03	< 0.01	1.3 ± 0.3	< 0.01

Our value of σ_c for hydrogen is somewhat smaller than the value given by Amaldi and Fermi (0.31×10^{-24} cm.²) which furthermore corresponds to a neutron velocity of 2.5×10^5 cm./sec. and should therefore be increased by a factor of 1.13 to be compared with our value. On the other hand, from neutron beam experiments we get a somewhat larger value (48 instead of 43×10^{-24} cm.²) for the scattering cross-section of hydrogen. For the mean number of collisions suffered by a slow neutron in paraffin before getting captured we find 205 ± 20 (instead of 140)¹.

Our value of σ_c for nitrogen agrees with the value found² by counting the protons emitted in the reaction $^{14}\text{N} + ^1_0\text{n} = ^{14}\text{C} + ^1_1\text{H}$.

We may mention another result of our investigations. We have compared the yield of photo-neutrons from beryllium and deuterium irradiated by gamma rays from radium, with the yield from a mixture of radon and beryllium. Assuming the latter yield to be 20,000 neutrons per second per milligram, we find for deuterium a cross-section of $\sigma_{d,\gamma} = 7 \times 10^{-28}$ cm.² for photo-dissociation by quanta of 2.2 Mev. energy. For beryllium, where two gamma lines of 1.8 Mev. and 2.2 Mev. are sufficiently energetic, we find $\sigma_{b,\gamma} + 0.3\sigma_{d,\gamma} = 2 \times 10^{-27}$ cm.².

A detailed account is to appear shortly in the *Proceedings of the Royal Academy, Copenhagen*.

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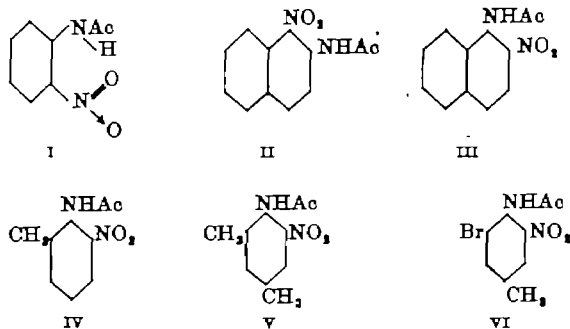
¹ Amaldi, E., and Fermi, E., *Phys. Rev.*, **58**, 899 (1936).

² Burcham, W. B., and Goldhaber, M., *Proc. Camb. Phil. Soc.*, **33**, 632 (1936).

Evidence of Restricted Rotation about the N—C Bond in 2:6-Disubstituted Acetanilides

THE failure¹ to effect optical resolution of substituted anilines having two large *ortho* groups has left unconfirmed the theoretical possibility of restricted rotation about the nitrogen-nuclear single bond in such compounds. That such steric effects are indeed present in suitably constituted molecules is now proved by a method entirely independent of optical activity.

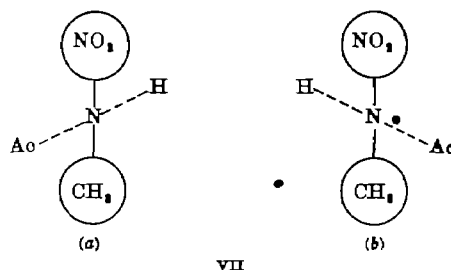
It has been shown² that the molecular association of amides is due to the bonding effect of the amide-hydrogen atoms, the complete replacement of which effectively checks association. Subsequent work has shown that, in the case of anilides, certain *ortho* substituents are effective in preventing association, and it is significant that such substituents are invariably hydrogen-acceptor groups such as $-\text{NO}_2$, $-\text{N}:\text{N}-$, $-\text{COOEt}$. In such compounds it is evident that the hydrogen atom responsible for association is no longer available for this purpose, it being engaged in chelate ring-formation, such as that depicted in *o*-nitroacetanilide (I). During these experiments an unexpected difference was revealed between the behaviour of 1-nitro-2-acetnaphthalide (II) and the isomeric 2-nitro-1-acetnaphthalide (III). The former is unimolecular, having a lower melting point and greater solubility in hydrocarbon solvents than the latter, which is associated. This led us to suspect steric influences, and to investigate other substances in which similar steric effects might be expected.



The results showed with surprising regularity that although *o*-nitroacetanilide (I) is unimolecular, the substitution of a second *o*-substituent in this compound (such as in IV, V and VI) restores the tendency to associate. The inevitable conclusion is that the amide-hydrogen atom in III, IV, V and VI is deflected by steric interference between the acetyl group and the methyl group (or the bromine atom) too far away from the neighbouring nitro-group to permit of chelate ring-formation, thus leaving the hydrogen atom free to exert its intermolecular bonding effect.

The sensitiveness of this method of detecting restricted rotation as compared with the classical method of optical resolution can best be explained by considering the example of 3-nitro-2-acet-toluidide (IV). A plan of this molecule as seen from a point above the nitrogen atom and remote from the benzene nucleus is shown in VII, the single line connecting the two *ortho* substituents ($-\text{NO}_2$ and $-\text{CH}_3$) representing the plane of the benzene nucleus. The size of the two *ortho* groups may be such as to limit, but not absolutely prevent, the rotation of the H—N—Ac axis from the position shown in VII a to that shown in the enantiomorph VII b. Any such rotation will

bring about a more or less rapid racemization. Nevertheless, only in a very small proportion of molecules intermediate between (a) and (b) is chelation between H and NO_2 possible, with the result that the majority of the molecules show association.



In other words, whereas the chance of resolving such a compound depends upon the non-conversion, or at least the slow rate of conversion, of molecules of type (a) into those of type (b), the test now applied is completely independent of such conversions, and depends solely on the inclination (in whatever direction) of the H—N—Ac axis to the plane of the benzene nucleus.

The degree of association of these compounds was measured cryoscopically in naphthalene, and the relevant figures will be published elsewhere.

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¹ Tuan, Han, and Hsu, *J. Chinese Chem. Soc.*, **4**, 131 (1936)
² Chaplin and Hunter, *J. Chem. Soc.*, 1114 (1937).

Liver Extract and Haemoglobin in Rats

RECENTLY Tschesche and Wolf¹ have stated that rats, made anemic on a diet consisting wholly of milk, respond differently to iron and copper and to liver extracts known to be clinically active in the treatment of pernicious anemia. According to these authors, erythrocyte and leucocyte counts and haemoglobin are all increased by the metals, while cell counts but not haemoglobin are increased by the liver extract.

Preliminary attempts in these laboratories to confirm the results of Tschesche and Wolf have led to the surprising result that liver extract produces an apparently significant increase in the haemoglobin of rats with milk anemia, while leaving the cell count as low as in untreated animals. It is proposed to publish fuller details of this investigation elsewhere.

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¹ Tschesche, R., and Wolf, H. J., *Z. physiol. Chem.*, **248**, 21 (1937).

Crystal Structure and the Magnetic Anisotropy of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

FROM a discussion of the magnetic susceptibilities of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ powder at different temperatures, Jordahl¹ concluded that the crystalline electric field acting on the Cu^{++} ion in the crystal should be predominantly cubic in symmetry, and further, from

the sign of the potential due to this field which fits the magnetic data, that the field should correspond to an octahedral distribution of six equal negative charges around the Cu^{++} ion. This result is not obvious from general structural considerations, since the crystal is triclinic, and there are five molecules of water and one SO_4 group associated with each Cu^{++} ion. The result, however, has been beautifully verified by the X-ray studies of Beevers and Lipson¹ on the structure of the crystal. The Cu^{++} ion is found to be at the centre of an octahedron of six negatively charged oxygen atoms. Four of them belong to four water molecules, and they form a square with the Cu^{++} ion in the centre. The other two, which are contributed by two sulphate groups, are located centrally above and below this square.

Now this octahedron is only approximately regular, the oxygens of the water molecules being closer to the Cu^{++} ion than the other two. The crystal field acting on the Cu^{++} ion should therefore deviate considerably from cubic symmetry, and its intensity along the normal to the plane of the water molecules should be less than for directions in the plane. Now there are two such Cu^{++} ions in the unit cell of the crystal, and the two corresponding squares of water molecules make with each other an angle of 82° , which is nearly a right angle. One would therefore expect: (1) that the crystal should be magnetically anisotropic, which is a trivial result since the crystal is triclinic; (2) that two of the principal suscepti-

bilities of the crystal should be nearly equal, and greater than the third (that is, the magnetic ellipsoid should be approximately an oblate spheroid); (3) that the axis of this spheroid should lie along the line of intersection of the planes of the two squares of water molecules in the unit cell. All these conclusions have been verified experimentally².

The directions of the two nearly equal axes of the ellipsoid can also be predicted from the fine structure of the crystal: the shorter of them should lie in the plane bisecting internally the two squares of water molecules. Since the angle between the two squares differs by only 8° from a right angle, this last conclusion cannot be accepted with the same confidence as the others. From a study of the magnetic anisotropy for a number of planes in the crystal, we have recently determined the directions of these two magnetic axes, and they too lie nearly as predicted from the structure.

Thus the magnetic data confirm in a striking manner the structure proposed by Beevers and Lipson for the crystal.

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¹ *Phys. Rev.*, **45**, 87 (1934).

² *Proc. Roy. Soc., A*, **148**, 570 (1934).

³ Krishnan and Mookherji, *Phys. Rev.*, **50**, 880 (1936).

Points from Foregoing Letters

Prof. A. C. Cuthbertson, Geoffrey Gee and Prof. E. K. Rideal find that pure vinyl acetate does not polymerize measurably at 100°C . even in the presence of oxygen. A peroxide derived from acetaldehyde, however, catalyses the reaction. The authors suggest that the discrepancy in the findings of various observers between the rate of polymerization of gaseous and liquid styrene may be likewise explained by the presence of a peroxide catalyst in the liquid phase.

J. S. Kennedy describes how solitary locusts belonging to the species *Schistocerca gregaria* on the Red Sea coast, crowd together into patches of dense but uneven vegetation, and this fortuitous concentration brings about the change from the solitary to the gregarious 'phase'.

A photomicrograph of a horizontal section of skin from a four months' old Merino lamb is submitted by Dr. A. B. Wildman in support of the late Prof. J. E. Duerden's view that the 'trio' follicles which at first produce the coarse birth-coat fibres may later produce a fine non-medullated wool fibre.

The appearance of male sex organs in female guinea pigs after the almost complete removal of the ovaries is described by Prof. A. Lipechütz. This, the author points out, does not exclude the possibility that male hormones are produced in the ovary.

Taking the elimination of Congo-Red dye from the body as a measure of the activity of the reticulo-endothelial system, C. Wetler-Liget and Dr. B. P. Wiener find that certain aqueous pituitary extracts stimulate the activity while other extracts of the anterior lobe of the pituitary having thyrotropic activity and containing a proportion of sex hormones lower the activity.

Following upon theoretical considerations of entropy increase, Dr. C. Zener calculates the frequency of transverse vibrations for which the internal friction is a maximum, in the case of wires of various materials (glass, steel, silver, etc.) from the known values of their Young moduli; he submits a table showing that the values obtained agree with those experimentally determined by Bennewitz and Rötger.

From measurements of the density distribution of neutrons around a source, in different hydrogenous liquids, Drs. O. R. Frisch, H. von Halban, jun., and Jergen Koch have obtained values for the capture cross-sections of hydrogen and nitrogen, for neutrons of thermal energy; in the cases of deuterium, carbon and oxygen, upper limits for the capture cross-sections have been established. Furthermore, the cross-sections of deuterium and beryllium for photo-dissociation by the gamma rays of radium have been determined.

Whilst certain *o*-substituted acetanilides give indication of chelate ring-formation between the two neighbouring groups, Dr. L. Hunter and H. O. Chaplin find that substitution of a group in the second *ortho* position prevents chelation. This fact is interpreted as evidence of restricted rotation about the nitrogen-nuclear single bond in 2 : 6-disubstituted acetanilides.

From a consideration of the fine structure of the $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ crystal (triclinic) analysed by Beevers and Lipson, Prof. K. S. Krishnan and A. Mookherji locate the directions of the maximum and the minimum susceptibilities of the crystal, and further state that the intermediate principal susceptibility should be almost equal to the maximum. These results have been verified experimentally.

Research Items

Ethnography of the Tanaina

IN continuation of his research among the Northern Athapascan Indians, Dr. Cornelius Osgood spent the summer of 1931 and part of that of 1932 with the Tanaina of Cook Inlet (Yale Univ. Pub. in Anthropol., 16, 1937. Oxford Univ. Press. 13s. 6d. net). The Tanaina are a nation of related subdivisions or tribes, of which, broadly speaking, there are seven. The name means "the people", as distinct from either Eskimo or Europeans. Their culture has suffered much disintegration from European contacts during a period of one hundred and fifty years. Their language belongs to the Athapascan stock, being most closely related to that of their neighbours to the north-west, the Irgalik Athapascans. It is unquestionable that the neighbouring Eskimo have had some physical, cultural and linguistic effect on them. No anthropometric study of them has been made, but they are taller than the Eskimo. A full-grown man of less than five feet eight inches is rare. The nose is prominent, frequently aquiline, the lips full, the skin darker than the Eskimo. The most important article of diet is fish, especially salmon; but the Tanaina are unique among the Athapascans in having access to sea mammals, seal, sea lion, etc. The meat of the white whale is much relished, but as they have not the correct 'medicine' for its killing, they buy it with furs. Of land animals they hunt the forest fauna, mountain sheep and goats, bear, etc. For vegetable foods they eat a variety of berries, spruce buds, wild rice, wild 'peas', fern roots, and, most important of all, the *kila*, a parsnip-like root, which is obtained only from the North Inlet, but is the principal article of trade and transported as such from one end of the country to the other.

Newfoundland Amphipoda and Decapod Larvæ

MISS NANCY FROST describes some interesting material collected by the S.S. *Cape Agulhas* in Newfoundland waters in 1931-35. The list of amphipods given includes a new species of *Hippomedon* (*H. stephenseni*) and a specimen of *Paramphithoe cuspidata* which differs considerably from the type. The decapod larvæ are numerous, the genus *Spirontocaris* being conspicuous and five species differentiated, although three of them could not be referred to distinct species. *Pandalus montagui* was the most abundant of all the larvæ and *P. borealis* fairly common. Two distinct megalopæ belonging to *Hyas* were found, one being *Hyas coarctatus*, and it is almost certain that the second is *Hyas araneus*, but this differs from *H. coarctatus* in having two small posterior dorsal spines on the carapace instead of one large one. If this identification be correct, this clears up much that was obscure in the previous descriptions. A young stage of *Labridius fucorum* is figured, two specimens having been secured, and there is a post-larval (or young stage) of *Spirontocaris grandlandica*, which fills a gap in the hitherto known life-history. Miss Frost finds that the mandibular palp is present in the post-larva of both species of *Pandalus*, which is very much earlier than it appears in some species of *Spirontocaris*.

New Mutation in *Drosophila*

A MUTATION in egg-shape of *Drosophila funebris* described by Prof. F. A. E. Crew and Dr. C. Auerbach (Proc. Roy. Soc. Edin., 57, Part 3) provides several points of interest. The eggs are shorter and broader than normal, and spheroidal in shape, the four attached filaments being very much shorter. The ability to produce these eggs is inherited as a recessive condition, and is found to be widespread in the wild population. The fecundity of females which lay spheroidal eggs is also very low. Whereas normal females lay more than 1,000 eggs, these lay mostly 30-50. The curve of egg production is also different and the spheroidal eggs are more variable. The correlation between length and width of the egg is positive in normal, negative in spheroidal eggs. This is the first mutation in egg-shape to be found in *Drosophila*, and as the females which produce these eggs are themselves normal in appearance, special tests are required to show the manner of inheritance.

Cobalt Chloride Treatment of Sheep

IN an earlier paper it had been shown that a lamb sickness in Southland, New Zealand, known locally as Morton Mains disease, could be successfully controlled by the use of small quantities of cobalt chloride administered in drench form. While drenching is reliable as a research method, since it ensures that every animal gets its proper dose, it has disadvantages in farm practice owing to the time and trouble involved. J. K. Dixon, of the Cawthron Institute, has now been able to show (*N.Z. J. Sci. Tech.*, 18, 892-97) that a salt lick made by spraying a solution of 4 oz. of cobalt chloride on a ton of dairy salt can be successfully used as an alternative method. Ewes and lambs supplied with such a lick kept in perfect health, but the use of it during pregnancy only was not sufficient to maintain optimum growth of the lambs during the following summer. The cost is not likely to exceed 4d. per sheep per year and great saving in labour is attained.

The Root-Knot Eelworm

MR. G. FOX WILSON has collected a large amount of information about the root-knot eelworm, *Heterodera Marioni* Goodey (*J. Roy. Hort. Soc.*, 62, Pt. 8, August 1937). The pest was formerly regarded as a pest of glasshouse plants, but it is now known to attack a wide variety of outdoor crops. It frequently appears on groundsel, chickweed and shepherd's purse, weeds which may spread the pest in unhygienic gardens. The life-cycle is described, and various methods of dispersal, such as the distribution of infected soil upon the gardener's boots or tools, and the return of greenhouse compost to the garden, are discussed.

Heteroauxin and Cambial Activity

As foreshadowed in an earlier paper (A. B. Brown *Canadian J. Res.*, 15, No. 1), an interesting series of experiments has been performed on the stimulation of the cambium of dormant branch segments of *Populus balsamifera* L., by the application of

heteroauxin (A. B. Brown and R. G. H. Cormack, *ibid.*, 15, No. 9). Bridged rings were cut in the bark in the middle of the segments, and the amount of new xylem cut off by the reactivated cambium was clearly visible on the surface of the old wood when the bark was stripped from the segment and the latter dried. In this manner xylem patterns were obtained showing that the induced activity was in all cases similar to that produced by wounding alone but more extensive. There was local activity at the three regions of wounding, namely, the ring and the top and bottom of the segments, in the controls; but there was a much greater, though still local, activity in the cases where heteroauxin had been applied. The influence of the latter was manifested at points some distance from the region of application, but without any renewed activity on the part of the intervening cambium.

Recent American Earthquakes

THE recent issue (July 1937) of the *Bulletin* of the Seismological Society of America contains several useful papers on recent earthquakes in North and South America. J. E. Ramirez (pp. 211-223) describes ten earthquakes in the department of Nariño, Colombia, within less than a year (1935-36), three of them of destructive strength. The region is one that has been visited by many great earthquakes (of which a list is given) since the Spanish conquest. A semi-destructive earthquake on July 15, 1936, with its origin near the boundary of the States of Washington and Oregon, is studied by B. H. Brown (pp. 205-209). Many tombstones in the cemeteries were rotated, about 70 per cent of them in the clockwise direction, but it is noted that some stones in close proximity were rotated in opposite directions. P. Byerly and J. T. Wilson (pp. 225-229) give a valuable list of 64 earthquakes in northern California in 1936. Many of the epicentres, as shown on the map, lie along well-known faults. The earthquakes of the New Madrid region (the scene of the great earthquakes of 1811-12) are receiving careful attention. F. Robertson (pp. 231-239) describes two slight shocks during the first half of the present year. The earlier (January 30) occurred, like a recent predecessor (May 12, 1929), at the height of the flood of the Ohio and St. Francis rivers. Its epicentre seems to lie on the edge of the Tiptonville dome, one of the largest areas partly uplifted during the earthquakes of 1811-12.

Secular Trends of Temperature

DURING the last few years, a number of investigators have discussed the secular trend of temperature over a long series of years at various places in Europe and America, generally with the aid of moving 10-year averages of mean temperature. In Prof. Note No. 77 of the Meteorological Office (London: I.M. Stationery Office), Miss L. F. Lewis gives a very thorough analysis of one of the best records for this purpose, that obtained at the Radcliffe Observatory, Oxford. The period covered is 1815-1934. The observations had been corrected for changes of instrument and exposure by certain of the trustees of the Observatory. The analysis covers the year and the four seasons separately, and brings to light a number of interesting facts. The annual curve of 10-year moving annual averages for the whole 120 years reveals three marked warm and two marked cold periods. The third warm period is the one that

we have been enjoying during the present century and is not very different in intensity from the two earlier ones; but when we come to the separate seasons it is seen that the mildness of the winters of the past forty years is without precedent. The summer and winter are the seasons which follow least closely the annual curve. The summers of the present warm spell have until the last few years been on an average decidedly cool, so that this latest warm spell is also one of notable equability. No previous 20-year means of the difference between mean summer and mean winter temperature have been so low as those for 20-year periods ending between the years 1912 and 1934. A definite answer to the question whether our climate is becoming milder cannot, of course, be obtained from these curves, but they certainly correct the impression of such a change given by a comparison between the latter part of the last century and the present century up to date.

Hydraulic Cements

IN a discussion on chemistry and building research in Section B of the British Association at Nottingham, Dr. F. M. Lee referred to some of the main problems met with in cement technology. He was dealing with hydraulic cements—those which set and remain permanent under water—and confined himself to Portland cement. From phase equilibrium studies of binary, ternary and quaternary oxide systems and from the application of microscopic, X-ray and other methods of examination the major crystalline compounds have been found to be $3\text{CaO} \cdot \text{SiO}_2$, which is mainly responsible for the development of strength in the early stages of hardening, $2\text{CaO} \cdot \text{SiO}_2$, which hydrates slowly and develops strength in the later stages, $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, and sometimes $5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$, and $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$. On hydration, it is probable that a hydrated dicalcium silicate or a $3\text{CaO} \cdot 2\text{SiO}_2 \cdot \text{aq}$. compound is formed, free calcium hydrate being liberated, and a hydrated tri- or tetra-calcium aluminate produced. Calcium-sulpho-aluminate is also formed by reaction with the gypsum used to control the set. When, as in practice, a limited proportion of water is used, the hydration products appear to be mainly gelatinous, but the view that this gel has a microcrystalline structure is as yet unconfirmed. Heat of hydration is greatest for the compound $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, and diminishes in the order $3\text{CaO} \cdot \text{SiO}_2$, $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$, $2\text{CaO} \cdot \text{SiO}_2$. Moisture content considerably affects the physical properties of the set cement. Theories concerning volume changes were also discussed.

Polymorphism under Pressure

THE issue of the *Proceedings of the American Academy of Arts and Sciences* of July contains a paper of ninety pages by Prof. P. W. Bridgman of Harvard on the polymorphic transitions of thirty-five solid inorganic substances under pressures up to 50,000 atmospheres and at temperatures from -100°C . to 200°C . The substance under test is placed in a cylindrical hole about 1 cm. long and 0.6 cm. diameter in a cylinder of 'solar' steel about 4 cm. long and 3 cm. diameter, and the pressure is applied by a 'carboly' piston forced into the hole by a hydraulic press. The pressure is determined from that in the press and the areas of the sections of the pistons of apparatus and press. To enable the cylinder to withstand the pressure without fracture, it is made slightly conical and the pressure applied

forces it into a wide collar of chrome vanadium steel in which a thermo-couple is placed to measure the temperature. The change of volume of the substance on transition is determined from the movement of the piston. The whole apparatus is surrounded by an oil bath. For the substances examined the transition of phase takes place in most cases at higher temperatures as the pressure is increased, but there are many exceptions. The change of volume may decrease or increase with increase of pressure, and Prof. Bridgman concludes that polymorphism is "an essentially haphazard phenomenon".

Densities of Mixtures of Light and Heavy Water

In many lines of investigation, the proportions of light and heavy water in a mixture are required, and the simplest method of finding these proportions is a determination of density. L. G. Longworth (*J. Amer. Chem. Soc.*, 59, 1483; 1937) has determined the densities of several mixtures of light and heavy water and finds that the two liquids mix without volume change, so that the volume of a mol of the solution may be expressed in terms of the mol fractions of the components by the formula $V_s = N_1v_1 + N_2v_2$, where the subscripts 1 and 2 refer to the light and heavy constituents. The actual molal volumes of the solutions are given by the relation $V = (N_1M_1 + N_2M_2)/d$, where M is the molecular weight and d the observed density. The expansions on mixing, $V - V_s$, were found to be zero within the limits of precision of the density determinations. The atomic weights used were $O = 16.000$, $H = 1.00756$, $D = 2.01309$, the atomic weight of hydrogen being given a correction for the deuterium normally present. If ΔS is the value of $1 - d_s/d$, referred to the density of deuterium-free water, the two equations may then be combined to give a simple relation between ND_2O and ΔS , namely, $ND_2O = \alpha \Delta S / (1 - \beta \Delta S)$, in which $\alpha = 9.285$ and $\beta = 0.0309$. This equation makes it possible to determine the proportions of light and heavy water in mixtures of the two.

Uranium Dioxide Starting Resistances

In starting an ordinary D.C. motor, a 'starting' resistance is placed in series with it and this resistance is gradually diminished by hand as the speed of the motor increases, so as to maintain so far as possible a constant current through the motor. In the autumn issue of *AEG Progress*, a description is given of new starting resistances made of uranium dioxide (UO_2). This material was discovered by two German engineering firms working in collaboration—the Allgemeine Elektrizitäts-Gesellschaft (A.E.G.) and the Osram Gesellschaft. Unlike ordinary metals, its resistance diminishes as the temperature rises, and as this fall occurs rapidly, a 'resistor' of this material when placed in series with a motor keeps the current constant during the starting period. The long life of these resistors is due, among other things, to the fact that during operation they heat only a few hundred degrees and never become red hot. A usual value for the resistance of one type of these resistors is one ohm when hot and fifty ohms when cold. Their starting times vary between half a second and 30 seconds, whilst their cooling periods last for some minutes. These resistances can also be thermally and electrically balanced so as to become voltage regulators. The cost of installing them in existing installations is very low. It is practically only necessary to provide lamp-holders.

Service Area of a Radio-telegraphic Transmitter

THE July issue of the *Amalgamated Wireless (Australia) Technical Review* contains a paper entitled "The Service Area of a Long Wave Telegraphic Transmitter" by A. L. Green. This paper discusses the factors of aerial efficiency, wave propagation and interference from atmospherics, which determine the delivery of a reliable day and night broadcast telegraphic service to all points within a radius of about 5,000 miles from the transmitter. In the study of this problem, a large amount of published data has been analysed and the results have confirmed two assumptions made in the author's calculations. The first of these relates to the use of Watson's propagation formula over a large range of wave-lengths, while the second is that the intensity of interference from atmospherics is directly proportional to the wave-length to which the receiver is tuned. As a result of the author's calculations, it is concluded that the optimum wave-length for the service contemplated is about 4,000 metres, and that the supply of 100 kilowatts of power to an aerial of an effective height 100 metres is sufficient. The use of a wave-length shorter than the optimum improves the service at the shorter distances; while a longer wave-length is necessary only if the service requires to be extended to very great distances. Under the conditions described above, the radiated field should provide a signal to noise ratio greater than unity at all points within a radius of 5,000 miles from the transmitter.

Geometry of Pipe Joints

SOME interesting geometrical problems arise in making neat and practicable bend connexions in sheet-material between one cylindrical pipe or duct and another. For those who are concerned with work of this kind or with analogous problems, a pamphlet by W. Sellar entitled "The Geometry of Conical Pipes Bends and Joints" (London: The Draughtsman Publishing Co., Ltd. 2s. net) will be found of positive assistance. In a pipe of uniform diameter, the arrangement of elbows and bends of various degrees of smoothness presents no special difficulty, and several of the methods in use are described and illustrated. When, however, the pipes to be connected are of different size and meet at an angle, the choice of a wrapped surface to which a flat sheet can be bent and which will form a convenient and pleasing intersection with the given surfaces is distinctly more complex. The solution lies in making use of the property that the ellipse is a plane section both of the cone and of the cylinder. The appropriate ellipse is obtained by arranging that the cone and the cylinder are both tangent to a common sphere, and in the pamphlet it is shown how, in a number of different problems, one or two or even more spheres can be used to obtain connexions for complex systems of pipes and branches in such a form as to minimise loss of pressure. The basic principle of this method of construction is clearly explained but no geometrical proof is given—nor for the purpose in view is it required. It is not clear, therefore, why a long list of what are described as essential points is given for these, and the figures illustrating them tend rather to complicate than to clarify the apparent simplicity of the method. The explanations given of the solutions of the numerous problems described are, however, concise and clear, and are illustrated by drawings which alone would form a sufficient guide to a draughtsman.

The Mellon Institute, Pittsburgh*

THE Mellon Institute of Pittsburgh has published in pamphlet form an account of the dedication of the new building on May 6-7, 1937 (*NATURE*, May 15, 1937). In the introductory address, the Hon. Andrew W. Mellon paid tribute to Dr. Robert Kennedy Duncan, who initiated the system of industrial fellowships; and to his book "The Chemistry of Commerce", from which Mr. Mellon derived his original interest in the scheme. Discoveries and inventions, rather than governmental or political action, he said, "increased production, lowered costs, raised wages, elevated the standard of living".

The addresses of Dr. Irving Langmuir, Dr. Harold C. Urey and Dr. William P. Murphy—all Nobel laureates—are reprinted. On the subject of chemical research, Dr. Langmuir said that it is a common experience of industrial laboratories that the cost of research on a problem, up to the point where a patentable invention is made, is only a small fraction of that required to make the invention commercially successful, and for this reason such laboratories cannot devote a large part of their effort to fundamental research. The application of modern physics to chemistry, he suggested, is receiving only a small fraction of the attention it deserves. The greatest field which would open itself within the next decade in chemical research would be in the application of the new physical methods to the study of the familiar properties of matter, which have been neglected by the physicist for many years.

"We need more fundamental knowledge, in terms of atomic structure, of the mechanical properties of metals, insulating materials, plastic materials, and in general, chemical substitutes of high molecular weights. The use of X-rays, electron diffraction, and electron optics . . . should open new fields to chemists."

Dr. Urey scheduled ten important technical processes developed in recent years. Two of fundamental importance, the fixation of atmospheric nitrogen and the hydrogenation of coal, are due largely to German men of science. As to the first, it is estimated that the I. G. Farbenindustrie has expended 150,000,000 gold marks in the development of the process. Synthetic woollen textiles are coming—already two Italian regiments are wearing imitation wool uniforms made from the casein of skimmed milk. Would artificial wools ruin sheep farmers? More thought should be given to such problems consequential on scientific discovery. The limitation of scientific progress is fixed by the number of men available. "Find the men! That is the problem."

Another serious problem is the dissipation of raw material. We may have to grow our fuel supply by plants specially developed for the purpose; but the replacement of metals presents greater difficulties, pending the conquest of Mars and Venus. Referring to the ideals of scientific men, he said:

"We wish to abolish drudgery, discomfort, and want from the lives of men and bring them pleasure,

comfort, leisure and beauty. Often we are thwarted and our efforts perverted to other ends, but ultimately we will succeed. You may bury our bodies where you will, our epitaphs are written in our scientific journals, our monuments are the industries which we build, which without our magic touch would never be."

Dr. Murphy, co-discoverer with Dr. George R. Minot of the liver treatment for pernicious anemia, commented on a weakness of medical research—the lag between discovery and its application to the cure of disease. The medical researcher has no incentive for the wide dissemination of his work, the profession as a whole showing no interest in commercial exploitation or in ensuring that the best product is put on the market. Progress in medical research has consequently been retarded in contrast to industrial research.

On the second day, a symposium on recent progress in science was held, including contributions from Dr. Frank B. Jewett on "Communication Engineering", Dr. George O. Curme, jun., on "Recent Progress in Synthetic Organic Chemistry", Sir Frederick Banting on "Early Work on Insulin", and Dr. William W. G. MacLachlan on "The Problem of Chemotherapy in Pneumonia". Dr. Curme said that the spectacular days of pioneering in the field of synthetic organic chemistry are passing, but the important task of its application to industrial and economic problems "is just getting under way". He instanced plastics as offering a wide field of work and regretted that "not one of our universities offers an adequate course of study, preparing students either for engineering application or research on plastic materials". Sir Frederick Banting said that the greatest advance in the treatment of diabetes since the discovery of insulin was due to Hagedorn and his colleagues, of Denmark, who in 1933-35 discovered that the addition of protamine to their insulin so delayed the action that the day's supply could be given in one injection. The presence of zinc was found by Scott to be necessary for this effect. It is estimated that more than a million people receive insulin each day. "Although much of the physiology is known, we do not yet know how insulin enables the body to utilize carbohydrates, nor do we know the cause of diabetes."

Dr. MacLachlan gave an interesting account of the systematic research carried on in the Institute on quinine derivatives for the treatment of pneumonia, 78 having been prepared and tested, a laborious process requiring about 20,000 white mice and other subjects. "As to our results for the past two years, we can say that hydroxyethylapocoupreine appears to be effective in a considerable number of cases", especially in cases of pure infection. The original discovery that ethylhydrocoupreine possesses strong powers of destroying pneumococci was due to Morganroth, in Germany, in 1911; but this preparation had the serious defect of producing blindness if given in adequate dosage. The object of the Pittsburgh workers, as of other workers in Japan and Germany, was to produce a derivative without this defect.

* Dedication of the New Building of Mellon Institute. Pp. 71. (Pittsburgh: Mellon Institute, 1937.)

Reaction Kinetics

ON September 13-15 the Faraday Society met under the presidency of Prof. M. W. Travers in the University of Manchester to discuss the modern theories and selected experimental aspects of reaction kinetics. The meeting was attended by a very large number of foreign guests and visitors.

The first section of the discussion was devoted to the theoretical treatments of reaction kinetics and resolved itself into a critical examination of the transition state or activated complex method and a comparison of the value of this method with that of the collision theory. The service done by this discussion lay in the emphasis on the differences which exist in the conceptual approach to the problem between those using the transition state method and those using collision theory.

The transition state method consists of two steps: the first is the construction of the potential energy surface for all configurations of the reacting atoms, and the second the calculation of the number of representative points which pass in unit time from the region of the potential energy surface that represents the initial state to that representing the final state of the reaction. The first step in this problem has been successfully carried out in a number of simple cases by the application of the semi-empirical method, developed by Eyring and Polanyi from London's theory. It was shown how the London theory can be modified so as to allow of an extensive use of empirical information and afford an interpretation of chemical reactivity in terms of bond strengths and the repulsion forces acting between atoms and molecules. A chemical change of the type $AB + C \rightarrow A + BC$ can be carried out by a complete dissociation of $AB \rightarrow A + B$ and the subsequent union of the atoms B and C . This would lead to an activation energy for the reaction equal to the dissociation energy of AB , no use having been made of the forces between atoms C and B . If, however, the centre C can be made to approach AB without overcoming large repulsion forces, then the attraction forces between atoms C and B can be utilized to reduce the activation energy. The driving force of a chemical change arises from the resulting bond formation BC , whereas the chemical inertia arises from the energy expended in achieving a configuration of atoms such that the driving force becomes operative. To attain this configuration, it is necessary to overcome the repulsion forces between AB and C and also the extension forces of the molecule AB .

The second step requires the definition of an 'activation surface' such that representative points crossing this surface lead to reaction. The number of points crossing this surface in unit time (reaction rate) is simply the density of points on the surface multiplied by their mean velocity perpendicular to the surface. The number of points in the 'activation surface' has been calculated by statistical equilibrium theory. Two very fundamental points were brought out in the discussion of this method.

1. The activated complexes AB (systems the representative points of which lie in the activation surface) are formed from molecules A^1 and B^1 of the initial state which possess sufficient energy in excess

over the normal molecules A and B . The transition state method assumes that equilibrium exists at all times between normal molecules and activated complexes, and this implies equilibrium between normal molecules and the energy-rich species A^1 and B^1 . It was emphasized that it is an assumption that the equilibrium numbers of energy-rich molecules A^1 and B^1 are maintained and not a condition which is necessarily fulfilled.

In most chemical reactions this condition is fulfilled since the equilibrium constant for a reaction can be expressed as the ratio of the reaction velocity constants in the forward and the reverse directions. Whenever the kinetic mass action law can be applied, it is justifiable to assume that the equilibrium number of energy-rich molecules is maintained and that the same conditions obtaining at equilibrium also hold when the products of reaction are removed.

2. In calculating the velocity of a chemical reaction by the transition state method, it is necessary to assume the validity of classical mechanics for the activated complex. Difficulties arise in the quantum treatment because of the fact that one cannot speak of a mean velocity of the representative point in the activation surface (Heisenberg indeterminacy principle) and, moreover, in certain cases tunnelling through the potential energy barrier may play an important part.

The statistical method of treating the activated complex has been translated into thermodynamic nomenclature and one speaks of the equilibrium constant $K^\ddagger$, the entropy change $\Delta S^\ddagger$ and heat change $\Delta H^\ddagger$ between the initial state and the activated complex. The heat change is the activation energy and the entropy change is related to the factor A in the velocity constant expression $k = Ae^{-Q/RT}$. This method has been used to account for reactions with abnormal A factors. An association reaction involving complex molecules has an abnormally small A factor, which in this theory is to be accounted for in terms of a negative $\Delta S^\ddagger$ between the initial state and the activated complex. The explanation in terms of the collision theory becomes identical with that of the transition state if the collision number is multiplied by a probability factor P which contains terms relating to the correct orientation, the correct 'internal phase' and the right internal energy distribution of the reacting molecules. These same factors appear explicitly in the partition functions which define the change entropy $\Delta S^\ddagger$.

The denaturation of haemoglobin and egg albumen are reactions where the breaking of many weak bonds leads to the formation of an activated complex in which there is a much greater randomness of motion than in the initial state. This leads to a large positive entropy change, which means an abnormally high A factor.

Of great importance to any treatment of reaction kinetics is the study of the changes in the factors A and Q (of the Arrhenius equation) in a series of related reactions. An adequate theory must be able to include and explain the regularities which exist between changes in $\log k$, Q , A and $\log K$ (K is an equilibrium constant). When substituents are

introduced into, say, benzene derivatives, the velocity at which these compounds react is changed and these changes are nearly all due to changes in the activation energy. In other cases, however, superimposed on the changes in Q are variations in A , and frequently the two variations tend to compensate each other. The factor A shows marked variations due to changes of the solvent in which reaction occurs, and both A and Q have been found to vary with changes in the hydrostatic pressure. Changes in the velocity constants of a series of chemical reactions are often related to the changes in the equilibrium constants for the same or for a very similar series of reactions by $\log k = \alpha \log K + \text{const.}$ This gives an important approach to the understanding of the reactivity of organic compounds. Although a quantitative explanation cannot yet be given, it is just beginning to be possible to connect some of these relationships with changes in bond strengths, repulsion forces and chemical driving forces.

The last section of the discussion dealt with ionic and proton transfer reactions. The mechanism of both types of change has been considered in terms of 'extension' and repulsion forces. In the field of negative ion reaction, it has been possible to trace a relationship between the mechanism on one hand, and the chemical structure of the reactants and the physical conditions of reaction on the other. This study is of great value to the understanding of organic reactivity and the nature of the factors influencing it.

In the proton transfer reactions the small weight of the proton and the comparatively short distances between centres make a quantum mechanical 'tunnel effect' possible, but the experimental evidence available does not directly demonstrate the presence or absence of this effect. The comparison of reactions involving deuterons with those in which protons take part has led to valuable information about the mechanism of acid-base catalysis and proton transfer reactions in general.

Institution of Gas Engineers

AUTUMN RESEARCH MEETING

THE ninth Autumn Research Meeting of the Institution of Gas Engineers in London on November 2 and 3 had an interest above the average. The Institution research organizations have hitherto concerned themselves with current technical problems. This year the fortieth and forty-first reports of the Joint Research Committee of the Institution and the University of Leeds deal with problems of the future, and offer a glimpse of a cherished ideal of the gas industry, namely, the complete conversion of coal into a gas suitable for general distribution. Seventeen years ago, at a meeting of the Institution, gasification with oxygen and steam was visualized as an approach to this problem. Cost of oxygen and unsuitability of composition of the gas offered obstacles then unsurmountable. In the meantime, the oxygen production has been improved and cheapened. High-pressure technique has also shown the possibility of synthesizing hydrocarbons. In Germany, the Lurgi Company has built and operated a high-pressure producer whereby the town of Hirschfelde is supplied with gas made from lignite. In the forty-first report, on experiments made by Dr. F. J. Dent, it is disclosed that solid fuel can be freely hydrogenated to gaseous paraffin hydrocarbons at quite moderate pressures.

After carbonization at low temperatures, a coke contains carbon in a condition very ready to take up hydrogen under pressure, giving gaseous hydrocarbons instead of liquids, but without requiring the very high pressures necessary to 'liquefy' coal. Indeed results quoted show that hydrogenation of the coke combined with gasification of the residue would enable a coal to be converted into a rich gas without exceeding steam boiler pressure, and with an efficiency of 80 per cent. Such a gas, made and purified under pressure, would probably be practically sulphur-free and ready for distribution over considerable distances. Such results would apparently

be attainable with almost any type of coal, whereas high-class coking coal must be used in current practice.

The transference of these results to an industrial scale may take time, but there is no reason to doubt its feasibility as the engineering problems involved have already been solved. There is thus in prospect a method of fuel distribution which should be kept in mind at a time when the future of the coal, fuel and power industries is the subject of repeated inquiry and comment.

The fortieth report, prepared by Mr. J. W. Wood, on the combustion characteristics of town gas, contains a review of the literature on the combustion of gas which is probably the most comprehensive available. It presents an attempt to ascertain the characteristic of a gas most suitable for general use, and is appropriately associated with the forty-first report, which suggests that a process of complete gasification might be capable of adaptation to suit the composition of the gas produced.

A paper on the ignition of gas by 'cold catalyst' by L. W. Andrew, A. B. Densham and E. W. Voice suggests that the time is approaching when gas burners may be ignited by the use of a switch only. H. Hollings, W. K. Hutchinson and R. H. Griffith read papers on the removal of sulphur from gas, showing a way to sulphur-free gas made by current methods. Towns gas is the purest commercial fuel—so far as sulphur is concerned—but the removal of the residual traces of sulphur has eluded the ingenuity of gas chemists for generations. Now several alternatives have appeared, and catalytic oxidation of sulphur compounds at 150° holds promise of almost complete removal. When the products of combustion of coal gas are free from sulphur, considerable expansion in the uses of gas can be envisaged, and the reports at this meeting show that this time is now in sight. H. J. HODGMAN.

Science News a Century Ago

Civil Engineering at the University of Durham

In the *Civil Engineer and Architect's Journal* for January 1838 is an article entitled "Regulations for Students in Civil Engineering of the University of Durham, passed by the Senate and Convocation, November 22, 1837". In commenting on the Regulations, the *Journal* said: "The engineer, to enter upon any task of magnitude, ought to bring to it natural talents, expanded by education, and strengthened by experience; he ought to combine the mind of the philosopher with the accomplishments of the mechanic; he ought to be a man of profound judgment; he ought to be able to decide not merely what to do, but what *not* to do; . . .

"A large proportion, in fact, the whole of the above-mentioned qualifications so far as education and a rigid academic examination can effect them, will be induced by the system of regulations and course of study prescribed by the Senate; and the practical application of the knowledge obtained at the College will be made most advantageously in the mining districts in the neighbourhood; without the combination of theory with practice, the student when he enters into the world will find himself loaded with a quantity of knowledge which he is more apt to forget than to seek out the opportunity of applying to the advancement of the arts."

Advantages of Medical Botany

At a meeting of the Medico-Botanical Society on November 22, 1837, reported in the *Lancet* of December 2, Mr. Johnson read a paper on this subject. "The advantages of the study of botany," he said, "were not immediately felt by the majority of medical practitioners, who were satisfied with obtaining their drugs from a wholesale druggist, and such herbs as they might require from Covent Garden. The physician, too, went on his daily practice of prescribing remedies which he had been in the habit of employing for years, and never daring to employ new remedies. This was the cause of the indifference with which medical botany had been treated by the majority of the profession. The objects of the Society were, perhaps, not sufficiently understood; it was not established for the purpose of forwarding the knowledge of botany in the abstract, the locating of certain genera and species, but for the purpose of ascertaining and testing the effects of remedies. Among other reasons why medical practitioners should study botany he might mention that of the present general diffusion of knowledge; many persons studied botany as an amusement, and the medical man, who it was generally considered ought to be better informed than common, should not be behind-hand in this science."

Magnetic Observations in America

At a meeting of the Royal Society on November 23, 1837, Francis Baily being in the chair, a paper was read entitled "Magnetical Observations made in the West Indies, on the Coasts of Brazil and North America, in the years 1834, 1835, 1836 and 1837". The author was Sir James Everard Home, Bt., Commander, Royal Navy, fellow of the Royal Society, and the observations had been reduced by the Rev. George Fisher, F.R.S.

"The observations of the dip were made with an instrument of modern construction by Dollond.

Each observation consisted of an equal number of readings of the position of the needle, before and after the inversion of its poles, and a mean of all the readings taken for the true dip. Tables are subjoined containing the dips observed at each place; the times of making a hundred vibrations of five horizontal needles, and the mean horizontal forces computed therefrom; and likewise the results estimated in the direction of the dipping needle, compared with direct experiments made with the dipping needle itself."

A Simulated Fast

THE *Lancet* of November 25, 1837, describes the following remarkable case of simulation: "A woman was lately exhibited in Paris as a phenomenon on the ground that she had taken no food for the last twenty months; she was fresh and fat, and carried a healthy child, six months old, at the breast. Not consuming any food the woman could not be supposed to excrete; she accordingly passed no excretion, and the miracle was complete. She carried her folly, or her knavery, so far as even to enter the *Hôtel Dieu* and place herself under the surveillance of a physician, M. Caillard, whom she assured that God was the father of her baby, and that he had commanded her to commence a fast in 1836. She was placed in St. Benjamin's Ward, and for several days the history she gave of herself seemed true; the food and drink placed beside the bed had remained intact; no trace of excretion could be discovered. Determined to find an explanation, M. Caillard passed her over to the care of M. Magendie, who happened to have a small closet unoccupied attached to one of his wards. The woman was shut up in this apartment with some food; the quantity of which was accurately measured. She resisted the sense of hunger for eight days, but ate on the ninth. The excretions were found carefully concealed in the mattress, which she had sewn up again."

University Events

BRISTOL.—Dr. Eric Ashby has tendered his resignation from the readership in botany as from December 31, on his appointment to the chair of botany in the University of Sydney.

CAMBRIDGE.—G. L. Clark, of Trinity College, has been elected to an Isaac Newton Studentship.

Dr. C. F. A. Pantin has been appointed reader in invertebrate zoology.

T. T. Paterson, of Trinity College, has been appointed curator of the Museum of Archaeology and of Ethnology.

Dr. J. A. Ramsay, of Queens' College, has been appointed Harding lecturer in experimental zoology. Dr. G. S. Carter, of Corpus Christi College, F. R. Parrington, of Sidney Sussex College, and Dr. G. Salt, of King's College, have been appointed University lecturers in zoology.

LONDON.—Mr. J. D. Bernal has been appointed to the University chair of physics tenable at Birkbeck College. Since 1934 he has been assistant director of research and in charge of the Crystallographic Laboratory at Cambridge.

SHEFFIELD.—The following appointments have been made: H. J. Barrie, as demonstrator in pathology; R. B. M. Jenkins, as assistant lecturer in civil engineering.

Societies and Academies

London

Royal Society, November 11.

F. W. ASTON: A second-order focusing mass spectrograph and isotopic weights by the doublet method. Several improvements have been embodied in this instrument, including adjustable slits and second-order focusing. The instrument has a resolving power of 2,000 and an accuracy of measurement approaching 1 in 10^4 . By its means, a large number of natural doublets have been measured. In many of these, one member is a hydrocarbon molecule, hence the isotopic weight of ^{12}C has been ascertained with particular care. From the results obtained the packing fractions and isotopic weights of more than twenty atomic species are tabulated, some for the first time.

J. E. BEST, F. T. FARMER and J. A. RATOLIFFE: Studies of the E region of the ionosphere.

Paris

Academy of Sciences, October 4 (C.R., 205, 549-584).

HENRI LAQATU and LOUIS MAUMÉ: The chemical determination of the cultivated plant.

ARISTOTILE D. MICHAL: General conformal geometry.

M. and MME. LUCIEN D'ARABUJA: Monochromatic images of the sun obtained on the spectroheliograph with the $\lambda 10880$ infra-red helium line, the violet hydrogen line H_ϵ and the infra-red lines of the same element $\lambda 10938$ and $\lambda 10049$.

AUBREY NICOLAU: The thermomagnetic study of two paramagnetic solutions. Details of measurements of solutions of nickel sulphate and ferrous ammonium sulphate. Both follow the law of Weiss.

MAURICE FALLOT: The magnetic properties of alloys of iron and rhodium. The results are given graphically. The magnetic properties of these alloys show one remarkable characteristic, the mean atomic moment increases with the percentage of rhodium.

GABRIEL BOSCHETTI and JACQUES BERBERA: Water, as ice, liquid water and in solution in dioxan studied in the near infra-red.

CHARLES DUFRAISSE and JEAN LE BRAS: Combustible substances, regarded as helping incombustible extinguishers, for the practical extinction of flames. Contrary to the usually accepted view, absolute incombustibility is not a necessary condition for fire extinguishers: partially combustible substances or mixtures may be more efficacious provided they do not form a true flame.

PAUL CHOVIN: Researches on Pechmann's colouring matter. The products resulting from the action of alkalis. Mechanism of their formation.

HENRI LONGCHAMON: The genesis of gneiss and granulites with sillimanite in the French Central Massif.

THÉODORE V. IONESCU: The calculation of the interval of time between two successive encounters of an electron with the molecules of the ionosphere.

ROGER GAUTHERET: New researches on the culture of cambium tissue. In an earlier communication, the author has shown the possibility of making true cultures of plant tissue. Details are now given of the effects produced by adding small proportions of

heteroauxin, cysteine hydrochloride and vitamin B_1 to the culture media. All these stimulate the proliferation of cambium tissue of *Salix caprea*, cultivated *in vitro*. Of the three substances named, vitamin B_1 gives the best results.

OCTAVE DUBOSQ, PIERRE P. GRASSÉ and MAURICE ROSE: The flagellae of *Acanthotermes ochraceus* of South Algeria.

BRUNO MINZ and RENÉ AGID: The influence of vitamin B_1 on the activity of acetylcholine.

GEORGES BLANC and MARCEL BALTAZARD: Crossed immunity between the pustular fever and purpura fever of the Rocky Mountains. Vaccination of the guinea pig against these two diseases by a living billeted virus of pustular fever. The immunity conferred by pustular fever against purpura fever is total. It is as strong in man as in laboratory animals.

RENÉ SALGUES: The wool of the osteomalacic sheep.

HENRI EMBRY: Immunization of the rabbit against the experimental epithelioma of Brown Pearce.

Cape Town

Royal Society of South Africa, September 15.

A. P. GOOSSENS: A study of the South African species of *Sporobolus* R.Br. with special reference to leaf anatomy. A historical account is given of the work done on the anatomy of grass leaves. The anatomy of the leaves of *Sporobolus* is discussed, and a key to the species is drawn up incorporating these anatomical features. The new species are described and the distribution of all South African species is given.

Moscow

Academy of Sciences, C.R., 15, No. 9, 1937.

J. A. MINDLIN: The boundary dynamic problem of the theory of elasticity for a circle with a given tension.

S. LECHNITSKY: Solution of the problem of elasticity of anisotropic bodies for the interior of an ellipse.

N. MOISEWITZ: Periodic trajectories around the point of balancing L_1 in the Copenhagen problem of three bodies.

S. A. BOROVIK and T. T. BOROVIK-ROMANOVA: Variations in the intensity of titanium and vanadium radiation on the introduction into the electric arc of salts of sodium and of potassium.

A. V. STEPANOV: The influence of surface state on the plasticity of crystals.

E. I. GURVICH: The problem of the presence of films on metals.

W. G. TRONOV: Solubility of noble metals at high pressure (1). The solution of metallic platinum in hydrochloric acid.

G. A. LEVITSKIY: Genotypic control of structural chromosome changes.

K. SUCHOBUKOV and B. STROGOV: The activators of peroxidase in sick plants.

M. I. GOLDIN: So-called masking of virus diseases.

P. J. SCHMIDT: Two new species of *Aricdiellus* Jordan from the Okhotsk Sea.

A. M. VASUTOCHIN: Regeneration of the myoid elements of the thymus gland of amphibians.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 22

UNIVERSITY COLLEGE, LONDON, at 5.30.—The Very Rev. W. R. Inge, K.C.V.O.: "The Price of Progress" (Pickman Godlee Lecture).*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—J. Rymill: Film of the British Graham Land Expedition.

ROYAL SCHOOL OF MINES, at 8.—Prof. B. P. Haigh: "Metallurgy and Mechanics in the Design of Steel Pipes" (Armourers and Brasiere's Company's Lectures. Succeeding lectures on November 29 and December 6).*

Tuesday, November 23

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. Rubin: "Experience and Perception, Thinking and Feeling" (succeeding lectures on November 24 and 26).*

EUGENIOS SOCIETY (at the Royal Society, Burlington House, W.1), at 5.30.—J. C. Trevor: "Some Anthropological Considerations of Race Crossing".*

Wednesday, November 24

BRITISH ASSOCIATION (at the Goldsmiths' Hall, Foster Lane, Cheapside, London, E.C.2), at 4.—Dr. R. E. Mortimer Wheeler: "Origins of Town Life in Britain" (Norman Lockyer Lecture).

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at University College, Gower Street, W.C.1), at 8.—Dr. D. J. Lysach: "Hooke's Theory of Combustion".

Thursday, November 25

ROYAL SOCIETY OF MEDICINE, at 3.—Prof. F. L. Golla: "Science and Psychiatry" (Eighteenth Mandale Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. G. Stoney, F.R.S.: "Scientific Activities of the late Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S." (Parsons Memorial Lecture).

INSTITUTE OF FUEL (at the Junior Institution of Engineers, 39 Victoria Street, S.W.1), at 6.—Symposium on "The Ignition of Fuel on Grates".

Friday, November 26

PHYSICAL SOCIETY (at the London School of Medicine for Women), at 5.15.—Thomas Young Oration.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at the Royal Society of Arts, John Street, Adelphi, London, W.C.2), at 5.30.—Brigadier M. N. MacLeod: "The Ordnance Survey and its Work".

BEDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. J. R. Partington: "Chemistry in the Ancient World".

ROYAL INSTITUTION, at 9.—Prof. H. Dingle: "Science and the Unobservable".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SENIOR ENGINEER (short-wave and ultra-short wave systems) and **ENGINEER** (acoustics) in the Research Department of the B.B.C.—The Engineering Establishment Officer, British Broadcasting Corporation, Broadcasting House, W.1 (November 23).

ASSISTANT LECTURER IN MATHEMATICS in University College, Leicester—The Registrar (November 27).

LECTURER IN PHYSICS in the Leicester College of Technology—The Registrar (November 27).

LECTURER IN GEOGRAPHY AND GEOLOGY in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (November 27).

LECTURER IN BOTANY (physiology or genetics) in the University of Bristol—The Registrar (December 2).

CHEMIST at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7 (December 31).

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 44, Section A, No. 1: Precision Measurements with a Radial Deflection Cathode Ray Oscillograph. By John J. Dowling and Dr. Thomas G. Bullen. Pp. 10+1 plate. 1s. Vol. 44, Section A, No. 2: Some Electrical and Optical Properties of Iodine Vapour. By K. G. Humeau, B. B. Cathcart and C. M. Minnie. Pp. 11-18. Vol. 44, Section A, No. 3: On some Symbolic Formulae in Probability Theory. By T. S. Broderick. Pp. 19-23. 1s. Vol. 44, Section A, No. 4: The Zeros of Legendre Functions. By Dr. P. G. Gormley. Pp. 29-43. 1s. Vol. 44, Section B, No. 1: The Influence of Temperature on the Activity of the Kidney in relation to its Influence on Oxygen Consumption. By E. J. Conway, J. M. O'Connor and D. K. O'Donovan. Pp. 18. 1s. 6d. Vol. 44, Section B, No. 2: Structural Laws of the Mammalian Kidney, with a Theoretical Derivation from a Diffusion-Pressure Theory. By E. J. Conway. Pp. 19-23. 1s. Vol. 44, Section B, No. 3: A Map of the Glacier-Lakes and the Local Glaciers of the Wicklow Hills. By Prof. J. K. Charlesworth. Pp. 29-36+plate 2. 1s. Vol. 44, Section B, No. 4: Studies in the Synthesis of Flavonols—The Oxidation of Flavonodiglucosides. By Dr. Joseph Algar and Isabella P. Carey. Pp. 37-44. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Morgate, Ltd.) [31]

Other Countries

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1936. (No. 776.) Pp. 51+304. (Ottawa: King's Printer.) [8016]

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt Band 8, No. 6: Isförhållanden vid Sveriges Kuster under Vintern 1870-71—1934-35. Av C. J. Östman. Pp. 63+3 plates. 3.00 kr Band 7, No. 1: Fyrsteln. Av Ragnar Malm. Pp. 15+1 plate. 1.50 kr (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [11]

Cornell University: Agricultural Experiment Station. Bulletin 673: Economic Studies of Vegetable Farming in New York. 2. Market-Garden Farms without Greenhouses, Rochester Area. By J. L. Paschal. Pp. 36. Bulletin 676: Tomato Fertilizer Experiments on Long Island. By J. D. Hartman, Paul Work and P. H. Weems. Pp. 12. Memoir 199: Index Numbers of the Cost of Goods and Services bought by Farm Families in New York, 1920 to 1935. By Helen Canon and Mabel Bollins. Pp. 23. Memoir 200: Relation of Size of Community to Marital Status. By Dwight Sanderson. Pp. 74. Memoir 201: The Daily Rate of Photosynthesis, during the Growing Season of 1935, of a Young Apple Tree of Bearing Age. By A. J. Heinicke and N. F. Childers. Pp. 62. Memoir 202: Quantitative Determination of Lactic Acid in Butter. By H. C. Troy and Paul F. Sharp. Pp. 17. Memoir 203: Incidence of Fire Blight in Young Apple Trees in relation to Orchard Practices. By E. M. Hildebrand and A. J. Heinicke. Pp. 26. Memoir 204: The Reliability of Flavor Judgments, with Special Reference to the Oxidized Flavor of Milk. By G. Malcolm Trout and Paul F. Sharp. Pp. 60. (Ithaca, N.Y.: Cornell University.) [11]

II^e Congrès Scientifique International de l'Alimentation organisée par la Société Scientifique d'Hygiène Alimentaire. La Science de l'Alimentation en 1937. Pp. A121+B73+O163+D78+H63+F90+iv (Paris: Congrès Scientifique International de l'Alimentation.) [11]

Bulletin of the American Museum of Natural History. Vol. 74 Art. 1: New Fishes from the Continental Tertiary of Alaska. By Brian M. Schalkjer. Pp. 24. (New York: American Museum of Natural History.) [31]

Catalogues, etc.

Allgemeine und angewandte Zoologie. (Antiquarische-Katalog Nr. 715.) Pp. 160. (Leipzig: Gustav Fock, G.m.b.H.)

Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 24 (London: The Marmite Food Extract Co., Ltd.)

Books on Botany, Part 2. (New Series, Catalogue No. 46.) Pp. 44 (London: Wheldon and Wesley, Ltd.)

The Lovibond Comparator for Colorimetric Determinations. Pp. 26. (Milford, Salisbury: The Tintometer, Ltd.)

Vermes. (Catalogue No. 93.) Pp. 68. (Den Haag: Antiquariaat W. Junk.)

The Debye Industrial X-Ray Unit. (Publication No. 257.) Pp. 9. The Spicker Minor Ultra-Violet Photometer. (S.B. 258.) Pp. 4 (London: Adam Hilger, Ltd.)

A Catalogue of Books Old and Modern, comprising Recent Second-hand Purchases, including Works on the Alps and Mountaineering Architecture, Art, Topography, etc. (No. 485.) Pp. 80. (Cambridge: Bowes and Bowes.)

"Cresall" Dimming Resistances. (List No. 67.) Pp. 2. "Cresall" Electric Branding Iron. (Leaflet No. 66.) Pp. 2. (Birmingham: The Cresall Manufacturing Co., Ltd.)

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SATURDAY, NOVEMBER 27, 1937

Vol. 140

Defence and Economic Adjustment

THE recent debate in the House of Commons on the second reading of the Air Raid Precautions Bill brought into clear prominence the close contact between the work of chemists and other men of science and protection from its devastating consequences under the conditions of modern warfare. Mr. G. Lloyd, Under-Secretary of the Home Office, made a comprehensive survey of the measures taken by the Government, and in course of development, to provide the civilian population with whatever means of defence is practicable against effects of air raids. The object of his Department is to make the community as a whole, as well as individual citizens, aware of the dangers of high explosives, toxic gases and incendiary bombs set free from enemy aircraft, and to institute reasonable precautionary measures against them. Possibly some of these anticipated dangers are exaggerated, especially that from gas, but it would be folly to disregard them; but for psychological reasons the people of the country must be given a certain amount of confidence in protective measures in order to prevent them from becoming panic-stricken. Even although it is sometimes difficult to distinguish between the necessity of expenditure upon increased armaments and that of defence programmes, it is in the interest of everyone that whatever precautionary measures are planned or contemplated should be as efficient as science can make them.

The attitude which chemists and other scientific workers should take in regard to the manufacture of munitions of war has been discussed on many occasions, but opinions upon it vary as much among them as they do among citizens in general. The suggestion put before the Technical Committee of the Disarmament Conference that the

chemists of the world should include in their code of ethics an undertaking not to work knowingly on the development and production of any prohibited method of warfare, and to expose publicly anyone who was detected in such work, is altogether impracticable. Chemists are citizens as well as men of science, and their services should, therefore, be available for what is regarded as the good of the community. At all stages of human history men have used for purposes of war the most effective means of destruction known to them; and there is little difference in principle in the employment of Greek fire many centuries ago and the use of incendiary bombs to-day. Even in those days boiling oil and molten lead were used as measures of defence against attacks on the walls of cities as well as of fortresses.

The scientific worker cannot stand apart, therefore, from reasonable and practicable steps taken towards the protection of the civil population from aerial attacks. He, with many others, may deplore the loss of his faith in the progressive ethical development of the human race, but his natural humanity must make him play his part in endeavours to prevent suffering and death.

While, however, we in Great Britain are planning and undertaking a defence programme which will cost many millions of pounds, it should not be forgotten that France, Germany and other nations have instituted similar protective measures against aerial attacks by other nations—ourselves included. As it may be assumed that most people wish to carry on their work in peace and to promote the industry and commerce of their country, such a condition of things is a reproach to human intelligence. It represents the acceptance of a

policy of despair of avoiding war instead of attempting to discover the causes which lead to armed conflict. Fortunately, efforts are being made in several quarters to promote inquiries into such causes before appeals are made to force. In a petition presented by a deputation to the Prime Minister on November 1, it was urged that H.M. Government should take the initiative in instituting an inquiry into the fundamental causes of rivalry and unrest among nations. More than one hundred fellows of the Royal Society were among the influential signatories of this petition. They, in common with many other distinguished representatives of other fields of intellectual activity, are horrified at the barbaric ways in which progressive scientific knowledge is permitted to be used in operations of war, and associate themselves with any action which may assist in preventing such calamities.

It was suggested by the petitioners that the inquiry might involve the collection and consideration of the basic facts in regard to such questions as access to war materials and world markets, colonial development, problems of surplus populations, and so on, which are often discussed without adequate knowledge and judged without evidence. Though some countries may decline to participate in such an inquiry, or be influenced by the results, it would represent a search for some means of reconciling conflicting national claims and thus make manifest the desire to promote peace on a secure and just foundation. In his speech at the Lord Mayor's banquet on November 9, and again in an address at Edinburgh three days later, the Prime Minister expressed his active interest in efforts of this kind to inquire into the origin and substance of the fears and suspicions which exist among nations, with the view of removing them. "Our country," he said, "has behind her vast, almost illimitable resources, and our very strength makes it easier for us to appeal to others to join in applying our common-sense, our common humanity, to the solution of those problems which carry with them such tremendous possibility for happiness or for misery to the future of the human race. I have faith in human nature. Because I have that faith I believe there will be a ready response to such an appeal."

The economic commission suggested by King Leopold of the Belgians a few months ago would have the same objects as those to which the Prime Minister referred. At the Guildhall on November 17, responding to the toast proposed by the Lord

Mayor of London, King Leopold expressed the hope that Great Britain would take a prominent part in inquiring into the economic difficulties which lie at the root of the international problem which beset the world. "In order to solve those difficulties," he said, "we should need to get a clear view of economic realities seen with a dispassionate eye and divorced from every other consideration. The British Empire represents an important part of the human race that it cannot help but realize more clearly than any other nation how closely the fate of mankind is bound up with its own. That is why your understanding of the great universal problems is so profound and why it is permissible to be hopeful that Great Britain may play a prominent part in the search for a solution of the major economic difficulties. Questioned upon the subject of this appeal in the House of Commons on Monday, the Prime Minister said that he was glad to have an opportunity of responding cordially to it on behalf of the Government, which, he said, are "fully prepared to play their part in the search for a solution of the world's major economic difficulties".

The Anglo-American trade agreement, which after months of informal conversations, has now reached a stage at which, as announced by the Prime Minister in the House of Commons on November 18, definite steps can be taken toward actual negotiation of terms, is an example of what can be done by the joint discussion of national problems; and its political implications are as important as its economic interests. It is by the application of scientific methods and of the scientific spirit in these fields that there is hope of discovering the causes, and averting the consequences, of international disputes. Though the impartial and responsible study of some of the international economic and racial problems to-day may not satisfy some national claims, would in any event make the civilized world understand whether or no national passions have been aroused in a just cause. Instead of waiting for war and at the end of hostilities inquiring into the causes which led to it, and adjusting the consequences in the bitterness of spirit which must then prevail, let us urge that every opportunity should be taken to promote full and frank inquiries into economic or other restrictions, grievances, so that a certain amount of attention may be diverted from preparation for offence or defence in war to the discovery of the conditions of creative peace.

Science in Psychology

Psychology down the Ages

By Prof. C. Spearman. Vol. 1. Pp. xi + 454. Vol. 2. Pp. vii + 355. 8vo. (London: Macmillan and Co., Ltd., 1937.) Two vols., 30s. net.

ABOUT the beginning of the present century, psychology began to emerge from the kind of chrysalis state in which it was lying dormant and cramped in the cocoon of associationism, and to become a natural science. Even so lately as 1890 no less a psychologist than William James, who made a valiant attempt to break away from the fetters of the system in which he had been trained, brought his "Principles" to an end with the words: "Even in the clearest parts of psychology our insight is insignificant enough. And the more sincerely one seeks to trace the actual course of *psychogenesis* . . . the more clearly one perceives 'the slowly gathering twilight close in utter night'." Not only here did he strike the same pessimistic note. In his "Brief Course" he concludes in the same strain: ". . . not a single law in the sense in which physics shows us laws, not a single proposition from which consequences can causally be deduced. . . . This is no science, it is only the hope of a science". What a confession to be obliged to make!

But some ten or fifteen years after those words were written by one of the then greatest living psychologists, there came a stirring into life of the apparently dead, and certainly quiescent, pupa. I say pupa, but there must have been more than one of these; for no fewer than six important systems of psychology sprang into being at about the same time, all of them (save one) showing signs of a profound metamorphosis. Of these, in this notice, we are concerned with that of Charles Spearman, whose psychological principles and theories are now probably better known and more highly appreciated in the academic world than those of any other contemporary psychologist. This was not so when Spearman first published the results of his researches into the nature of intelligence. It was not so when, in a series of papers dating from 1904, he gave forth his mathematical conclusions as to the joint operation of two factors in every cognitive activity. At first there was much dissent and criticism. But all this has now for the most part subsided; and the most trenchant of the erstwhile critics have adopted his mathematical treatment of psychological data, and are busily extending it to cover temperamental and character qualities as well as

cognitive ones. Moreover, the *noegenetic* (knowledge originating) principles of the apprehension of experience, the finding of relations within apprehended experience, and the extension of knowledge even beyond experience, so obviously account for the observed facts that, like Newton's laws of movement, they can scarcely be gainsaid. Some critics have objected that these principles are logical rather than psychological; but a like criticism might as well be urged against Newton's laws. They also are logical; if they were not they could scarcely be rational, or in any sense explanatory.

Apart from his contributions to psychological, educational, statistical and other journals, Spearman has published two outstanding, and even, as a former reviewer called one of them, "epoch-making" works ("The Nature of Intelligence and the Principles of Cognition", 1923; "The Abilities of Man", 1927). In these he developed his own theories, and substantiated them by the results of a large number of researches carried out under his direction by his numerous students in the laboratory of University College, London, as well as by those of many other investigators elsewhere. The researches he himself directed clearly were governed from the outset by a definite plan. They all converge upon the problem he had originally set himself, namely, to discover what it is that makes for ability in mental effort. In these two volumes he expanded and developed the qualitative laws of *noogenesis*, together with the quantitative laws of mental energy, retentivity, fatigue, control, and the basic conditions of all mentation. By means of these two sets of laws, he claims, it is possible to account for every sort of knowing, whether original or subsequential. In these works also he gave convincing evidence for the 'Two Factor' theory, which requires the co-operation of a general and common factor that is involved in every mental operation, together with special factors that are restricted to each different kind of cognitive process. But in them he did not especially show the immense acquaintance with psychological literature, ancient, medieval and modern, which must have been in the background of his mind throughout. In "Psychology down the Ages" this becomes apparent. Nor did he in the previous works more than lightly touch upon the "erectile" side of the mind. In the present work, this is much more amply treated, especially with regard to volition, emotion and psychological types of character and temperament.

In a sense the present two volumes should have been the first to appear. They do not constitute a history of psychology in the usual meaning of the word, but they show how psychology has advanced from the primitive conceptions of the animists, through the ruminations of the philosophers, to win the status of an empirical science. They show, too, how much has been forgotten and rediscovered, how many mistakes have been made, and how, despite them, psychology has advanced like a slowly flowing tide. To change the metaphor, as Spearman writes in his prologue, "we hope to indicate the chief assets, as also liabilities, which have been accumulated, and so to draw up a fair and square balance sheet". This aim he has certainly accomplished.

Beginning with a section which deals with the subject-matter and scope of the science, Spearman next examines the operations and constitution of what he, disregarding the misleading (because theologically and metaphysically contaminated) terms like 'soul', 'mind' and 'consciousness', calls the 'psyche', and goes on to the establishment of genuine psychological laws (sequences) which, like any other scientific laws, explain the data to be explained, and also, when known and applied, permit of both the prediction and the control of events.

The final section of the work deals with concomitances: 'What goes with what?' This is a matter of statistical evidence; and here the old 'faculty doctrine' is put upon its right footing. It cannot be assumed that, because a name, like 'memory', 'sense' or 'intellect', is given to a

presumably unitary, psychological function, such a function is in fact unitary. Indeed, experiment has shown that there are different kinds of 'memories'; and it is obvious that one cannot infer an acuity of one sense from the acuity of another. One may have an excellent sense of touch and a very poor one of hearing, or an exquisite appreciation of odours, and yet be totally colour-blind. These faculty 'concomitances' have to be proved, not assumed; and the only way of proving or disproving them is that of correlation. It is perhaps Spearman's chief achievement that he has forced psychologists to recognize this. Piling up introspective or observational data with no instrument for dealing with them is a thankless task, and leads nowhere in science. For centuries people have made introspections (to say 'I am angry, or hot, or interested' is to report the result of an introspection); but no laws have resulted from them alone. Treating data, the significance of which is not known, statistically, may yield coefficients of correlation but by itself is meaningless and nonsensical. It is only the marriage of these two methods that yields a legitimate and healthy offspring, in the shape of principles or laws.

"Psychology down the Ages" is an eminently sane, judicious and scientifically balanced work, easy to read and understand, and (to borrow the words of a reviewer of a former work of Spearman and apply them to this) the "most distinguished British contribution to experimental psychology that has been made in recent years". Indeed, both in comprehensiveness and clarity, it excels "The Abilities of Man".

F. AVELING.

Intermediate Chemistry

Intermediate Chemistry

By Prof. T. M. Lowry and A. C. Cavell. Pp. xvi + 880. (London: Macmillan and Co., Ltd., 1936.) 12s. 6d.

AS the title indicates, this book is written expressly for the student preparing for an Intermediate examination in chemistry, and it should fulfil its purpose excellently.

It is comprehensive within its field, and so, after the usual general theory and descriptive inorganic chemistry have been dealt with, very faithfully, in the first half of the text, there follow three further sections dealing respectively with analysis, with physical chemistry and with the broad principles of organic chemistry. Thus, within one cover (which, with typical thoughtfulness and good sense, is made waterproof) we have assembled

all that the Intermediate student requires—the equivalent of three or four other books. It is remarkably good value for money.

Good value, too, in quality: every section gives a precise and remarkably full account of its subject from a thoroughly modern point of view. Indeed the one possible adverse criticism seems to be that the matter given, especially perhaps in the physical part, is needlessly extensive and more than the average first-year student can assimilate. Such criticism, however, would be unsound: it is surely desirable, even though a young student cannot be expected to remember all that is here, that the residue which does stick, whatever general sense of chemistry he gains, should be derived from reading an account of chemistry which takes a properly generous view of his intellect and interest.

The authors have adopted the very sound view that it is the teacher's job to make chemistry alluring and theirs to write a plain, unvarnished tale, with every fact and argument so clearly delineated that the apt student may discover for himself the beauty of the science. It is not least among the many merits of this book that from its concise, plain English, delightfully free from any looseness or ambiguity of thought or statement, he will learn more than chemistry.

There are so many features one would like to commend in detail, for example, the chapters on the structure of matter and the electronic theory of valency, or the large and useful collection of questions at the end (with answers), that it is impossible in a brief review to deal with the book in this way. It must suffice to say that it should be possessed and studied by every serious student or teacher of chemistry.

H. V. A. BRISCON.

That Leviathan

Giant Fishes, Whales and Dolphins

By J. R. Norman and F. C. Fraser. Pp. xxviii + 361 + 8 plates. (London and New York: Putnam and Co., Ltd., 1937.) 15s. net.

"NOW the Lord had prepared a great fish to swallow up Jonah." The interminable debate goes on among dabblers in textual criticism as to whether it was a whale or a fish that engulfed the prophet. At best the discussion has been scientifically of a low order, but there is no longer any excuse for vagueness now that J. R. Norman and Dr. F. C. Fraser have gathered all the possibilities (barring those of special creation) into one compact volume.

Here are assembled under one roof, so to speak, all the great denizens of the sea, both fish and whale, together with their respective dependants and victims. A concise introduction elucidates the chief points of difference between fishes and whales. Their comparative anatomy, modes of reproduction and habits are described. Fortunately, this section is short enough to enable inquirers to find what they want by reading through the text, since the indexing of this section, in Roman numerals, leaves much to be desired.

Then follows Norman's account of the giant fishes, beginning properly with the most ancient order, Selachians, among which are to be found the most savage and bulky fishes. Sharks and rays are clearly described and differentiated. Their distribution, breeding habits, and relative voracities are touched upon, usefully dispelling the prevalent notion that all sharks are ferocious man-eaters. The author recalls that the reward of 500 dollars offered for an authentic case of a man having been attacked by a shark in temperate waters was never claimed. The description of seventeen different sharks is agreeably leavened by anecdotes of their rapacity and catholic appetites. Tenacity of life is theirs to a high degree, as witness the Blue shark which was caught, gutted, and returned to

the sea, only to be recaptured on a hook baited with its own intestines; while the Great White shark that turned King's evidence, yielding on capture the incriminating log-book of an American privateer, may perhaps be awarded the palm for unwitting loyalty to Britannia.

All the great fishes and some of the small ones are described, and some of the largest recorded catches are mentioned, together with much other piscatorial anecdote. Flying fishes have been wisely included, since they are so often seen by travellers; the gliding nature of their flight is emphasized. A simple key to the large fish concludes this section.

Both sections of the book are profusely illustrated with drawings, and there are eight coloured plates of great beauty. Lieut.-Colonel Tenison's scrupulous illustrations greatly enhance the value of the book, particularly for non-scientific readers, who by referring to them should be able to identify both fish and whale easily.

Fraser's contribution on whales and porpoises is of the same high standard, and similarly enriched by narrative. Every whale that the traveller is likely to see is fully described and depicted. There is also a key to this section. A concise history is given of the exploitation of the remunerative species of whales. This story of virtual extermination of one species after another makes sorry reading, but it is particularly apposite at the present time, when the rorqual fisheries of the Antarctic are invaded yearly by huge fleets of highly equipped whale catchers. The author has omitted to point out that there are clear indications that the stock of Blue whales is already greatly diminished. With the decline of Blue whales, the burden of slaughter is falling more and more on Fin whales, of which 12,500 were killed in 1935-36. When the latter also shall have become too scarce to be profitably hunted, the last chapter will have been written in a history of brutal and wanton

exploitation. Other breeds of whales have not in the past had the advantage of scientific investigation; with the statistics which are now available, whalers cannot plead ignorance as they kill the goose that lays the golden egg.

The book is well printed on good paper. The

beginning and end of most chapters are embellished with witty line-drawings. Here is an unusual blend of liveliness and scientific accuracy, which should find a place in ships' libraries and on the shelves of all interested in the creatures of the deep.

A. H. L.

A Catechism of Evolution

Evolution and its Modern Critics

By Dr. A. Morley Davies. Pp. xii + 277. (London: Thomas Murby and Co., 1937.) 7s. 6d. net.

BY evolution we understand that integration and combination of originally homogeneous atoms which has produced our world and its contents. These are governed mainly by physical forces, which are as yet little understood but which represent the governance of the universe. There may in our minds be other thoughts, even certainties, with which we have no quarrel; but these should scarcely be allowed to affect the consideration as to the combinations by which life was originally produced and as to how that life was moulded to give the varied series of organisms we find to-day. It is infinitely more difficult to imagine the production of living matter with its functional reactions to the world around it, than to consider if it evolved afterwards, and the driving forces which caused this evolution. Conversely, if evolution to produce the present organic world be proved, utilizing only natural forces, there is a strong presumption that such forces gave rise to life.

It is with thoughts such as these, here imagined for Dr. Morley Davies, that a start is made on an attempt to prove the adequacy of the evolution theory to explain the diversities of the organic world. In this there is never dullness, for there is originality in both treatment and thought. A good instance is in the chapter devoted to the palaeontological record, wherein is patiently explained the exact position in respect to the remains of the organisms of past ages, the impossibility that they shall at present provide any record approaching that completeness for which the student so frequently inquires. Instead of a hypothetical discussion, the author takes Mr. Douglas Dewar's 'Difficulties of the Evolution Theory' in place of a young student's questions, this reinforced by the late G. K. Chesterton's journalism. The student proceeds on his appointed course from the simple to the complex, but Mr. Dewar apparently has reversed, birds having been his love. We wonder whether he understands the basal phenomena of

living matter and the essential functioning of every part of an animal's body with its environment. Quotations from his book in Dr. Davies's chapter on "Reptiles and Birds" suggest this question and he certainly does not understand an animal's fate after death, almost a miracle if its body does not provide nutriment on which the next generation grows. In this connexion a search in the writer's garden produced several hundred clay pipes, but associated with them no recognizable bones other than those of the ox—this he can readily understand, for his dogs allow no other mammalian remains to be recognizable for long. Then too these varied quotations suggest to us that Mr. Dewar considers evolution to have been an infinitely slow process, whereas modern research, especially cytological, suggests a speed in changes which would only by rare accident allow of the preservation of intermediate stages in fossil form. Dr. Davies can scarcely allow Mr. Dewar's idea "of evolution within the family but not beyond it", since there is no understanding among systematists as to the practical definition of "family"; the unit in evolution is the individual, and, if it can change, the question of genera, families and even phyla scarcely needs discussion.

We are always interested in W. R. Thompson's thoughts here quoted; to us he seems to be rather unnecessarily dragged in here. It is otherwise with Sir Ambrose Fleming, of high distinction in the domain of electrical engineering, who in what is in many ways a mischievous lecture dealt with a subject with which he was unfamiliar. He wrote of "Darwinian evolution" requiring a high birth-rate and a low death-rate whereas it requires "a high but selective death-rate". Then there followed Sir Ambrose's attack on the validity of palaeontological evidence in respect to man, for which little is claimed—pathetic because there is so little understanding as to what is evidence in scientific and in historical research. The reply here is adequate—and we recommend this little book as likely to be useful to the public as well as to professional teachers and students of science.

J. S. G.

Rock Magmas and their Products

Das Magma und seine Produkte:

unter besonderer Berücksichtigung des Einflusses der leichtflüchtigen Bestandteile. Zugleich zweite Auflage des Buches "Die leichtflüchtigen Bestandteile im Magma". Teil 1: Physikalisch-chemische Grundlagen. Von Prof. Paul Niggli. Pp. xi + 379. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 34 gold marks.

THE solid igneous rocks are the products of colossal natural processes working unceasingly within and upon the crust of the earth. The study of these phenomena forms the special province of the petrologist, who attempts to discover the manner in which an original silicate melt—the magma—becomes differentiated into the varied mineral assemblages he finds in Nature.

For more than thirty years the chief project of research of the workers of the Geophysical Laboratory of the Carnegie Institution at Washington has been the experimental investigation on quantitative lines of chemical systems embracing the common rock-forming oxides. Starting with the simplest combinations and proceeding to more complex systems, these investigators have gradually accumulated a wealth of data of fundamental importance to petrology. To this project Prof. Niggli has himself given experimental support, and he is well qualified to survey the experimental studies and the contribution they make to the problems of petrogenesis.

The present book, forming Part 1 of a two-volume treatise on rock magmas and their products, concerns itself with the physical chemistry of heterogeneous and homogeneous systems with special reference to experimental silicate melts. The succeeding volume will be devoted to a consideration of the phenomena of natural systems—magmatic melts and their solidified products, the igneous rocks and ore deposits.

The book opens with a historical account of the development of ideas on the role of volatile substances in the magma. There follow chapters of pure physical chemistry presenting a systematic account of phase equilibria in condensed heterogeneous systems, special attention being paid to the phenomena of petrological significance displayed by ternary silicate melts. The majority of such experimentally investigated systems is included in this survey, which gives a clear account of the alternative courses of crystallization permitted by continuous and discontinuous reactions which may prevail in ternary silicate solutions.

Some criticism may here be made of the method of presentation adopted for ternary melts. In order

to trace readily the changing composition of a residual liquid in terms of a specialized variation diagram, and presumably in preparation for more extended discussion in volume 2, the author redraws the ternary figures on a molecular per cent basis. These transformations involve considerable complication when the fundamental phases are themselves complex silicate compounds. It may well be doubted whether so cumbersome an innovation will make appeal to petrologists who have still to discover the superior convenience of the 'Niggli type' of variation diagram for which this procedure is more peculiarly fitted.

In the second half of the book, Prof. Niggli enters upon a discussion of heterogeneous equilibrium in systems containing volatile phases—a subject to which the author has himself made important original contributions. The treatment follows closely the text of his earlier published work—of which this part may be considered a revision.

Equilibria in binary and ternary mixtures involving retrograde boiling and critical phenomena in saturated solutions are thoroughly discussed. Since the experimental data on ternary silicate systems involving water comprise only those of the complex $H_2O-K_2SiO_3-SiO_2$, the importance of critical phenomena in magmatic systems has yet to be assessed. While the critical state is assigned a more important place in the history of the cooling magma than is usually conceded, the author's renewed discussion of volatile systems is a welcome contribution serving to remove from the field of contention misunderstandings which have followed the publication of his earlier work.

This account is followed by a chapter on homogeneous equilibria in silicate melts. This is a subject of great importance, but unfortunately our knowledge of it is meagre and largely confined to deductions that may be drawn from the behaviour of heterogeneous systems. Here the author rightly lays emphasis more especially on the influence of volatile constituents in modifying the chemical as well as the physical condition of the magmatic melt.

The book closes with an ingenious portrayal in ternary diagrams—admittedly schematic and immensely simplified—of the differentiation course of a typical Atlantic and Pacific rock province. Presented here without elaboration, it is presumably a signal of a more detailed treatment in the concluding volume. Comment upon it may well be deferred. The high reputation of the author is a guarantee that a stimulating and fruitful discussion of these problems is to follow.

O. E. TILLEY.

Overseas Plant Products

By J. H. Holland. Pp. vii+279. (London: John Bale, Sons and Curnow, Ltd., 1937.) 6s. net.

THE author has very ably dealt in 268 pages with nearly all the important plant products of the world. Short explanatory notes to each of the products mentioned are authentic, accurate and up to date. Eleven pages of bibliography at the end of the book is a valuable addition. Those interested in further information on any one of the products discussed in the book can consult the particular literature relating to that product. Common vernacular names used generally in different countries might have been added for the advantage of local dealers in plant products. Short notes on the marketing of those products would also have been encouraging to the producers. With the progress of research on various plant products, and the discovery of the uses of many hitherto unknown plants in different countries, particularly in India, Burma and Africa, the list of plant products is growing so rapidly that it is to be hoped a second edition will be quickly necessary; slight discrepancies in some places might then be rectified also.

The book is a valuable addition to the publications on economic botany. It will undoubtedly prove useful not only to those who deal in plant products, but also to anyone interested in the relation of plants to human needs. It will be indispensable to museum workers, economic botanists and pharmacologists. The book is well printed and bound.

Materialprüfung mit Röntgenstrahlen:

unter besonderer Berücksichtigung der Röntgenmetallkunde. Von Prof. Dr. Richard Glocker. Zweite umgearbeitete Auflage. Pp. v+386. (Berlin: Julius Springer, 1936.) 33 gold marks.

SINCE the appearance of the first edition of this well-known work in 1927, the use of X-rays in the examination of materials has been greatly extended. The new edition is similar to the old in general arrangement, and any considerable increase in size has been avoided by careful revision of each section. The description of X-ray outfits (of German manufacture), now includes a full account of portable apparatus for the detection of flaws in built-up structures as well as the laboratory types, and the methods used in the examination of castings, forgings and welds are described. The discussion of determination of crystal structures, which occupies the greater part of the book, is both clear and informative. Tables of important structures are given, including a survey of the principal alloy systems, and such subjects as deformation textures and the determination of internal stress are treated in detail, although British work in this field has been overlooked. The section on transformations in the solid state also suffers through being too closely confined to German investigations, but the general presentation is fair, and the book can be recommended as a sound guide to a very important method of experiment. The mathematical treatment is simple and straightforward, and references to the more important papers under each head are collected in the bibliography.

Quantitative Analysis:

a Theoretical Approach. By Prof. William Rieman, III., and Dr. Jacob D. Neuss. (International Chemical Series.) Pp. ix+425. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18s.

THIS is a most satisfactory text-book for the student. It is up to date, the theoretical principles underlying the various methods are clearly and accurately stated and the conditions for carrying out individual exercises are given in ample detail. To each chapter there is a useful résumé in the form of graded problems, and answers are provided to the numerical ones.

To deal with the theory and technique of potentiometric methods immediately following the volumetric determination of the chlorine ion and before discussing the methods of acidimetry and alkalimetry will be novel to many teachers. Its treatment could scarcely be better, although the authors have to assume a knowledge of mathematics unfortunately not possessed by all students who can profitably work through such a book as this.

No modern method of volumetric or gravimetric analysis with which the student might be expected to be familiar seems to have been omitted. Apart from anything else, the references to original and text-book literature will indicate to the student that quantitative chemical analysis is an important and continually expanding branch of chemical science.

C. S. G.

The Social Thought of the Ancient Civilizations

By Prof. Joyce O. Hertzer. (McGraw-Hill Publications in Sociology.) Pp. xvi+409. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24s

NO one would dispute the desirability of the possibility of an examination of the social thought of the ancient civilizations, especially after reading the very able book of Prof. Hertzer. It is not only history, but also sociology and philosophy which can benefit from such an examination. For social forms of civilizations are necessarily an embodiment of the thought and attitude towards life of the various races concerned. The systematic exposition of the social thought of the ancient Egyptians, then of the Babylonians with special emphasis upon the Assyrians and Hittite collections of laws, then of ancient Persia, of early India and of ancient China, and finally of the Hebrews, is illustrated with a wealth of quotations from all available sources. The discussion of the principles involved is based also on the general background of the races concerned. The author has taken great trouble in selecting his material and in classifying it in such a way as to provide an intelligible and interesting study of the subject.

G. T.

Wireless Servicing Manual

By W. T. Cocking. Third (revised) edition. Pp. x+241. (London: Hiffe and Sons, Ltd., n.d.) 6s. net

A very useful and reasonably priced monograph on the pathology of the wireless receiver, which can be recommended as supplementary reading to the usual text-books.

A Century of Geological Investigation

A CONNECTED history of the work of the Geological Survey of Great Britain has long been overdue. It is true that many details can be gathered from the lives of Edward Forbes, Murchison and Ramsay, from Geikie's 'Long Life's Work', and from the registers of the Royal School of Mines and the Royal College of Science. But what was wanted was an impersonal account of the service and its work, written from the point of view of the service itself; and that has now been furnished by Sir John Flett in "The First Hundred Years of the Geological Survey of Great Britain"*. It was the last act of his thirty-five years' service, during fifteen of which he was director, and for another ten assistant to the director for Scotland. It marks the centenary in 1935 of the Survey, and the opening of the new Geological Museum at Kensington by H.R.H. the Duke of York, now His Majesty King George VI.

The author has succeeded in making a clear statement of the complicated history of the Survey itself, and the other institutions now or formerly a part of it or very closely associated with it. He directs attention to the demand for such an institution on the part of the mineral industries of the country and the influence of famous geologists and of the Geological Society, which caused the idea of a State survey to be accepted and even welcomed by the authorities of the time. He has indicated in due proportion the share in the mapping and description of the country taken by the leading geologists of the Surveys. And he has enabled the reader to form a fair judgment on the progress effected as a result of royal commissions and committees of inquiry, and by the successive directors in the favourable or unfavourable conditions prevailing during their periods of office.

It is impossible to speak too highly of the work and influence of the first director-general, Sir Henry De la Beche, appointed in 1835, after he had offered, at trifling cost, to "affix geological colours" to the new maps of Devon and Cornwall about to be issued by the Ordnance Survey. He set himself to do four things which he considered to be essential at the time, and which he saw could be carried out, at first at any rate, by a State Survey as he conceived it: (1) The mapping and description of the geology of the country, especially in relation to its mineral resources; (2) the collection and preservation in some accessible

place of the evidence on which such work is founded, the records of the work as it advanced, the literature necessary for proper working up of the material, and specimens to illustrate the geology and mineral resources; (3) the education and training of men capable of doing the work or of directing the development of the mining industries; (4) the collection and preservation of mining statistics and records, especially so far as they are necessary to guide future exploitation. The first two objects have remained and grown as the special care of the Survey; the other two sooner or later budded off and are now living separate and vigorous lives of their own.

It being essential first to acquire an exact knowledge of the ground-work, the geological nature and structure of the land, attention was concentrated on mapping, with a remarkable team which grew steadily in strength. The director himself and his assistants, among whom Aveline, Ramsay, Jukes, Logan and Selwyn were leaders, worked at high speed and with an accuracy which is wonderful when it is considered that only one-inch maps, uncounted and often unsatisfactory in topography, were all that were available for either field-work or publication. Maps were supplemented by 'horizontal' sections (illustrated by explanations) along specially surveyed routes, and by 'vertical' sections on a large scale giving full detail of thoroughly explored ground. More maps and sections were published under this régime than at any later time. Little leisure, however, was left for writing, and few memoirs were published, those put out being mainly essays on scientific subjects, or descriptions of considerable regions, such as the South Staffordshire coalfield by Jukes.

A museum was opened at Craig's Court in 1841, but ten years later the Prince Consort opened its successor, the Museum of Practical Geology at Jermyn Street, where the collections and workers were housed for eighty years. This "was the first important building in Great Britain designed to be occupied by the staff of a purely scientific institution". The Museum was intended to be definitely national, economic and practical, and in time these objects came to overshadow the scientific side, for example, in the large and valuable collections of metal work and pottery. For these, new and more appropriate sites were found soon after 1901, and room was thus provided for the more direct applications of geology. A distinguished staff was employed in the Museum

* The First Hundred Years of the Geological Survey of Great Britain. By Sir John Smith Flett. Pp. 280 + 13 plates. (London: H.M. Stationery Office, 1937.) 7s. 6d. net.

and in expert work in connexion with the mapping. It included such men as Hooker, Forbes, Phillips and Playfair (afterwards Lord Playfair), Percy, Hunt, Warrington Smyth and Huxley.

Several of the staff were employed as professors in the School of Mines, which had its home also at Jermyn Street. In spite of this work and their routine duties for the Survey and Museum, time was found for the issue of works on fossils (*Decades and Monographs*), of memoirs on the economic or other geology of districts, and for the delivery of technical lectures and of more popular lectures for working men. The desire of the Prince Consort, who had given whole-hearted support to the plans, to see the School of Mines grow into a more comprehensive scheme for scientific and technical education was thought premature by De la Beche and his successors, and was indeed not fully brought about until 1910, when the Royal School of Mines, the Royal College of Science and the City and Guilds Engineering College were incorporated as the Imperial College of Science and Technology. The School of Mines was, however, largely by Huxley's influence, removed to South Kensington between 1872 and 1883, and many of the books were taken from the library to form the basis of the Science Library there.

Sir Roderic Murchison, as director-general, brought to the institution from outside great organizing ability and valuable social influence. His work (1855-71) was mainly comprised within the framework of his predecessor's scheme, but he strengthened the administration and inspection, and brought about a much-needed increase in staff. All De la Beche's plans of publication were continued, but there was inaugurated the issue of memoirs on individual map sheets, and on several coalfields on which the mapping was being concentrated, while museum handbooks and district memoirs were added to those already published, including Ramsay's great memoir on North Wales. The first index map, of Wales and its borders, on the quarter-inch scale, was also published.

The appointment of Sir Andrew Ramsay as director-general in 1871 illustrates one of the difficulties that have been inherent in the Survey. The duties of inspection, reporting and administration are so heavy that a director must practically abandon all his own field-work, and thus the field staff loses both an inspiration and a standard. Ramsay was certainly one of the finest field-men who ever lived and his loss was most serious in this capacity. Fortunately it proved that his organizing powers were also considerable, but the work speedily wore him out. Under his direction, the first 'drift' maps were prepared, new museum catalogues and handbooks were issued, very valuable collections were acquired by the Museum,

such as the Ludlam collection of 20,000 minerals, and some of the most important memoirs ever written were published, among them that on the Yorkshire coalfield, and those on London, Rutland, and the Weald. The Survey being, up to this date at least, the principal training ground for professional geologists, had to face the inevitable loss of some of its best men to fill teaching posts in universities and colleges and to assume the direction of other surveys.

Sir Archibald Geikie, who had been a member of the Survey for twenty-six years, a great part of that time in sole charge in Scotland as well as professor at Edinburgh, was appointed director-general in 1882, and served in that capacity for twenty years. In accordance with his undertaking, the 'solid' map of England was finished by 1884, and that of Ireland four years after. A 'drift' survey, of as great value to the agriculturist as the 'solid' maps are to the miner, now chiefly claimed attention, and as maps were revised for this purpose they were also brought up to date on the 'solid' side. This entailed the publication of a large number of maps, many of which were now accompanied by sheet memoirs. Some district memoirs, a few on coalfields, the first one on water-resources, and the first complete index map on England and Wales, were also published. But the chief departure, one abandoned by his successors, was the issue of memoirs devoted to individual formations—Jurassic, Cretaceous, etc. Petrology was now put on a level with palaeontology, and specialists were appointed. Teall was brought in to deal with Scottish, and particularly Highland, rocks, and Harker to map and describe the Tertiary igneous complex of Skye. Much was done to exhibit Survey material worthily in museums at Edinburgh and Dublin, and the customary "Annual Report" was converted into a "Summary of Progress", containing some account of the chief discoveries made during the year. This "Summary" has now also become a magazine for communications by the staff. A start was made with the much-needed revision of the coalfields, among others that of South Wales, which was put in charge of Strahan. It expresses the state to which grading and organization in the service had sunk when it is realized that the officer chosen for this highly responsible task was still an 'assistant-geologist' after sixteen years' service, and that he had under him men who had been full 'geologists' for more than twenty years.

The very considerable improvements in organization recommended by the Wharton Committee of 1900 took effect in the appointment in 1901 of Sir Jethro Teall as director, and a new grading and enlargement of the staff. This inaugurated a period of renewed activity. Much coalfield

revision, recommended by the Coal Resources Commission, was carried out in England and Scotland, and many coalfield, coal-chemistry, oil-shale, water and sheet memoirs were published. Field-work was now all executed on the six-inch scale, and the revision published on the 'New Series' ordnance maps. Colour printing replaced the old hand colouring on all one-inch maps, the quarter-inch index, and the new small-scale map of the entire kingdom. Thus maps were cheapened and made available to a much larger public, and it became possible to supply them in quantity at a reduced price for educational purposes. Vertical and horizontal sections were also printed on the map margins. The publication of palaeontological monographs was resumed, and the district memoirs included the great works on Skye, the Highlands and Lowlands of Scotland, and the Isle of Man. Much use was made of photography for illustration as well as in the Museum, and the removal of extraneous collections and of the lecture hall gave fresh space for developing the modified purposes of the building. The Survey of Ireland was separated in 1908, after a series of new drift maps had been published under Lamplugh's direction.

The directorship of Sir Aubrey Strahan (1914-20) was crippled by the Great War, the staff being largely called on for service. What remained of them brought out the publications that were on the stocks and then, with some voluntary help, devoted themselves to writing a new series of memoirs dealing with the mineral resources of the country, many of them seriously needed to replace supplies from abroad now cut off. Water problems and other geological ones at the seats of war were met by members of staff in the army or at home, and special search was made for sources of such things as sand, quartz, oil, refractories, fluorite, sapphire, etc., needed for munitions. At the end of the War, the Survey was taken over from the Board of Education by the new Department of Scientific and Industrial Research; and a Geological Survey Board was formed to assume the duties formerly discharged by a Committee of Advice.

Sir John Flett does not give very full details in his book of the progress under his own directorship, but much can be gleaned of efficiency and progress from what is stated. The staff was enlarged, publication of sheet memoirs and maps was pushed on more actively than even before, the resources memoirs were brought up to more than thirty, coalfield and water memoirs continued to appear, monographs and vertical sections were resumed, and experiments were made on the applications of geophysical apparatus. Uncoloured six-inch maps with geological lines prepared from the field sheets were rendered available.

Co-operation was given to Boards of Fuel and Building Research, to the Inland Water Survey, to the search for oil, and to the making of soil-maps. New rights to information revealed by shafts and borings were acquired, the careful collection of kindred information, often confidential, was continued, and the relations of mutual respect and confidence with the managers of mining and other industrial operations were strengthened. A successful experiment on decentralization was tried, and four centres in the north of England were established. The publication of the last of the great series of memoirs on the Scottish Tertiary volcanic centres contributed what is perhaps the most important addition ever made to knowledge of active as well as extinct volcanoes; and memoirs on concealed coalfields give leading to fresh industrial development.

Meanwhile, probably as a result of the explosion of an aerial bomb in Piccadilly, the Museum had fallen into irreparable disrepair, and much of it had to be closed. When it was clear that repair was out of the question, the Survey Board, and especially its chairman, Sir Francis Ogilvie, seconded by the Museums Commissions, pressed on the Government the need for a new museum. Eventually a site was found and a new building erected, the site of the old one proving so valuable that it may be even said the change was an actual source of profit, a last legacy of the far-seeing De la Beche. The director and his staff carefully planned the utilization of the increased space provided, removed and replaced all the collected material, and devised methods of storage, illustration and display which have given fresh uses and great popularity to the new Museum.

An account is given at the end of the book of the opening of the new Museum and the celebration of the Survey centenary, which were attended by a large concourse of Government and scientific delegates, who came from all parts of the country and all over the world to bring their congratulations and commendation. A group photograph of the delegates and a full list of them are given in an appendix. Other appendices give a bibliography and a carefully prepared list of nearly three hundred Survey officers who could be traced, with brief notes on their service and career. This list contains the names of four presidents of the Royal Society.

Thus the Survey makes an auspicious and hopeful beginning of its new century, and the author of this work and his colleagues, past and present, are to be congratulated on such a worthy record of a hundred years of sound and faithful work, a justification of the hopes and ambition of its originator, and a valuable asset to the industrial life of the nation.

W. W. WATTS.

Pasture Problems

THE many problems connected with cultivated grassland have recently received considerable emphasis. The International Grassland Congress, meeting at Aberystwyth in July, brought together some four hundred delegates, and further discussion of the subject took place during the Nottingham meeting of the British Association at a joint symposium of Sections K (Botany) and M (Agriculture). An outline of the range of problems there discussed may prove of some general interest.

Grassland problems are largely determined by the perennial nature of the crop, which is a mixture of several species that are in constant competition with one another. These species settle down to a certain equilibrium among themselves, but this is easily upset by changes in the environmental conditions. Rainfall, temperature, sunshine and drought all play their part in encouraging some species at the expense of others, so causing either temporary or permanent changes in the balance of composition of the herbage. The quality and type of herbage are also very dependent upon the general management of manuring and grazing. Uncultivated grassland tends to become very rough and often develops a layer of peat on the surface, but with correct grazing a more even sward is obtained and the more valuable species are encouraged. Land that is always out for hay bears a different flora from that which is grazed, owing to the variation in the response of species and the two methods of treatment. The time of seeding is also an important factor, and helps to determine the question of survival under cultivation. Wild white clover is a most valuable feeding plant, and is encouraged where land is properly grazed so that competition for light and air is reduced to a minimum.

Of recent years, the work of the Welsh Plant Breeding Station at Aberystwyth has shown the importance of selecting the varieties and strains of grasses that are appropriate for the particular purpose for which they are required. Pasture types and hay types of the same species are radically different in their habits, and success or failure in establishing new areas of grassland largely depends upon the selection of the seeds sown.

In sowing down new pastures, the type of mixture to be used presents its own problems. Complex mixtures of many species and simple mixtures of few species each have their advocates, and no definite ruling can be made as to which is prefer-

able. Much depends upon environment and upon the object that it is desired to attain. Experiments and analyses carried on at Rothamsted for ten years, on land sown with a variety of seeds mixtures, have shown that the ultimate composition of the sward is very similar, regardless of the simplicity or complexity of the mixture initially sown. Some species are short lived, and though they may prove useful in providing grazing for the first year or two, they soon disappear, and their place is taken either by some other constituent of the original seeds mixture or by interloping species which establish themselves naturally. The balance existing between the groups consisting of grasses, leguminous and miscellaneous species may be entirely upset by prolonged drought, which in some cases may kill out the wild white clover, leaving bare spaces which are often invaded later by grass.

In addition to climatic variations, the grazing animal plays a most important part in the development of a sward. The various types of plants in a pasture are all in keen competition, and any factor which weakens one species gives the others a better chance. The grazing animal naturally eats down the most palatable species first, leaving the inferior plants alone except in times of scarcity. The lack of palatability of the latter plants thus affords them protection from grazing and so enables them to increase unduly. Very careful manipulation of the grazing is necessary to prevent this undesirable change in the balance of the species, and controlled grazing periods, together with artificial feeding of the animals at certain critical periods of the year, are necessary to keep the herbage at its best.

During the discussion at Nottingham, special emphasis was laid on the interdependence of the various principles of grassland management. Improvement may be considered from the point of view of the botanical composition of the herbage, pasture and stock management and soil fertility, but whatever is done in one direction is reflected in the reaction of the grassland as a whole. Methods of improvement and management vary in temporary and permanent pastures, and the botanical composition and the yield respond to the contrasting systems of management.

An outstanding problem is the difficulty of getting an accurate measurement of the value of grassland from the point of view of its productivity and feeding capacity. Empirical observations of

the herbage and the stock afford a useful guide to the skilled farmer, but more accurate and quantitative information is necessary for the true comparison of different systems of management. The accurate assessment of yield presents many difficulties, as estimates obtained by continuous cutting to simulate grazing are misleading, since the period and intensity of actual grazing have very far-reaching effects on the sward. In order, therefore, to simulate grazing conditions as closely as possible, experiments of somewhat complex design are necessary, in which there is sufficient replication to permit grazing over the greater part of the experimental period, with infrequent cuts for the actual determination of yield. The type of stock used and variation in seasonal conditions also play their part in complicating the problem.

In the open discussion at the end of the symposium, the question was raised as to the

possibility of laying down some clear directions for the practical man in the management of his sward. From the nature of the case, however, this is an impossibility, as the problems are so complex and the correct methods of management are so diverse. Treatments that are effective in one place, on one type of soil or under certain climatic conditions may be quite unsuccessful elsewhere or in other seasons. Careful observation of the effect of grazing on the sward, together with intelligent use of the results of such observation, are essential for the successful production of first-class pastures providing feed of high nutritive value. Furthermore, recent developments in the improvement of wild hill pastures along economic lines have opened up great possibilities for extended and profitable grazing, provided the active co-operation of the interested farming community is forthcoming.

WINIFRED E. BRANCHLEY.

Zoological Expedition to the Oasis of Siwa, Egyptian Libya

By Joseph Omer-Cooper, Rhodes University College, Grahamstown, South Africa

THE Armstrong College Expedition to Siwa, consisting of Dr. Malcolm Cameron, Mr. C. L. Smith and myself was financed by the Royal Society, the Godman Exploration Fund, the Percy Sladen Trust, the British Museum (Natural History) and the Armstrong College Research Fund. Its object was the study of a typical Libyan oasis. We left England in March and returned in October 1935, after spending six months in the Libyan Desert and achieving all our objectives. Transfer from the staff of the Department of Zoology, Armstrong College, Newcastle-on-Tyne, to Grahamstown, South Africa, has been the principal cause of delay in presenting a preliminary report of the Expedition's results.

Siwa is watered by more than two hundred wells and springs. These in many cases flow into storage reservoirs from which the gardens are irrigated. The irrigation waters ultimately flow into pools or lakes from which there is no outlet. These are saline, and if large are known as 'birkets'. The water of the springs is thermal, the bottom water varying from 25° to 29° C. The salinity, which is slightly more variable, appears to be affected by the proximity of the birkets. In Siwa the larger springs, in which concentration by

evaporation was negligible, had a chlorine content of 0.685-1.475 gm. chlorine per litre. The water contains little oxygen. Smith examined water from pipe wells, so obtaining pure samples of the subterranean water, and found only 0.105 c.c.m. oxygen per litre. The water is supersaturated with gas which is more than 97 per cent nitrogen; the residue being oxygen, carbon dioxide and inert gases. As the springs in several other Egyptian oases have the same peculiarities, it is probable that the water is derived from one great subterranean source.

The North African subterranean waters contain a considerable fauna, but no subterranean forms have been recorded from Egypt. This curious fact is adequately explained by the small oxygen content. This also explains the absence of the indigenous Siwan Cyprinodont fish from the larger springs, and the failure of Dr. H. Faouzi to introduce *Tilapia* into these springs, which appear excellently suited to them.

In certain springs the Cyprinodonts have the swim bladder much swollen and are unable to submerge. Some fish are almost globular. This is no doubt due to the water being supersaturated with nitrogen.

Siwa was notorious for immense swarms of mosquitos. It was this, in part, which caused us to choose it for investigation. In 1930 Dr. Zoghbi started an ingenious and successful anti-mosquito campaign. The indigenous Cyprinodont was present in a few of the springs and streams only, and these were much overgrown with reeds, rushes and other vegetation. Dr. Zoghbi had the springs and ditches cleaned, and introduced the fish into those not already containing them. Fortunately for us, during his one year of duty at Siwa, he was unable to deal with all the springs, and by the time we arrived many of these had been long neglected, so that we were able to study the primitive conditions. While we were there, Dr. Zoghbi was again sent to Siwa as medical officer and continued his work. In this he was aided by the successful introduction of *Tilapia* by Dr. Faouzi. Before we left, the mosquito breeding places had been almost eliminated.

The introduction of *Tilapia* by Dr. Faouzi in 1932 has already had an effect. In certain slow-flowing springs, they have multiplied greatly. The change produced is the most striking ecological effect, produced by a single organism, which I have seen. The plants have disappeared and with them the Cyprinodonts, Mollusca and insects; even the Crustacea have been almost eliminated; *Cladocera* are absent and Copepods and Ostracods are scarce. The water, clear in similar springs in which *Tilapia* are absent, is cloudy and contains numerous flagellates, Protozoa and rotifers. The fish feed on the mud. Within a few years it is probable that they will have exterminated the greater part of the aquatic fauna.

Most of the birkets are very saline, and at the most contain a few *Artemia*. At Baharein in the East Lake, there were numbers of minute Hydrophilid beetles but nothing else. The water was cloudy, unpleasant smelling, and had a specific gravity at 60° F. of 1.1498. It is possible that the beetles lived on drowned insects. In an inlet fresh water flowed over the salt water and contained fish. Smith found that the surface temperature was 27.2° C., but it rose rapidly and towards the bottom reached 52.9° C. His observations here and at Siwa show that this temperature gradient was due to solar radiation in the absence of convection currents. At Sitra, springs rose in the lake and the fresh-water spread for some distance over the surface. In these springs were fish which appeared to feed on the *Artemia* living in the saline water. The Birket El Gessabaia had a specific gravity at 60° F. of only 1.0357 and contained a number of marine organisms including diatoms, algae, *Cardium edule* var., *Mytilus minimus*, *Pirenella conica* and *Balanus* sp. The *Cardium* and *Balanus* were

recent but we found no living specimens, although we obtained living *Mytilus* and *Pirenella*. This fauna is similar to that of the Birket Qarun, and may have been introduced by birds.

In searching our material from El Gessabaia and some other localities for algae, Dr. Kathleen Blackburn discovered Foraminifera. These were sent to Mr. Heron Allen, who reported that *Trochammina*, *Miliolina*, *Reophax*, *Discorbina* and *Gromia* were present. Some of the species he believes to be identical with those described by L. Gauthier Lièvre from the lakes of the Oued Rhin. None of the species are common Mediterranean forms. This fact, coupled with their occurrence in such widely separated localities, suggests that they may have had a different origin from the recent marine immigrants of El Gessabaia. It is possible that they are very ancient relicts.

It is very generally believed that much of the desert fauna aestivates. My experience of the Somali desert made me sceptical of this and, despite much adverse criticism, we made the summer our chief collecting time. In this we were justified, for, contrary to the general belief, insects proved most numerous in July and August. During the heat of the day there was a striking absence of insects in the open desert, although Hymenoptera were numerous in the oasis. In the evenings and at night, however, insects and arachnids abounded. It is this, no doubt, which has given rise to the popular belief that the fauna aestivates.

One of the objects of the Expedition was to find out whether Siwa is a nodal point in the bird migration. Our observations were sufficient to convince me that it is not. The birds cross the desert on a wide front. The concentration which occurs in the oases is due to the infiltration of stragglers, marooned in the desert.

The insect fauna appeared to be Ethiopic rather than Mediterranean; although, as was to be expected, a considerable proportion consisted of widely distributed forms. The dominant groups were Odonata, Orthoptera, Neuroptera and Hymenoptera; Lepidoptera were also abundant, but Coleoptera and Diptera were scarce. Ancient forms appeared to predominate in the desert regions: *Thysanura*, for example, were numerous. The shifting sands of the desert, like those of the sea, appear to form a refuge for archaic forms of life.

Towards the end of our stay at Siwa, we rarely obtained species not previously captured. This gives us reason to hope that our material is adequate to give a true picture of the ecology of Siwa, and that when the collections have been worked out our results will be reasonably complete.

The British Association and the Indian Science Congress

THE majority of the members of the British scientific delegation to the jubilee meeting of the Indian Science Congress Association (see *NATURE*, Oct. 9, p. 609) left Tilbury on November 26, on the P. and O. liner *Cathay* for Bombay. Some of the party will join the ship at Marseilles, leaving London overland on Thursday, December 2. The British delegation will include representatives of every major department of science; and several distinguished foreign and other representatives have been invited directly by the Indian Science Congress Association; the party will number in all more than a hundred.

The great majority will make a tour through northern India before the Congress in Calcutta, after an official reception in Bombay (December 16-18), and a visit to Hyderabad, where they will be the guests of the Nizam's Government (December 19-21). Agra will be reached on December 22, and Christmas Eve and Christmas Day will be spent in Delhi. At Dehra Dun (December 26) the Forest Research Institute and the Geodetic Branch of the Survey of India will be visited, and there may be an occasion for a run to Mussoorie for the view of the Siwalik Hills and the outer Himalayas. Benares will be visited on December 27-28, and between this and Calcutta a geological party will diverge southward from the railway. Calcutta will be reached on December 29, and as the Congress will not begin until January 3, it is expected that a number of members will occupy intervening days with excursions to Darjeeling or elsewhere.

It is understood that H.E. the Viceroy will open the Congress, and that Sir James Jeans, as president, will give a brief address and will then communicate to the meeting the presidential address prepared by the late Lord Rutherford, who was to have occupied the president's chair.

The sectional presidents of the Congress are:

(1) Mathematics and Physics, Dr. O. W. B. Normand, director-general of observatories, Meteorological Office, Poona 5.

(2) Chemistry, Prof. S. S. Bhatnagar, director, University Chemical Laboratories, Lahore.

(3) Geology, Mr. D. N. Wadia, officiating superintending geologist, Geological Survey of India, 27 Chowringhee, Calcutta.

(4) Geography and Geodesy, Dr. A. M. Heron, director, Geological Survey of India.

(5) Botany, Prof. B. Sahni, professor of botany, University of Lucknow.

(6) Zoology, Prof. G. Matthai, professor of zoology, Government College, Lahore.

(7) Entomology, Mr. M. Afzal Hussain, principal

of the Punjab Agricultural College, Lyallpur, Punjab.

(8) Anthropology, Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta.

(9) Agriculture, Rao Bahadur T. S. Venkatraman, Imperial sugar-cane expert, Lawley Road, Coimbatore.

(10) Medical Research, Sir Upendranath Brahmachari, professor of tropical medicine, Carmichael Medical College, Calcutta.

(11) Veterinary Research, Sir Arthur Olver, animal husbandry expert, Imperial Council of Agricultural Research, New Delhi.

(12) Physiology, Brevet-Colonel R. N. Chopra, officiating director and professor of pharmacology, School of Tropical Medicine, Calcutta.

(13) Psychology, Dr. G. Bose, University College of Science, Calcutta.

The Congress will run from January 3 until January 9, with an intervening day (January 6) for short excursions. Afterwards some fifty of the B.A. party will visit Madras, Bangalore and Mysore, while others will pay individual visits to other places in connexion with their special scientific interests. A large proportion will leave Bombay homeward bound by the S.S. *Strathaird* on January 15. Among the party are:

Dr. F. W. Aston.	Sir Arthur Hill.
Prof. F. G. Baily.	Sir Frederick Hobday.
Prof. E. O. C. Baly.	Dr. O. J. R. Howarth.
Prof. E. Barker.	Prof. G. W. O. Howe.
Prof. V. H. Blackman.	Sir James Jeans.
Prof. P. G. H. Boswell.	Prof. J. E. Lennard-Jones.
Prof. A. H. R. Buller.	Dr. I. L. Wynn Jones.
Prof. P. A. Buxton.	Mr. R. H. Kinvig.
Mr. J. M. Calie.	Mr. J. McFarlane.
Prof. G. D. Hale Carpenter.	Dr. C. S. Myers.
Prof. N. M. Comber.	Dr. W. G. Ogg.
Prof. F. A. E. Crew.	Prof. A. G. Ogilvie.
Dr. E. M. Crowther.	Mr. H. J. E. Peake.
Prof. Winifred Cullis.	Dr. E. P. Poulton.
Dr. O. D. Darlington.	Prof. H. H. Read.
Prof. C. G. Darwin.	Dr. A. B. Rendle.
Mr. T. S. Dymond.	Prof. H. R. Robinson.
Sir Arthur Eddington.	Dr. R. N. Salaman.
Prof. O. B. Fawcett.	Lt.-Col. R. B. S. Sewell.
Prof. W. G. Fearnside.	Prof. J. L. Simonsen.
Sir Lewis Fermor.	Prof. R. V. Southwell.
Prof. R. A. Fisher.	Prof. C. Spearman.
Prof. H. J. Fleure.	Dr. L. Dudley Stamp.
Prof. F. E. Fritch.	Prof. F. J. M. Stratton.
Prof. R. Ruggles Gates.	Sir Henry Tizard.
Prof. W. T. Gordon.	Dr. A. E. H. Tutton.
Prof. J. W. Healop Harrison.	Dr. W. W. Vaughan.
Sir James Henderson.	Dr. J. A. Venn.
Prof. J. Hendrick.	Prof. R. G. White.

The following non-British men of science will also be among the visitors:

Prof. L. Diels, Botanical Gardens, Berlin.
Prof. F. von Eickstedt, Anthropological Institute, Breslau.
Prof. C. G. Jung, University of Zurich.
Prof. W. Straub, University of Munich.
Prof. Dr. L. Cipriani, Royal University, Florence.

Obituary Notices

Prof. G. A. Schott, F.R.S.

GEORGE ADOLPHUS SCHOTT was born at Bradford on January 26, 1868. From Bradford Grammar School he went up to Trinity College, Cambridge, in 1886 as a pensioner with an open exhibition in science. He took a first in each part of the Natural Sciences Tripos, and it is interesting to notice, in view of his later career, that his first in the second part of the Tripos was in chemistry. He became a College scholar in 1888 and took his bachelor of arts degree in 1890.

In 1893 Schott was appointed lecturer in physics at the University College of Wales, Aberystwyth. There his interest turned increasingly towards the mathematical side of his subject. During the year 1906-7 he was granted leave of absence to work abroad, chiefly at the University of Bonn, on electromagnetic radiation, the subject which held most of his attention throughout his life. Between 1906 and 1908 he published a series of papers on this subject in the *Philosophical Magazine* and in German periodicals. In 1909 he won the Adam's Prize with an essay based on these papers and entitled "The radiation from electric systems or ions in accelerated motion and the mechanical reactions on their motion which arise from it". His book "Electromagnetic Radiation", published by the Cambridge University Press in 1912, was an extension of this essay, and still remains a standard work on the mathematical aspect of the classical theory.

Schott became lecturer in applied mathematics at Aberystwyth in 1909, and in 1910 was appointed to the chair of applied mathematics there. He was indeed the first holder, and he himself built up the department. Later, in 1923, he became head of both the departments of pure and applied mathematics, and it was only at his own request that the departments were again separated in 1929.

From 1915 or thereabouts until the end of his life, Schott was particularly interested in the new developments of the electromagnetic radiation theory which arose from the relativity and quantum theories. He published a series of papers in the *Proceedings of the Royal Society*, and elsewhere, on topics in this field. He became a doctor of science of the University of London. In 1922 he was elected to fellowship of the Royal Society.

For a considerable period before his retirement, a large part of Schott's time had been devoted to College business. In 1932 he was appointed vice-principal of the College and for a time in 1933, during the illness of the principal, his duties became very heavy indeed. It was typical of him that even during this period of overstrain, the work of his department was not allowed to suffer in the smallest detail.

Dr. Schott retired from the chair of applied mathematics at Aberystwyth in June 1933, but held office as vice-principal until the end of December of

that year. While still in his full powers he died very suddenly on July 16, 1937.

As a mathematician, Schott was a master of technique, his interests ranging over almost the whole field of applied mathematics and mathematical physics. His best work was done in connexion with the classical theory of electromagnetic radiation. It is noteworthy that he maintained until the last that the classical theory had yet to be proved inadequate. His most recent work is concerned with the rigorous calculation of the field of a rigidly electrified sphere and the resulting reaction on the sphere. In particular, he proved that such a sphere is capable of moving in radiationless orbits, a very significant result from the point of view of atomic structure.

The keynotes of his personal character were sincerity and scrupulous attention to detail. His academic distinction was carried with a simple kindness that coloured with affection the deep respect and admiration of his colleagues and students towards him.

We regret to record the death of Miss B. Pullen-Burry, which took place on September 21 at Hindhead at the age of seventy-nine years. Miss Pullen-Burry, who was born on February 14, 1858, was for many years a familiar figure at anthropological gatherings. She was a staunch believer in the anthropological method of approach in the study of problems of cultural contacts when that point of view had still to win recognition outside certain not very widely extended circles. It was this aspect which she stressed in her communications to the Anthropological Section of the British Association, dealing with the Negro under British rule and in America, and with the natives of New Britain, and afterwards incorporated in her books "Jamaica As It Is" (1903), "Ethiopia in Exile" (1906), and "In a German Colony" (1909). Miss Pullen-Burry travelled extensively in Europe, the Holy Land, Egypt, India, Japan, Australasia, German New Guinea, the West Indies, the United States and Canada. In 1912, she was the first president of the Union of Women of Geographical Interests, an organization which she had a large share in founding.

We regret to announce the following deaths:

Sir Jagadis Chunder Bose, C.S.I., C.I.E., F.R.S., emeritus professor in the Presidency College, Calcutta, and founder and director of the Bose Research Institute, Calcutta, on November 23, aged seventy-eight years.

Prof. C. Gravier, professor of zoology in the Muséum national d'Histoire naturelle, Paris, on November 14, aged seventy-two years.

Prof. Ludwig Plate, formerly professor of zoology and director of the Phyletic Museum, Jena, aged seventy-five years.

News and Views

Dr. R. R. Marett, F.B.A.

ON November 20, the University of Oxford conferred the honorary degree of D.Litt. upon Dr. Robert Ranulph Marett, rector of Exeter College, Oxford, in recognition of his services to the study of anthropology. Dr. Marett has been closely identified with Oxford for the greater part of his life, first as senior exhibitor of Balliol College, then as fellow, sub-rector and tutor of Exeter College, of which he became rector in succession to the late Dr. L. R. Farnell in 1928. Dr. Marett has held a distinguished position in academic circles as a philosopher since the days when he crowned his career as an undergraduate by winning the Green Essay Prize in Moral Philosophy, after being awarded the Chancellor's Prize for Latin verse; but to the outside world he is best known as an anthropologist, the formulator of the theory of preanimism in the study of primitive religion, the author of a number of books and contributions to scientific publications dealing with the beliefs and ethics of primitive man, as well as a writer on matters of prehistoric archaeology with a knowledge based upon practical experience in cave exploration and excavation.

WITHIN the precincts of the University, however, it is recognized that Dr. Marett's services to the study of anthropology go beyond his personal contributions to research and the advancement of knowledge. He has played the part of pioneer and advocate in organizing facilities within the University for others to pursue these studies. Not only did he take a prominent part in the arrangements for the instruction of officers destined for the Sudan Civil Service, as well as in the institution of a diploma in anthropology, but after the vacation of the professorship of anthropology by the late Sir Edward Tylor, when the chair was virtually in commission, he with the late Prof. Arthur Thomson, the anatomist, and Dr. Henry Balfour of the Pitt-Rivers Museum, were the protagonists in a struggle to secure increased recognition for a subject which had not yet won popularity among academic subjects. It was mainly through Dr. Marett's efforts that the University readership in social anthropology, which he had held for some years, was raised recently to the dignity of a professorial chair.

Dr. R. E. Priestley

THE newly appointed vice-chancellor of the University of Birmingham (see p. 942), Dr. R. E. Priestley, has had a varied career. Born at Tewkesbury and educated at Tewkesbury Grammar School under his father, he proceeded to the University of Bristol. His course there was interrupted when in 1907 he joined Shackleton's expedition to the Antarctic as a geologist and was thus occupied until 1909, when he went to Sydney and resumed his geological studies,

working out with Prof. Edgeworth David the results of the Expedition. In 1913 he joined Scott's antarctic expedition and became a member of the Northern Party, a history of which he gave in his book "Antarctic Adventure". Returning to England after the outbreak of the Great War, he joined the army, going to France with the R.E. Signals and attaining the rank of major and being awarded the M.C. Later, at the War Office he wrote the history of the Signal Service in France and a book called "Breaking the Hindenburg Line". He then went to Christ's College, Cambridge, and took the M.A. degree. He was elected a fellow of Clare College, and ultimately became secretary general of the Faculties of the University. In 1935 he was appointed vice-chancellor of the University of Melbourne and while holding that office he visited many universities in Canada, the United States and New Zealand, thus acquiring knowledge of the problems of the English-speaking university world.

Prof. Carl Neuberg

Enzymologia, the new journal edited by Prof. Carl Oppenheimer, devotes its entire third and fourth volumes, 568 pages in all, to commemorate the sixtieth birthday of Carl Neuberg, which took place on July 29, 1937 (Vol. 3. Neuberg-Festschrift, Teil 1. Pp. xiv + 300 + 5 plates. Vol. 4. Neuberg-Festschrift, Teil 2. Pp. viii + 268 + 9 plates. Den Haag: Dr. W. Junk, 1937. 15 florins each). No fewer than 87 papers by nearly twice that number of colleagues are contributed in honour of Neuberg, all dealing with some branch of the ever-widening enzyme question. It may be recorded that in the course of his forty years activity, he and his students have published 1,000 papers, whilst not the least of his services to his chosen science has been his editorship of the *Biochemische Zeitschrift*, which he founded in 1906 and produced 280 volumes by 1936. The numerical introduction we have given indicates a perfect spate of research and publication far too great to be properly assimilated by any one reader, though it is scarcely necessary to emphasize that Neuberg has to his reputation achievements of outstanding quality, notably his work on fermentation. The writer well remembers him working as a student of A. Wohl in Emil Fischer's laboratory in 1900 onwards, when Neuberg was also acting as assistant to Ernst Salkowski in the pathological institute of the University of Berlin, and may be allowed to use this opportunity to offer him also the congratulations of his English colleagues. Neuberg followed Wassermann in 1920 as director of the Kaiser Wilhelm Institute for Biochemistry in Berlin-Dahlem and has carried out all his work there until he retired last year. He made this institute an outstanding centre of research activity and attracted workers of all countries to it.

Edward Divers, F.R.S. (1837-1912)

Among the British men of science and engineers who some sixty years ago laid the foundation of scientific instruction in Japan, none was more highly esteemed than Edward Divers. Born in London on November 27, 1837, he attended the City of London School and then studied under Hofmann at the old College of Chemistry, Oxford Street. He graduated M.D. at Queen's College, Galway, and later was lecturer in materia medica at Queen's College, Birmingham, and in medical jurisprudence at Middlesex Hospital Medical School. In 1873, at the invitation of the Public Works Department of Japan, he, with ten other Englishmen, went to that country to establish a College of Engineering. The first principal of the College was Henry Dyer (1848-1918), but on his return home in 1882, Divers was appointed to succeed him. Later, when the College became a part of the Imperial University, Divers became professor of chemistry in the Department of Science. He remained in Japan until 1899, when he was made emeritus professor. After his retirement, Divers settled in London, where his house became the 'Mecca' of Japanese students visiting England. He received honours from the Japanese Government, and a bronze statue of him was erected in the College courtyard. Most of Divers' original papers were contributed to the *Journals* of the Chemical Society and Society of Chemical Industry. Of the former society he became a vice-president and of the latter he served as president in 1905-6. He died on April 8, 1912, and was buried at Brookwood.

Town Life in Early Britain

DR. R. E. MORTIMER WHEELER's Norman Lockyer Lecture for 1937, which was delivered on November 24, the first occasion on which this lecture of the British Science Guild has been given under the auspices of the British Association, in dealing with the beginnings of town life in Britain in the light of the evidence of recent archaeological investigation, was of marked importance for the history of the growth of civilization among the British people. It was at the same time a striking demonstration of the manner in which modern methods of archaeological research and interpretation are able to illuminate the dark places of history, and even in some instances modify in no small degree inferences from literary and other sources which have attained the status of dogma. Dr. Wheeler's purpose was to test the statement that town life was non-existent in pre-Roman Britain and to check our estimate of the Roman contribution to the urbanization of Britain. Excavations at Wheathampstead and Verulamium, he pointed out, have filled in details of the picture of the British 'city' in Kent and Hertfordshire as given by Caesar, to whom they appeared as fortified woodland clearings. The recent excavations have shown that the size, situation, interdependence and cohesion of these settlements lift them out of the parochialism of a mere peasant kraal.

It is, however, in south-western Britain, on the downlands of Wessex and along the foothills of the

Welsh border that, as Dr. Wheeler went on to show, the most obvious and dramatic vestiges of our pre-Roman communities have survived. Sites of the Iron Age between central Hampshire and eastern Devon alone number upwards of seventy. Such fortified settlements, of which the recently excavated Maiden Castle is a conspicuous example, in their size and their domestic and defensive economy imply no small degree of authority and skill. They can only be designated 'towns' or 'cities' in a full sense of the term. In the light of these new facts—or newly verified facts—it is difficult to deprive the Celtic inhabitants of lowland Britain of the rights of citizenship. But there is another side of the picture; and this modification of the traditional view must not be pressed too far. As Dr. Wheeler indicated, one important element of city life is lacking, namely, commerce. The economic basis of these communities was agricultural and their sphere a given limited tract of country. At Maiden Castle, for example, where hundreds of objects have been recovered in four years' excavation, it is surprising to find how few had been brought from far afield. It was made clear in Dr. Wheeler's account of British organization on and after the Roman occupation that it was this lack of appreciation of the commercial element in civic life that caused the Romanization of Britain to make little permanent impression on the life of the people, except in so far as the villa system gave rise to something in the nature of a squirearchy, which was not foreign to native agricultural tradition—a tale not without a moral for our modern administrators of backward peoples.

Roman Pottery from Ewell, Surrey

It is to be inferred from the number of antiquities of the Roman period which have been discovered at Ewell in Surrey that the Roman township of which it is the modern representative was one of the more important of the stations which research has shown to have been strung out, probably for the convenience of travellers rather than for military purposes, along Roman Stane Street. A recent find of pottery fragments is of more than usual interest, owing to the fact that they are inscribed with names, of which indeed portions only remain, but sufficient to indicate that they have not previously been recorded among the names of the manufacturers of the pottery which was then being imported into Britain from the Continent in something like wholesale quantities. The fragments, which are described in *The Times* of November 8, were found in the south arm of Church Street, between High Street and the old church tower, and consist of two massive amphora handles, and the mouth portion of a mortarium. They are of buff ware and of second century type, the amphoræ of characteristic Roman form used for the transport of oil and wine, having thick, flat, ringed mouthpieces, made separately and joined to the neck and globular body. It is probable that the amphoræ of which these are fragments were made in Gaul. The handles were inscribed respectively *buche* and *oropo*, while the mortarium is inscribed

invasion; these, as already mentioned, have not previously been recorded among potters' marks of the period.

Archaeological Research and the Prehistory of India

AN instructive general view of the results of his journeys of archaeological reconnaissance in Southern Persia as a whole was given by Sir Aurel Stein before the East India Association on November 16, when the Marquess of Zetland, Secretary of State for India, was in the chair. As might have been anticipated, Sir Aurel stressed the need for further and intensive archaeological investigation, the aim of which should be to throw light on the dark period covering the Aryan invasion and the beginning of the historic era, when Cyrus, in the middle of the sixth century B.C., extended his dominions to Gandhara, including the whole Kabul valley. It is evident, he pointed out, that the Aryan invader, as may be gathered from the Rig-Veda, had been familiar with a considerable portion of the Indo-Iranian borderland long before they settled in the Punjab. Sir Aurel stressed the gratitude due for the archaeological discoveries of recent years in the Indus Valley, when so much relating to the period of the Aryan invasion must remain conjectural; but, he went on to say, his own explorations of the past few years in the great provinces of Kerman, Fars, Khuzistan and Kermanshah, right up to Kurdistan, had left no doubt about an essentially uniform chalkolithic civilization having prevailed here wherever physical conditions permitted of settled life. Yet nowhere on the ground visited had there been found remains filling the wide chronological gap between the chalkolithic mounds traced in such abundance and the numerous burial sites of Baluchistan and Makran, dating at the earliest from the last centuries before our era. Not until sites abandoned much later than Mohenjodaro had been explored could we hope to learn of the actual state of civilization prevailing in the Indus Valley and beyond at the time of the Aryan invasion.

Destruction of Chinese Centres of Learning

AFTER the great Japanese earthquake of September 1, 1923, when three hundred thousand persons lost their lives, and the buildings of the Imperial University in Tokyo were destroyed, including the loss of about seven hundred thousand volumes in the library, an influential British committee was formed to replace the English section of the library, not only as a token of British sympathy but also as a tribute to the intellectual life of Japan. The calamity which evoked this appeal was a natural one, and unavoidable, but it is ironical now to have to record that Japan itself has destroyed many schools, colleges and universities in China by air raids. We express no opinion upon the causes of the conflict, but we do deplore the barbaric methods of modern warfare which seem to permit no discrimination between combatants and the civilian population, and bring desolation to seats of learning as brutally as to fortified places or other military centres. We are

therefore in complete sympathy with the righteous indignation expressed in a telegram organized by "For Intellectual Liberty", and signed in their individual capacity by more than one hundred members of twenty-two British universities, which was sent to the Minister of Education, Nanking, early last month. The replies received from the Shanghai Association of Universities and Colleges, and from representatives in Hankow of ten universities, show deep appreciation of the sympathetic message from England. "In name of world civilization," say the Hankow colleagues, "we thank you for your noble sentiment and moral support. We request you will give unswerving attention to prevent Far Eastern crisis and lend us further support in mobilising all British intellectual and humanitarian forces to the side of our common cause of international justice, which if humanity would exist must prevail."

Jews in Poland

THE Warsaw correspondent of *The Times* wrote on October 6 describing a system whereby Jewish students are being divided from 'Aryan' students in the lecture rooms of the Warsaw Polytechnic. Part of the benches have been marked for students belonging to a union almost exclusively controlled by 'Aryans', and others for the Jewish students' union, while a few seats for non-union students are left unmarked. The University of Warsaw has its seats numbered, and students sit according to the numbers on their identity cards. All 'Aryan' students, who have even numbers, occupy one half of the room. Unlike the Polytechnic, the University has no unmarked seats. It is stated that other educational establishments in Poland will probably follow suit. In the issue of *The Times* of November 18, appears a letter signed by Prof. George Barger, Mr. G. D. H. Cole, Mr. T. Edmund Harvey, Dr. Julian Huxley, Prof. Norman Kemp Smith and Prof. J. B. Trend, referring to the apparent surrendering of the authorities of the high schools and universities to the agitation of anti-Semitic students. They state that the Minister of Education, a year ago, gave an assurance that separate benches would never be introduced in the universities. They ask, "Will it enhance the good name or the welfare of the Polish republic if such a spirit of intolerance is officially allowed and deliberately fostered in the very institutions in which are trained our future legislators and administrators?"

Foot-and-Mouth Disease

THE outbreak of foot-and-mouth disease in the eastern counties of England has produced the usual crop of suggestions, in the form of letters to the daily Press, for dealing with this scourge. It is evidently not widely known that a Foot-and-Mouth Disease Research Committee is in existence, and published a substantial fifth Progress Report on its work so recently as early last summer (see *NATURE*, June 19, p. 1033). Replying to questions on November 15 in the House of Commons, the Minister of Agriculture, Mr. W. S. Morrison, referred to the work of this Committee, and stated that "the most effective

method of preventing the spread of infection is the prompt slaughter of affected animals and those in immediate contact". The work of the Research Committee is costing, he said, £18,000-£17,000 a year. In a written reply to a question, Mr. Morrison stated that the Government has paid out £4,900,233 in compensation for animals slaughtered on account of foot-and-mouth disease during the twenty years 1917-36. The Royal Society for the Protection of Birds has issued a circular letter asking if there is any evidence that starlings and other birds are responsible for bringing infection into England. The Research Committee, in its report referred to above, does not apparently favour the view that birds are responsible, but nevertheless Mr. Morrison declared that in the opinion of the Ministry, "the present outbreak is caused by migrant birds".

Monument to Wireless Pioneers

A GRANITE column has been erected by the Marconi Company at Poldhu Cove, Cornwall, on November 21, to mark the site of the former Poldhu wireless station. A plaque on the monument states that the Poldhu wireless station, designed by J. A. (now Sir Ambrose) Fleming, occupied that site from 1900 until 1933. A second plaque states that the Poldhu station was used for the first trans-oceanic service of wireless telegraphy, which was opened with a second Marconi station at Glace Bay, in Canada, in 1902. There is also a third plaque, which commemorates the fact that in 1923 and 1924 C. S. Franklin, inventor of the Franklin beam aerial, directed from there his short-wave wireless beam transmission to Marconi on his yacht *Elstira*, cruising in the South Atlantic. These experiments laid the foundation of modern high-speed radio-telegraphic communication to and from all quarters of the globe. Mr. H. A. White, chairman of the Marconi Company, who presided, said that Marconi had always realized that inventors working under the auspices of the company which bore his name do not usually receive adequate recognition. Most of the success of modern methods of radio-telegraphy and radiotelephony, and many other wonderful achievements in scientific technique, can be traced back to Sir Ambrose Fleming's invention of the thermionic valve in 1904.

The German Autobahnen

CONSIDERABLE attention has been given recently by scientific and technical workers to the remarkable system of new motorways now in course of construction by the German Government, at the invitation of which a delegation from Great Britain recently made a tour of inspection of the roads, both those in course of construction and also those now completed. Of the latter, 650 miles were opened to traffic on September 27, 1936, and it is stated that another 650 miles will be completed each year until a total of some 4,500 miles of new roads are constructed. Only mechanically propelled vehicles are permitted to use the *Autobahnen*, and the requisite land is purchased by the German Government, proprietors refusing to sell being expropriated, an exchange process between adjacent plots being arranged in

such cases. The work gives employment to about 250,000 workers, and is financed directly by the Reich. Dual concrete carriageways, clover-leaf intersections, and transition curves suited to high-speed traffic are adopted, through and local traffic are segregated, and the mixing, placing, consolidation and finishing of the concrete surfaces is done by mechanical means throughout.

It is understood that the delegation which visited these roads, composed of representatives of the Automobile Association, the Royal Automobile Club, and the British Road Federation, together with various technical experts, has been asked by the Minister of Transport to present to him its considered views on the German *Autobahnen*; and at the meeting of the Public Works Congress in London last week, a private session of the delegates was held at which the best method of preparing such a report was discussed. It is clear that although all who have seen these new roads have been greatly impressed by them as an engineering achievement, there is by no means unanimity of opinion in technical circles as to their applicability to conditions in Great Britain. Questions as to land values, possible effect on railway interests, the smaller size of Great Britain as compared with Germany, distribution of industry, and the strategical aspect, make the matter a difficult problem. It is suspected that methods easy of adoption in a totalitarian State may prove to be an entirely different proposition in Great Britain.

Richard Watson and the Constitution of Elements

PROF. H. A. HARRIS, of the Anatomy School, Cambridge, has directed our attention to a statement by Richard Watson (1787-1816), bishop of Llandaff and professor of chemistry at Cambridge, an account of whose work was recently given by Prof. J. R. Partington (*Chemistry and Industry*, 56, 819; 1937). Prof. Harris quotes from Watson's "Chemical Essays" (vol. 4, Essay 7), "Of the Transmutability of Water into Earth", in which he says "the diversities of bodies subsisting in the universe, will no longer be attributed to the different combinations of *earth, air, fire* and *water*, as distinct, undecomposed, immutable principles; but to the different magnitudes, figures, and arrangements of particles of matter of the same kind". This idea of a composition of particles of what were then believed to be elements from simpler particles in different arrangements and motions is to be found also in the "Sceptical Chymist" of Robert Boyle, written in 1661, in which he says: "The greatest part of the affections of matter, and consequently of the Phaenomena of nature, seems to depend upon the motion and the contrivance of the small parts of Bodies", and that "the difference of Bodies may depend merely upon that of the schemes whereinto their common matter is put . . . so that according as the small parts of matter recede from each other, or work upon each other . . . a Body of this or that denomination is produced". In these statements of Boyle and Watson an idea of the present view of the structure of the elements is expressed.

Public Health in Great Britain

IN his annual report for 1936, published last week, Sir Arthur MacNalty, Chief Medical Officer of the Ministry of Health, points out that this year of the Coronation is also the centenary of Queen Victoria's accession, and he takes the opportunity to present an impressive statement of the remarkable progress that has been made in national health and in medicine in the past hundred years and of the amazing decline in mortality rates during that period. For 1936, the crude death-rate was 12.1 per 1,000 living, compared with 22.4 in the eighteen forties, the infant mortality rate was 59 as against 153, and the number of infants who died at less than one year of age was 35,425—less than half the number who would have died under conditions of as little as thirty years ago. The standardized death-rate from tuberculosis, respiratory and non-respiratory, was 657 per million living, compared with an average of 3,476 in the fifties of last century. There is an increase in the mortality from cancer, the number of deaths being 66,354, an increase of 1,847 on the previous year, which is a larger increase than that in 1935 over 1934. The maternal mortality rate was 3.8 per 1,000 live births, the lowest recorded since 1923. Reference is made to the importance of the consumption of a sufficient quantity of milk, described as "the key to proper nutrition", and commendation is expressed for properly operated milk bars. The report points out the risk of skin affections from the use of certain substances in lip-stick, hair-dye, face cream and other cosmetics, but observes that untoward results are relatively very few. Reference is made, in conclusion, to the national health services, the need for knowledge of these services, and to the intensive national health campaign organized and launched this autumn.

Photo-electric Control in Industry

AT the Nottingham meeting of the British Association, Mr. A. L. Whiteley contributed to Section A a paper on photo-electric control in industry. The photo-electric cell provides greater rapidity of action and a higher sensitivity than other light-sensitive devices. The greatest field for it is the talking picture industry, but this does not come under the subject of his paper. In industry the cells are usually made in standard sets called photo-electric relays, containing an amplifier circuit and a small contactor capable of making or breaking 15 amperes. An obvious application of this unit is counting objects on a conveyor belt or vehicles passing on a road. It can easily be used to make the pointer of an instrument actuate an external circuit on reaching a pre-determined scale reading. Applications of this nature include automatic weighing of mass-produced parts and automatic termination of operations on high precision grinders when a mechanical gauge records that a certain diameter of the part operated on has been reached. It is also used to control street lighting according to variations in the intensity of the light. In many types of automatic wrapping and bag-making machines a continuous preprinted web of paper or "Cellophane" is fed to the machine at a high speed. It is necessary that positional relation-

ship between the printed matter and the fold or cut be maintained. This is done by the response of the printed matter itself. The system is used abroad to maintain 'register' between the design and the perforations of postage stamps. It can be applied to record the intensity of the smoke coming from a chimney and the temperature of strip steel as it comes from the hot rolls of a rolling mill.

Blood Groups in Central Africa

MR. R. ELSDON-DREW, of the South African Institute for Medical Research, Johannesburg, has recently returned from his six months' expedition to Central Africa for research on the blood-grouping of the various native inhabitants of this region. In a communication to the Editor, he has included a long table of percentages based on his observations, for which space cannot be found. His investigations covered tribes of Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda, reaching so far north as to the Nilotic peoples of the lowlands to the north-east of the great lakes. In all, thirty-four tribes or groups of peoples were examined, the numbers in each group ranging from one hundred and twenty-three (Tumbuka) to five hundred and seventy-six (Yao). In the majority of instances, however, the numbers were between four and five hundred, thus approximating in size to the eleven groups of natives of South Africa previously reported (see NATURE, July 10, 1937, p. 77), each of which numbered five hundred. These later results have not yet been analysed, so that any inference from the observations would be premature; but the percentages of the groups already worked out suggest that the analysis, when completed by Mr. Elsdon-Drew, will prove not only of great serological interest, but will also afford material of considerable significance for the ethnologist. These percentages follow the results of the earlier investigation in suggesting a striking tendency to the predominance of the O group among Bantu-speaking peoples. In the thirty-four sets of observations, the O group is less than 50 per cent in six instances only. In fourteen it ranges from 50 to 60 per cent, in twelve from 60 per cent to 70 per cent, and in two it is more than 70 per cent. Among the Wagogo the grouping is: O, 73.1; A, 19.6; B, 5.8; AB, 1.6; among the Vandau: O, 74.4; A, 13.4; B, 10.4; AB, 1.8. The highest percentage of A appears in the Wakamba: O, 53.3; A, 31.8; B, 12.9; AB, 2.0; and the highest B among the Lango (Nilote): O, 41.1; A, 27.6; B, 28.9; AB, 2.4.

Cables for 200,000 volt Pressures

FOR several years, research has been made in the laboratories of Callender's Cable Company with the object of designing an underground cable which will withstand the high electric pressures necessary for the economic transmission of electric energy over considerable distances. The new impregnated cable has now undergone a continuous test of 5,000 hours at 200 kilovolts and the application of numerous heat cycles during this period. According to the *Electrician* of November 19, it has also passed through the

official tests in Holland. This cable marks a very notable advance in the transmission of electric energy underground and will be most useful in the neighbourhood of towns and in populous districts. The dielectric is similar to that used in the 'solid' type of cable, but after the installation has been completed, dried nitrogen gas under pressure is admitted to the cable. The pressure used is 200 lb. per square inch and the gas finds its way along the cable in the narrow space between the dielectric and the lead sheath. All the dielectric is subjected to this pressure and so any void spaces which form in it during the working of the cable must contain gas at this high pressure. The electric strength of the void space will therefore be much greater than if the gas were absent. Very long continuous cables can be made in this way; no supplementary feed points are required. The strength required to withstand the high internal gas pressure is afforded by strengthening the lead sheath with copper tapes. The cable is treated just like the normal solid type cable during transport and installation. The point of entry of the gas is at the base of two sealing ends, and it is buried to a depth of about a yard. The cross-section of the conductor is about 0.65 sq. in. and the overall diameter is 3.46 in. The losses in the dielectric as compared with a solid cable have been reduced by 25 per cent, and there is no increase in the losses with rise of temperature.

National Institute of Sciences, India

At a meeting of the Council of the National Institute of Sciences of India held on November 6 the following were elected fellows of the Institute: *Ordinary fellows*: Prof. Y. Bharadwaja, professor of botany, Benares Hindu University, Benares; Dr. B. L. Bhatia, principal, Government College, Hoshiarpur; Prof. G. R. Paranjpe, professor of physics, Royal Institute of Science, Bombay; Dr. H. Srinivasa Rao, assistant superintendent, Zoological Survey of India, Calcutta; Dr. K. Rangadhama Rao, reader in physics, Andhra University, Waltair; Prof. M. R. Siddiqi, professor of mathematics, Osmania University, Hyderabad-Deccan; Prof. A. C. Sircar, professor of chemistry, Presidency College, Calcutta; Dr. M. B. Soparkar, medical officer, Plague Research Inquiry, Haffkine Institute, Parel, Bombay; Sir Shah S. Sulaiman, judge of the Federal Court of India, New Delhi; and Col. F. C. Temple, chartered civil engineer, Calcutta. *Honorary fellows*: Prof. Ludwig Diels, director of the Botanical Gardens, Berlin-Dahlem, Germany; Sir James G. Fraser, London; Prof. Robert Robinson, Waynflete professor of organic chemistry, University of Oxford; Dr. C. M. Wenyon, director-in-chief, Wellcome Bureau of Scientific Research, London.

The Oxford Farming Conference

In view of the interest aroused by the two conferences already held, the Oxford Farming Conference is to be established as an annual event. At the same time it has been decided that in future years the Conference shall not be confined to mechanized farming but shall provide a common

meeting ground for farmers, research workers and others, at which any subjects of particular interest to British agriculture may be discussed. The next Conference will be held on January 4-7, 1938, and will deal mainly with the maintenance of fertility, with special reference to the Government's new agricultural policy and to the control of weeds and pests. Further information can be obtained from the Conference Secretary, 10 Parks Road, Oxford.

Electron Diffraction in Crystals

DR. P. P. EWALD, writing* from the Crystallographic Laboratory, Cambridge, with reference to the note on the Nobel Prize award to Dr. C. J. Davison and Prof. G. P. Thomson for work on this subject (*NATURE*, Nov. 20, p. 882), points out that W. Elsasser predicted the effect in 1925. Elsasser's work is mentioned early in a paper by Prof. G. I. Finch and H. Wilman entitled "Study of the Surface Structure by Electron Diffraction" published in *Ergebnisse der Exakten Naturwissenschaften*, 16, 353-436 (1937), to which reference can be made for a review of the subject. In the course of two paragraphs dealing mainly with the work of Dr. Davison and Prof. Thomson, it was neither possible nor desirable to attempt to survey the whole field of electron diffraction.

Observation of the Orionid Meteors

MOHD. A. R. KHAN informs us that he carried out observations of this shower at Begumpet, Deccan, on October 18-20, in spite of the difficulties attending strong moonlight. Altogether he observed forty-one Orionids, and his results again confirmed the easterly movement of the radiant, the positions of which on October 18 and 20 were respectively R.A. 6^h 5^m, Decl. 15° N; R. A. 6^h 15^m, Decl. 15° N.

Annular Eclipse of the Sun, December 2-3

AN annular eclipse of the sun will take place on December 2-3 but will be invisible from Europe. The path of annular eclipse, which will cross the Pacific Ocean, extends from long. 139° 4' E., lat. 26° 4' N. to long. 115° 0' W. lat. 21° 8' N.; the respective times of beginning and ending of annular eclipse corresponding to the extremities of this path are December 2^d 21^h 18^m and December 3^d 0^h 52^m. Washington Island and Fanning Island in mid-Pacific lie on the track, the duration of the annular phase at these places being about 11½ minutes.

New Minor Planet close to the Earth

HERB K. REINMUTH, Königstuhl, discovered an object, magnitude 10, on October 28, the position being R.A. 1^h 34.2^m, N. Decl. 8° 6'. It was moving rapidly—an indication of proximity to the earth. Other observations were made, but as these extended only over three days, the orbit derived is very rough. It is moving at a small inclination to the ecliptic, probably not exceeding 6°, and has a perihelion distance of about 0.6. The remarkable thing is the close approach to the earth at the end of October, namely, less than 700,000 miles. In *Mon. Not. Roy. Astro. Soc.*, 92, 7 (May 1932), Dr. Davidson gave a

description of Minor Planet 1932 HA, which came to $6\frac{1}{2}$ million miles from the earth, and predicted the discovery of other similar objects. Since then Adonis was discovered in 1936 and made an approach to the earth of $1\frac{1}{2}$ million miles. The recent planet, 1937 UB, has made the closest approach of any, but it is quite possible that others may be discovered nearer still. These small objects present certain very interesting features in connexion with the evolutionary history of our solar system.

The Night Sky in December

At the time of the winter solstice on December 22, the night lasts $16\frac{1}{2}$ hours in the latitude of London. The moon is new on December 2 at 23.2^h and full on December 17 at 18.9^h U.T. Mercury is an evening star setting at about 17^h, but the planet will be difficult to see, even at the time of greatest elongation (21° east) on December 12. Venus rises as a bright star in the late dawn. Mars, Jupiter and Saturn are evening stars, their respective times of setting in mid-December being 16.3^h, 14.6^h and 18.3^h. Conjunctions between the planets and the moon occur as follows: Mercury on December 4^d 17^h; Venus on December 1^d 14^h; Mars on December 9^d 0^h; Jupiter on December 7^d 0^h and Saturn on December 12^d 1^h. At 22^h in the middle of the month, Algol, Capella, the Pleiades and Aldebaran are near the meridian. The variability of Algol may be watched about 1 $\frac{1}{2}$ hours before and after the following times: December 3^d 0.7^h, 5^d 21.5^h, 8^d 18.3^h, 20^d 5.6^h, 23^d 2.5^h, 25^d 23.3^h, 28^d 20.1^h and 31^d 17.0^h. Comet Encke is traversing the constellation of Ophiuchus; according to Crommelin's ephemeris given in *B.A.A. Handbook*, p. 34, the comet will reach perihelion on December 27. The Geminid meteors, at maximum frequency about December 10, have their radiant point west of Castor. On a clear night, two nebulae that are very different in nature may be seen with the naked eye. The great nebula in Orion, situated within our stellar system, is a very extensive gaseous nebula nearly 600 light years from the earth. The great Andromeda nebula, 800,000 light years away, is one of the nearest two of a vast host of extra-galactic nebulae extending into remotest space.

Announcements

THE Symons Gold Medal for 1938 of the Royal Meteorological Society has been awarded to Dr. G. M. B. Dobson, reader in meteorology in the University of Oxford.

SIR KINGSLEY WOOD has announced that an inquiry is to be held into the causes leading up to the outbreak of typhoid fever in Croydon, and the steps taken to deal with it. The inquiry will be held by Mr. H. L. Murphy, K.C., who will have as assessors Sir Humphry Rolleston, lately regius professor of physics at Cambridge, and a former president of the Royal College of Physicians, and Mr. H. J. F. Gourley, a past president of the Institution of Water Engineers.

DR. E. F. ARMSTRONG gave away the prizes and delivered an address at the annual prize distribution

and conversations of the Birmingham Central Technical College on November 17. He was then awarded an honorary associateship of the College. This distinction was inaugurated last year when it was given to Lord Austin, Dr. Sumpner, the first principal of the College, and Dr. C. C. Paterson.

THE RIGHT HON. LORD MACMILLAN will open the new buildings in Foster Court of University College, London, on December 1 at 2.45 p.m. After the opening ceremony, the new buildings (the Foster Court Library, the rooms of the Faculty of Laws, the Departments of Geography and Archaeology, the Junior Laboratory of the Department of Physics and the Department of Zoology) will be open for inspection.

A SPECIAL programme of films on scientific subjects will be shown at the Academy Cinema, Oxford Street, London, on Sunday, December 12, at 2.30 p.m., under the auspices of the Scientific Film Group of the Association of Scientific Workers. Tickets, price 1s. and 1s. 6d., may be obtained, prior to the day of performance, from the Secretary, Association of Scientific Workers, Kelvin House, 28 Hogarth Road, S.W.5, or from Film Centre, 34 Soho Square, W.1.

ON November 19, Capt. G. E. T. Eyston broke the world land speed record at Bonneville Salt Flats, Utah, in his car *Thunderbolt* by driving twice over the measured kilometre at an average speed of 312.20 miles per hour. Sir Malcolm Campbell held the previous record with an average of 301.47 miles per hour. *Thunderbolt* has two Rolls-Royce engines, each capable of developing 2,350 horse-power.

Flying Officer A. E. Clouston and Mrs. Kirby-Green returned to London from Capetown on November 20 in their Comet aeroplane, after making another record (*NATURE* of November 20, p. 388). The journeys were made in 5 days 17 hr. 28 min. The outward journey was done in the record time of 45 hr. 2 min., and the return journey in 57 hr. 23 min., the latter beating the previous best time by 39 hours. The round trip was faster by 88 hr. than any hitherto made. Another record was set up on November 22, when M. Codos and three companions flew from France to the Argentine in 48 $\frac{1}{2}$ hours.

A REPORT has been prepared by a joint committee consisting of representatives of the British Rainfall Organisation, the Institution of Water Engineers and the Royal Meteorological Society, appointed to consider methods for determining rainfall over any area. The report will be discussed at the general meeting of the Institution of Water Engineers to be held in the rooms of the Institution of Civil Engineers, Great George Street, Westminster, on December 10, at 2.15 p.m. Advance copies of the report can be obtained by members of the institutes concerned from their assistant secretaries.

A CHAIR of social medicine has recently been founded in the Paris Faculty of Medicine with Dr. Crouzon as its first occupant.

Letters to the Editor

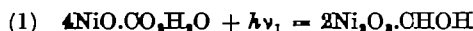
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 935.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Photosynthesis of Carbohydrates, *in vitro*

It has been proved that carbohydrates are photo-synthesized when a surface of pure nickel oxide coated with an adsorbed layer of hydrated carbon dioxide is irradiated with white light. The photo-synthesis is accomplished by two successive photo-chemical reactions which are as follows:



where $h\nu_1$ is a quantum of blue light ($\lambda = 4000 \text{ \AA.}$), $h\nu_2$ is a quantum of red light ($\lambda = 6400 \text{ \AA.}$), and CHOH represents a molecule of activated formaldehyde which polymerizes on the surface to a carbohydrate. These two processes are followed by a thermal or dark reaction:



which takes place in the presence of hydrated carbon dioxide, with the result that the photosynthesis is continuous.

The first product of photosynthesis is a complex carbohydrate which is unstable and undergoes polymerization or condensation into a still more complex carbohydrate which is stable in solution. This second complex substance when thus formed in solution does not appear to be hydrolysed by acid or by diastase. If, however, this substance is deposited on a surface, it at once becomes capable of hydrolysis by diastase to reducing sugars. The stable complex carbohydrate appears, therefore, to be the hitherto unknown parent of a starch, since as the result of its deposition on a surface it becomes endowed with the characteristic property of starch, namely, its ready hydrolysis by diastase.

The stoichiometric relations shown by the two photochemical reactions indicate that the essential criterion of success is a surface of a true crystalline lattice of nickel oxide. Owing to the remarkable power which the hydroxide and carbonate possess of adsorbing hydroxyl ions, thereby becoming highly dispersed, considerable difficulty has been met with in preparing satisfactory surfaces of nickel oxide. Indeed all failures to achieve photosynthesis have been due to the dispersion of the nickel compound by alkali. This difficulty has now been overcome, and two methods of preparation have been standardized.

E. C. C. BALY.

University,
Liverpool.
Nov. 6.

Spectrum of Nitrogen and Atmospheric Pressure at High Altitudes

IN a series of experiments on the excitation of nitrogen bands by a controlled electronic bombardment, I have observed, as Dr. Kaplan did¹, the great modifications of the spectrum which accompany any change in the experimental conditions. As the pressure decreases, the intensity of the negative system of bands (emitted by N_2^+ ions) increases in comparison with that of the second positive system. On account of the rarity of collisions, the average energy of the exciting particles (ions or electrons) rises progressively and, at the same time, the probability of excitation of the negative bands becomes higher².

Dr. Kaplan proposes a simple method for obtaining the actual value of the atmospheric pressure between the boundaries of the auroral zone, that is, 100 km. and 1,000 km. After measuring the altitude of one aurora and observing its spectrum, it would be sufficient, in laboratory experiments, to seek for the pressure which permits the reproduction of a similar spectrum.

The idea is attractive, but we can oppose to it serious objections. Observation of auroral displays having a height of several hundreds of kilometres shows that the spectral composition is nearly the same at each point. This fact excludes any important influence of the pressure. Such an influence should enhance considerably, at the lower limit of the aurora, the bands of the second positive system of nitrogen, chiefly for low-altitude auroras. It seems that this change has never been observed. Moreover, it would be now difficult to question the electronic origin of the aurora. Admitting this view, I have recently shown that the only factor capable of altering the relative intensities of the radiations emitted is the energy of the electrons. Making use of photometric comparisons, as suggested by Dr. Kaplan, I even succeeded in assigning to the aurora a definite potential of excitation³. The development of this work is now going on at the Auroral Observatory of Tromsø.

In conclusion, the influence of the pressure on the composition of the afterglow spectrum is probably too complex a phenomenon to be considered as a source of precise information on the physical state of the upper atmosphere.

RENÉ BERNARD.

Institut de Physique Générale,
Université de Lyon.
Oct. 25.

¹ NATURE, 139, 1112 (June 25, 1937).
² C.R. Acad. Sci., 204, 450 (1937).
³ C.R. Acad. Sci., 204, 903 (1937).

Abnormal Zenithal Distribution of Cosmic Rays

MANY experimenters, and especially Auger and Ehrenfest, have shown that the intensity of cosmic rays, measured by counter coincidences, at different zenithal angles, is different from what it should be as deduced from the variation of vertical intensity at various heights in the atmosphere.

The intensity at a zenithal angle of 45° and at an altitude corresponding to a pressure of 0.7 atmosphere is about 30 per cent less than the vertical intensity at sea-level, unless the rays have to cross the same equivalent depth of air, supposing the composition of the atmosphere independent of altitude.

An absorbing layer, on the top of atmosphere, more absorbing than air for corresponding densities, would explain the anomaly, but the existence of such a layer is not easy to justify. I suggest that the whole of the anomaly would also be explained by taking into account the diffusion of cosmic rays in the air. A very rough calculation shows that a mean deviation of 20° in a screen of 1,000 gm. cm.⁻² is sufficient to explain the observed facts. Such a value for the diffusion does not seem to me to be in opposition with the known properties of the cosmic rays.

In seeking a quantitative justification of that hypothesis, a more elaborate calculation of the effect to be expected is now in progress, and will be published soon.

MAX G. E. COSYNS.

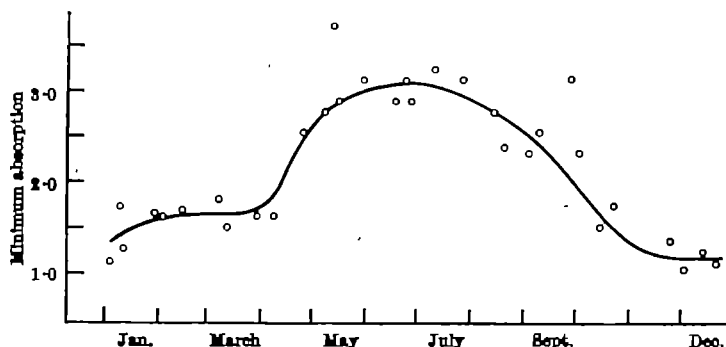
"Fondation Medicale Reine Elisabeth",
Brussels.
Oct. 26.

Annual Variation of the Absorption of Wireless Waves in the Ionosphere

A WIRELESS wave, incident normally on the ionized regions in the upper atmosphere, will, under suitable conditions of ionization and frequency, be returned to the earth from the *F* region. By the method described previously¹, the magnitude of the total absorption suffered by the wave in its atmospheric path (*f.k.d.s*) may be determined as a function of the frequency of the wave at any given time of day. From measurements made at noon, with the emitting station at King's College, London, and the receiver at the Halley Stewart Laboratory, Hampstead, it has been shown that on any day the absorption has a minimum value, different from zero, provided that the frequency of the wave is not near the critical frequency for a reflecting region. As a critical frequency is approached, the absorption increases, but at other frequencies the minimum value of the absorption is independent of frequency, to the accuracy possible in this work.

This result indicates that there are two zones of absorption for waves reflected from the *F* region. The first is at the top of the wave trajectory and is of importance only at frequencies near the critical frequency for a reflecting region. The second is lower in the atmosphere, and the waves pass through it twice in their journey to and from the *F* region. The latter is principally effective in causing the minimum absorption mentioned above.

Some evidence of the variation of the minimum absorption from winter to summer has already been given. Since the publication of the previous results, however, the work has been continued and the annual variation in the magnitude of the absorption in the lower zone has been more definitely established. The complete results for the period, January–December 1935, are shown in the accompanying figure.



The lower zone of absorption is more absorbing in summer than in winter, the ratio of the mid-summer value of *f.k.d.s* to the midwinter value being 2.27.

F. W. G. WHITE.

Canterbury University College,
Christchurch, C.1, N.Z.

L. W. BROWN.

"Breen", Moron Avenue,
Broomfield, Chelmsford.
Oct. 23.

¹White and Brown. *Proc. Roy. Soc., A*, **153**, 639-660 (1935).

Cytology of *Lepidosiren*

I HAVE just seen the issue of *NATURE* of August 28, in which Prof. E. W. MacBride refers to an early work of mine on the spermatogenesis of *Lepidosiren*. Although a reply after such a long interval loses much of its point, his use of that work as a disproof of the chromosome theory of heredity is so surprising that I feel that a reply is desirable.

My account of the longitudinal pairing of the homologous chromosomes in the *xygotene* stage, and the subsequent re-pairing of the temporarily separated ex-conjugants, is made to read very strangely by MacBride's using, as interchangeable terms, the pairing of the homologues prior to meiosis, and meiosis itself. But the main object of this reply is to state that I can see nothing in my description of the meiotic phase in this animal which is inconsistent with the now generally accepted view of the arrangement of genes in the chromosomes, and the genetic theory of crossing-over. The peculiarity in *Lepidosiren* consists merely in the unusually complete temporary separation of the ex-conjugants between the *xygotene* stage and the placing of the bivalents on the spindle of the first division. As I pointed out in my original paper (1911), this is in favour of the hypothesis that the pairing of the homologues performs a double function—that of allowing an interchange between them, and that of associating them together in the correct

relations for the meiotic division. Prof. MacBride does not believe in this double function; but he cannot logically cite the case of *Lepidosiren* (and similar cases which have been described) as evidence against it.

W. E. AGAR.

University, Melbourne.
Oct. 11.

PROF AGAR has read with insufficient care my article on "Mendel, Morgan and Genetics" which was published in *NATURE* of August 28. I reproduced in that article two drawings of the figures given by Prof. Agar of two meiotic "pairings" within the same nuclear cycle. I further said that Prof. Agar's hypothesis to explain these was plainly incredible and I gave the credit for perceiving that *Lepidosiren* would furnish a critical case for testing the "crossing-over" theory and for planning the research to Prof. Agar's teacher, Prof. Graham Kerr.

Prof. Agar's statement "the now generally accepted view of the arrangement of genes in the chromosomes, and the genetic theory of crossing-over" is pure assertion. Amongst the foremost zoologists in Great Britain—those who have really the right to speak on the specific problem—there is a widespread scorn of the whole 'gene' theory, and to say that this theory is "generally accepted" in view of the evidence given in my article, of the bitter regret of Johannsen that he had ever invented the word 'gene', of Mohr's statement that 'genes' responsible for mutations continually occur in all chromosomes and are all expressions of a lowered vitality, and finally of the view of the Development Commission that factors valuable to the farmer do not 'mendelize', is simply obfuscation—a deliberate shutting of the eyes to unwelcome truth.

West Bank, near Alton,
Hants.
Nov. 3.

E. W. MACBRIDE.

Gene Doublets as Evidence for Adjacent Small Duplications in *Drosophila*

It is to be assumed—by analogy with the cell, the nucleus and individual chromosomes—that genes are always derived from parent genes, and are not created *de novo* from non-genic material. Evolution, as seen in the phenotype, must go hand in hand with an increase of the number of genes. Polyploidy as a method of increase of gene numbers is common in plants, but does not seem to have played an important part in the evolution of animals. The work of Bridges¹ on salivary gland chromosomes in *Drosophila* shows that small duplications, often adjacent, are common in *Drosophila*. They appear as 'repeat' sequences of very similar or identical bands; when extensive enough, these 'repeats' have a tendency to show somatic pairing within the individual chromosome.

If the interpretation of these 'repeats' is correct, they must have carried identical genes at the time they were formed. Development on divergent lines would lead to these genes gradually taking on different functions in ontogeny; but it is to be assumed that these functions would be similar in the early stages. If this is so, one would expect that genes with similar phenotypic effects would often occur as doublets in close proximity in the same chromosome. A survey of the genes of *Drosophila*

melanogaster shows that there is in fact a considerable number of such cases, a number too great to be due to chance alone. The cases are most striking where the type of phenotypic effect is rare and the proximity close. Some examples are:

chlorotic—*yellow* (I, -0.1 and 0.0); also possibly *silver* (I, 0.1); only three other light body colours are known.

lozenge—*almond* (I, 27.7 and 27.7 ±).

miniature—*dusky* (I, 36.1 and 36.2); *the same doublet occurs also in *D. virilis*, *hydei* and *pseudo-obscura*.

isotrapera—*bithorax*—*bithoraxoid* (III, 51.3, 53.7 and 59.5); no other similar phenotype elsewhere in the whole complement.

pupal—*unexpanded* (II, 51 ± and 54 ±); only three other similar mutants known.

blistered—*balloon* (II, 107.3 and 107.4) } Only six other similar mutants are known; two of these (*blot-blot*, II, 55 ± and 59 ±) form possibly another doublet.
blister—*Bubble* (III, 53.5 and 54 ±) }

achaete—*acute* (I, 0.0 + and 0.0 + +).

It appears that the increase of gene number by small adjacent duplications is reflected in the non-random distribution of genes in the chromosome complement.

A detailed analysis will be published elsewhere.

Department of Biometry, HANS GRÜNBERG.
University College,
London.
Oct. 12.

¹ Bridges, C. B., *J. Heredity*, 26 (1935).

Interaction between Cell Nucleus and Cytoplasm

DR. CURT STERN¹ has suggested a new and ingenious method of showing what he says has not been shown before, that the genes inside the resting nucleus act on the cell outside it. This action, however, is implied by everyday cytological observations, and is shown by many particular demonstrations in plants.

In all hybrid plants four cells are produced at meiosis with genetically different nuclei, and their genetic differences may be readily seen to express themselves before the nuclei come to divide, since many of these nuclei, on account of their genetic defects, never divide again. In general terms, we may say that this is one of the conditions of apomixis in most plants. It is precisely where the potential embryo-sac nucleus fails to divide that it is replaced by purely vegetative development of maternal tissue. This happens in the versatile apomictic species of *Hieracium*, *Artemisia*, and most probably in *Rubus*, *Rosa* and elsewhere. Similarly on the male side we find that, in triploids and other forms with irregular segregation at meiosis, a proportion of the pollen grains have usually died before their first mitosis could have taken place. That this failure is due to the individual properties of the pollen grain is shown by the selected population of pollen grains (in regard to chromosome number) which actually reaches division². Moreover, in two respects the pollen grains with different chromosome numbers often behave differently; first the length of the resting stage is different, so that in anthers taken at different times

we get a different sample of numbers², and secondly the pollen grains grow differently, so that the most unbalanced grains are disproportionately small³.

Two examples of the resting stage action of the chromosomes are of specific genetic importance. In the hybrid *Oenothera* species, the nucleus which, on account of its position, is expected to produce the embryo-sac, fails to divide if it has a certain female-defective genetic constitution. A nucleus of the opposite type (segregated from it at meiosis) then divides and takes on its function⁴. On the other hand, in *Rhus discolor* pollen grains are formed not only with the haploid 6 chromosomes but also, owing to non-disjunction, with 5 and 7. Those with 7 come to division, those with 5 being genetically defective do not⁵. This indeed is a rule to which only one exception is known. In spite of the frequency with which defective pollen grains are known to be formed at meiosis, only once has such a pollen grain been observed to reach mitosis, and this pollen grain was in the exceptional state of having remained attached to a complementary sister grain of the meiotic tetrad⁶.

The evidence of the genetic individuality of cells raises another problem: How far is the choice of egg cell amongst the genetically different products of meiosis genetically determined, as it is in *Oenothera*? We know that the position of the embryo-sac cell is variable both where there are several mother cells, as in *Euphorbia*, and where there is only one, as in *Culcitium*⁷. We know also that the determination takes place after meiosis. We can therefore scarcely doubt that where important genetic differences distinguish the products of meiosis (as in triploids and structural hybrids), there will be a natural selection of favourable combinations in the egg cells. It remains to say that, where all the products of meiosis are not separated by cell walls (as in the *Lilium* and *Scilla* types of embryo-sac), it is impossible to decide from direct observation alone whether the egg-cell is not sometimes genetically instead of positionally determined. Breeding tests will be necessary. This is a question worth deciding, because selective fertilization in the wasp *Habrobracon*⁸ indicates that separate nuclei within a single cell are capable of showing by their movements a genetic individuality distinct from that of the cell as a whole.

That the interface or monomolecular film which separates the nucleus from the cytoplasm protects it from mere dispersion and violent external fluctuations is obvious. That in doing so it acts as a semi-permeable membrane may be shown in various ways⁹. But that it could utterly preclude chemical intercourse and therefore genetic action between the outside and the inside is contradicted every time the nucleus of an egg divides on the stimulus of a sperm; for if the nucleus cannot act on the cytoplasm outside, how can agents outside act on it, determining its division or its death?

C. D. DARLINGTON.

John Innes Horticultural Institution,
Merton, S.W.19. Oct. 30.

¹ NATURE, 140, 770 (1937).

² Darlington, C. D., "Chromosome Behaviour and Structural Hybridity in the *Tradescantia*", *J. Genet.*, 31, 207-236 (1932).

³ Darlington, C. D., "The External Mechanisms of the Chromosomes, I-V", *Proc. Roy. Soc., B*, 131, 264-319 (1936).

⁴ Renner, O., "Heterogamie im weiblichen Geschlecht und Embryo-sackentwicklung bei den *Oenothera*", *Z. Bot.*, 18, 609-631 (1921).

⁵ Belling, J., "The Origin of Chromosomal Mutations in *Utricularia*", *J. Genet.*, 16, 245-266 (1925).

⁶ Schmidt, K., "Embryologie der Angiospermen", *Hb. Pflanzenanat.*, 10 (1929).

⁷ Whitting, P. W., "Sex Determination in Bees and Wasps", *J. Hered.*, 28, 263 (1935).

Germination of Resistant Spores of *Blastocladia Pringsheimii*

LETTERS¹ have appeared in NATURE relating to the germination of resistant spores, and in them certain suggestions have been put forward as to the needs of such spores. With these in mind, controlled conditions have been found suitable for the germination of the supposedly resistant resting spores of *Blastocladia Pringsheimii* Reinsch. The lack of success of former attempts to germinate them is perhaps due to the use of spores either immature or desiccated. A simple method has been found of storing the spores so that they may have time to mature and yet not become desiccated, or lost, meanwhile.

Blastocladia Pringsheimii Reinsch can be grown in the laboratory on small tomatoes in a jar of water. This fruit is particularly satisfactory, as the skin is thin and transparent and can easily be removed bearing the fungus *in situ*. Fruits were inoculated in April and again in May of this year, and as soon as young plants of the fungus were observed growing on them (with the mycelium ramifying within the pulp of the fruit and the sporangia emergent in the water) the fruits were well washed in fresh water daily to keep down the bacteria. In June the fungus, now bearing a good crop of resting spores, was stored: the fruit skin bearing the fungus was torn into pieces which naturally rolled up, the outer side within the roll, so that the fungus, with such spores as still remained attached, was conveniently held within the roll of skin. Small flasks were taken and plain agar agar poured in, to a depth of half an inch. When this had set, the rolls of skin were placed on the surface and more agar agar was poured upon them to a depth of half an inch, making one inch depth all told. These flasks were left in the laboratory until September, when the pieces of skin were taken out and unrolled, exposing the mature, but not desiccated, spores. These germinated in water in about 24 hours. Other pieces of fruit skin were unrolled from time to time throughout October and into November, and a good percentage of the spores always germinated readily in water within a day or so.

This is not the place in which to describe the phenomena of germination and the habit of the germlings, an account of which will, it is hoped, appear shortly in a botanical journal.

ELIZABETH BLACKWILL.

Royal Holloway College,
Englefield Green,
London. Nov. 16.

¹ NATURE, 136, 306 (Feb. 23, 1935); 136, 546 (April 6, 1935); 136, 753 (May 1, 1937).

Photodynamic Action of Carcinogenic Agents

IN a recent communication¹, we described the photosensitization of white mice by four carcinogenic agents. Since then we have sought other ways of demonstrating this reaction quickly, and have found that *Paramecium* is an excellent test object.

When benz-pyrene is ground up with tap water, and then spun for half an hour at 2,000 revs., a slightly opalescent liquid results containing not more than one part in 10,000. *Paramecia* will live in this in the dark for many days, but when placed in a glass cell, opaque to radiation of wave-length less than 3600 Å., in sunlight or in front of a mercury

vapour lamp, they die and cytolyse in a few minutes. In tap water without benz-pyrene they withstand this treatment indefinitely, provided that the effect of radiant heat is excluded. Exposure of the benz-pyrene in tap water to sunlight or to the mercury vapour lamp for long periods of time does not render it destructive to *Paramecia* when they are afterwards added and kept in the dark. The use of colour filters shows that radiations between 3500 Å. and 4100 Å. are effective.

Paramecia which have been subjected to benz-pyrene overnight and repeatedly washed in tap water by slow spinning, retain their photosensitivity.

Similar reactions occur when dibenzanthracene is used, except that the *Paramecia* require longer exposures to light than in the case of benz-pyrene.

We have not been able to sensitize red corpuscles, and this suggests that the *Paramecia* may be ingesting colloidal particles, especially since keeping them for a day or two in the benz-pyrene preparation in the dark greatly increases their sensitivity. Colloidal particles are present in the preparations made as described, but whether any of the benz-pyrene is in solution has not yet been ascertained.

Shale oil and coal tar likewise sensitize *Paramecia* when a dilute emulsion obtained by shaking with tap water is used.

These results therefore confirm our previous findings with white mice.

J. C. MOTTRAM.
I. DONIACH.

Mount Vernon Hospital,
Northwood,
Middlesex,
and
Radium Institute,
London.

NATURE, 140, 588 (Oct. 2, 1937).

Selection and Mental Factors

METHODS of 'factorizing' the correlation-matrix of a team of intelligence tests have been described in the last few years by Spearman, Kelley, Thurstone, Hotelling and others, and it is of interest to observe what the influence of selection (including natural selection) in the population tested is on the number and nature of the 'mental factors' thus arrived at. I have discovered that if a team of $n = p + q$ tests has been resolved into r general and n specific factors which are normalized and mutually orthogonal, and if the variances and covariances of p of these tests are changed by selection, then the team can still be analysed into r generals and n specifics, but, in addition, a certain number l of new group factors will appear which, however, run through the p directly selected tests only. Further, these $r + n + l$ factors will again be uncorrelated and normalized, but they are in general different from the original factors. Selection can thus be seen creating, destroying and changing factors.

A fuller account of this, together with a rigorous mathematical proof which Dr. Walter Ledermann has made for me, will be published as soon as possible.

GODFREY H. THOMSON.

University,
Edinburgh.
Nov. 1.

Conversion of β -Phellandrene into a Derivative of α -Phellandrene

RECENT observations^{1,2,3} of the co-existence of α - and β -phellandrenes in certain essential oils suggest a possible biogenetic relationship between these two terpenes. So far as we are aware no evidence of such an interconversion has been put forward although this might be anticipated from the apparently analogous conversion of β -pinene into α -pinene⁴. Since this lack of evidence may be due to the difficulty in detecting small quantities of one isomer in the presence of the other, it may be of interest to note that by condensation of maleic anhydride with l - β -phellandrene we have obtained a product which, from its melting point, mixed melting point and rotation, is apparently identical with the compound obtained from l - α -phellandrene³. The l - β -phellandrene employed was obtained from Canada balsam oil which has been shown to be free from α -phellandrene³.

Further evidence of the identity of the product is being sought and the mechanism of the reaction is being investigated. A full account of the experiments will be published elsewhere.

N. F. GOODWAY.
T. F. WEST.

Sir John Cass Institute,
Aldgate, E.C.3.
Oct. 23.

¹ Berry, Macbeth and Swanson, *J. Chem. Soc.*, 1444 (1937).

² Duncan, Sherwood and Short, *J. Soc. Chem. Ind.*, 50, 410T (1931).

³ Goodway and West, *J. Soc. Chem. Ind.* (In Press).

⁴ Simonsen, 'The Terpenes,' 2, 169 (1933).

Free Radicals in Solution

WITHIN recent years numerous investigations have proved beyond doubt the existence of free alkyl and aryl radicals, which are formed in the gaseous phase by the thermal or photochemical decomposition of suitable organic molecules. More recently, Norrish and Bamford¹ have devoted their attention to the production of free alkyl radicals in solution and have shown that the alkyl radicals R and R' , formed by the photodecomposition of a ketone $RCOR'$, do not combine together, as in the gaseous phase, thus: $R + R' \rightarrow RR'$; $R + R \rightarrow RR$ and $R' + R' \rightarrow R'R'$, but mainly react with the solvent by abstraction of hydrogen with the formation of the simple hydrocarbons RH and $R'H$. Further, Walker and Wild² have studied the photodecomposition of diacetyl peroxide in solution (cyclohexane or ethyl alcohol) and have shown that more methane and less ethane is formed under these conditions than when the decomposition is effected in the absence of a solvent. This reaction would also appear to involve the production of free alkyl radicals, which again have the characteristic property of abstracting hydrogen from the solvent.

More than three years ago^{3,4}, attention was directed to certain classes of organic compounds, namely, the diazo hydroxides, the nitrosoacylarylamines, the arylazotriarylmethanes, and the diacyl peroxides, which in many of their reactions showed characteristics indicative of a non-ionic fission into free radicals and either nitrogen or carbon dioxide. Strong confirmatory evidence for this view was published a year ago⁵. These communications showed that, as with the alkyl radicals discussed by Norrish and Bamford, marked differences were to be found

between reactions of aryl radicals in the vapour phase and the corresponding reactions in solution, since in the latter case the free radical invariably reacted with the solvent molecules. The characteristics of the phenyl radical, formed in the presence of a solvent, may be summarized as follows: (a) the free radical is extremely reactive and able to interact with almost the first molecule of any type encountered; (b) polymerization to diphenyl does not take place; (c) reaction with all non-aromatic hydrogen-containing solvents results in the formation of benzene ($C_6H_5 \cdot + RH \rightarrow C_6H_6$); (d) reaction with all non-aromatic halogen-containing solvents results in the formation of a halogeno-benzene ($C_6H_5 \cdot + RHal \rightarrow C_6H_5Hal$); and (e) reaction with neutral aromatic liquids results in the formation of diphenyl derivatives in which the radical enters the aromatic nucleus at the *ortho* and/or *para* position with respect to any directing group which may be present.

A close similarity is thus revealed between the properties of alkyl radicals and those of aryl radicals in solution, and this correspondence gives striking support to the views originally put forward with reference to a non-ionic mechanism for certain reactions of the diazo hydroxides, the nitrosoacetylaminines, the arylazotriarylmethanes and the diacyl peroxides. In addition, various lines upon which the correspondence may be further extended immediately suggest themselves. The whole subject of reactions involving free radicals in solution will shortly be reviewed elsewhere.

University,
Manchester.

D. H. HWY.

University,
Durham.
Oct. 22.

W. A. WATERS.

¹ Norrish and Bamford, *NATURE*, **140**, 195 (1937).

² Walker and Wild, *J. Chem. Soc.*, 1132 (1937).

³ Grieco and Hey, *J. Chem. Soc.*, 1797 (1934).

⁴ Hey, *J. Chem. Soc.*, 1906 (1934).

⁵ Waters, *J. Chem. Soc.*, 113 (1937).

Behaviour of Cylinders of Inflammable Gas in a Fire

IN a letter to *NATURE*¹, my friend, Prof. K. C. Bailey, refers to the evidence I gave before the Free State Government's inquiry into the Pearse Street fire of October 5, 1936, where, owing to the failure of the water supply, three firemen lost their lives through carbon monoxide poisoning. Prof. Bailey's success in extinguishing a flame with a burst of gas from a high-pressure container will scarcely surprise anyone who has tried to light a gas jet (at only a few inches water-pressure) by holding a kindled match directly in its path. A draught of air, also, will extinguish a candle; though it might perhaps be expected to contribute to the combustion. A draught does not extinguish a blast-furnace.

Prof. Bailey's theory accounts for the two explosions that were heard by so many witnesses as being due (1) to the bursting of the coal-gas cylinder, and (2) to the chemical explosion of the atmosphere then constituted. Actually the evidence is perfectly clear that the coal-gas cylinder yielded plastically, bulging and dividing into a "pair of trousers". All the witnesses were shown this cylinder at the time of the inquiry.

Now the companion oxygen cylinder burst in such a manner as to blow part of its wall away; yet this rupture, though it must have been percussive in the highest degree, is apparently held to have been inaudible, and the discharge of 120 cubic feet of oxygen into a highly super-fuelled atmosphere is not, apparently, held to have been a similar cause of explosion.

There is no doubt, surely, that whatever cooling took place in the body of the liberated coal-gas, its periphery must quickly have attained ignition temperature in the burning inferno which Prof. Bailey postulates. Then it must have moved as a flame-mantled blimp towards and through the great ventage whence a glass roof had fallen in at some time before the two explosions.

22 Tree Root Walk, OLIVER C. DE C. ELLIS.
Sheffield, 10.
Oct. 29.

¹ *NATURE*, **149**, 503 (Sept. 18, 1937)

Points from Foregoing Letters

THE synthesis of a complex carbohydrate from carbon dioxide and water in the presence of light, by means of a specially prepared nickel catalyst, is reported by Prof. E. C. C. Baly. The compound, when deposited on a surface, can be hydrolysed by diastase, and hence it may prove to be the parent of a starch-like substance.

Although the spectrum of nitrogen excited by electron bombardment varies greatly with pressure, R. Bernard finds that the spectral composition of auroras having a height of several hundred kilometres remains nearly constant. He considers, therefore, that the energy of the electrons and not pressure is the factor affecting the relative intensity of the radiations emitted.

M. G. E. Coeys suggests that the anomalous distribution of cosmic rays coming from different directions (zenithal angles) may be explained by taking into account the diffusion of cosmic rays in air.

Dr. H. Gruneberg gives a list of pairs of mutations of the fruit fly, *Drosophila*, which have very nearly related characters, such as chlorotic-yellow, and points

out that the corresponding genes occur as doublets in close proximity within the same chromosome. He suggests that new genes arise by small adjacent duplications followed by differentiations.

Dr. C. D. Darlington states that the genetic action of chromosomes in the resting nucleus on the cell may be inferred from the rapid death of pollen grains and embryo sacs with defective chromosome complements in hybrid plants.

Further to the experiments on the sensitization by certain cancer-producing substances of mice by light, Dr. J. C. Mottram and Dr. I. Doniach find that paramecium is destroyed by benz-pyrene suspensions (1 in 10,000) in the presence of light of wave-length between 3500 Å. and 4100 Å., but not in the dark.

Dr. D. H. Hey and Dr. W. A. Waters point out that the reactions of free alkyl radicals produced photochemically in solution are exactly similar to those of free aryl radicals which they consider to be formed when certain classes of complex organic molecules decompose.

Research Items

Intoxicants in Sarawak

MR. E. BANKS, curator of the Sarawak Museum, has made a study of the customs and behaviour of Sarawak pagan tribes in relation to native alcoholic drinks (*Sarawak Mus. J.*, 4, 4). It is usual among the pagan tribes to offer visitors to the long house a drink made mainly from fermented rice and occasionally from sweet potato, sugar-cane, or even fruit. This helps to place hosts and guests at their ease and assist free discussion of intimate matters. The women, though brewing the liquor, drink sparingly, if at all, fearing intoxication. The Land Dayaks of Kuching and Salong prepare a very sweet yellow-brown drink from a reddish orange fruit. This contains 23 per cent alcohol. These people, who are much repressed, are abstemious from fear of intoxication. If they become intoxicated, they are never quarrelsome, but fall asleep. The Sea Dayaks, or Iban, brew a sweet and milky drink with about 20 per cent alcohol; but they drink rarely and are singularly sober. This, however, is due largely to thrift and lack of opportunity; and European drinks, if free, are absorbed in large quantities by both men and women without noticeable effect. Drink plays a very large part in the life of both Kayan and Kenyah, no birth, death, or marriage ceremonies being complete without a liberal supply of drink for all, including visitors. The same applies to agricultural ceremonial. Cooked rice mixed with water is the mainstay of the drink, which is brewed by women, but with great uncertainty as to what the product will be, both in strength and flavour. Fruit, berries and a yeast are added to the rice liquid, the alcoholic content in samples tested ranging from 18 to 23 per cent. Strong alcohol is obtained from this liquor by distillation. There is considerable etiquette in drinking, and the ritual is prominent in their customs. They drink frequently and jovially, and hold their drink well. The Kelabit and Murut, on the other hand, living farther north and at a considerably greater altitude—3,000–4,000 ft., where the nights are cold—are mighty drinkers; but whereas the Kelabit shows no ill-effects, the Murut is drinking himself out of existence.

Biological Action of X- and γ -Rays

THE keynote to "Some Quantitative Aspects of the Biological Action of X- and γ -Rays" by C. M. Scott (Med. Res. Coun. Special Report Series No. 228. London: H.M. Stationery Office, 1937. Pp. 99. 1s. 6d.) is the term quantitative, for the author has summarized and criticized the work of radiologists where quantitative, rather than qualitative, results have been claimed. All the important effects of X- and γ -rays upon living tissues come under consideration in Part 1—some at length, others more briefly. The author's chief aim is to direct attention to our scanty knowledge of the nature of the primary action of these rays, at the same time maintaining that this action is largely exerted on the nucleus of the cell and thereby on the cell processes that control growth. Part 2 contains detailed description of the author's experimental work upon the effects of X-rays and radium on the isolated frog's heart and upon the eggs of *Calliphora erythrocephala*. The

general plan of these experiments might well serve as a model for others, showing as they do the essential features of quantitative work. Mr. Scott's conclusions will not be accepted by all, but they will be treated with the respect that their sincerity warrants, and his views generally will prove a stimulant to research.

The Protein of Yellow Enzyme

THE importance of the 'yellow enzyme' is considerable: its identification as lactoflavin-5'-phosphoric acid, of known structure, coupled with a specific protein, has been one of the outstanding achievements in the laboratory of recent years. A successful attempt has now been made by Prof. Richard Kuhn and P. Desnuelle of Heidelberg to establish the nature of the protein (*Berichte*, 1907; 1937). Normally such an analysis requires very considerable quantities of material, whereas the yellow enzyme is known in milligrams rather than in grams. The absorption process of Weygand has enabled somewhat larger quantities of the pure yellow enzyme to be prepared so that the amino acids obtained on acid hydrolysis of the protein could be estimated quantitatively. To do this the latest microbiological technique has been applied, colour reactions for the individual amino acids have been used to estimate them photometrically, and the hexone bases were separated by electrodialysis. The achievement is a striking one and an outstanding example of the delicacy and the advantage of this new technique. So far, no particular variation from the known proteins is shown either in the nature or the quantity of the amino acids—65 per cent of the nitrogen has been identified. The hexone bases are of importance, since the protein is attached through basic groups to the rest of the molecule in two places. It may be of significance that the total of histidine, arginine and lysine is the same as in the protein of haemoglobin, but their relative proportions are entirely different.

Insects and Mites in Stored Grain

THE attention of entomologists is directed to Miscellaneous Publications 258 (July 1937) of the United States Department of Agriculture, written by Messrs. R. T. Cotton and N. E. Good. This 80-page brochure lists the insects and mites associated with stored grain and cereal products from all parts of the world. Under each species is given its geographical range, habitat, food habits, its parasites and predators together with its relative importance as a pest: wherever necessary, references to literature are also given. The various invaders of grain, etc., are classified according to their status or, in other words, whether they are of major or minor importance or only incidental pests. They are also classified taxonomically, which facilitates easy reference from that point of view.

Antarctic Vegetation

AN interesting geographical extension of the scanty flora of the Antarctic regions is noted in an article in the *Polar Record* of July on the work of the R.R.S. *Discovery II*. Until recently, the only two flowering plants, a grass (*Deschampsia antarctica*)

and a small caryophyllaceous plant (*Colobanthus* sp.), recorded were poor and stunted specimens from the South Shetlands and the north-western part of Graham Land. These two species are now recorded from Signy Island which lies on the south of Coronation Island, the largest of the South Orkney group. The previous search by the *Scottia* expedition for these plants on Laurie Island, another island of the group, had proved fruitless. The discovery of a liverwort on Signy Island is another extension of geographical distribution in the Antarctic.

Origin of Lead Ores •

This problem has been recently discussed in the light of atomic weight evidence by Arthur Holmes (*Econ. Geol.*, 763-782; 1937). The lead dispersed through rocks in minute quantities is called rock-lead; it consists partly of common lead, originally present in the rock material, and partly radiogenic lead, generated in the same rock material by the disintegration of uranium and thorium during geological time (taken as about 2,000 million years). From the available determinations of lead, uranium and thorium in various types of rocks, it is shown: (a) that the average atomic weight of granitic rock-lead should have decreased progressively during geological time from 207.21 at the beginning to 207.14 at the present day; (b) that the average atomic weight of basaltic rock-lead should have similarly decreased from 207.21 to 207.10. The atomic weight of rock-lead concentrated in cotunnite from the 1806 magma of Vesuvius is 207.05, a result which confirms the inference that rock-lead has an atomic weight significantly lower than that of common lead. The atomic weight of common lead, that is, the lead concentrated in ore-deposits, is found to be 207.21 ± 0.01 and—as far back as 1,800 million years—to be independent of the geological age of the ore. It follows that such ore-lead cannot have been derived from granitic or basaltic rocks, or from the sediments formed from such rocks, and that it has no genetic connexion with acid or basic magmas. Ore-lead must, therefore, have ascended from depths below the sialic and basaltic layers of the earth's crust. The view of the late J. W. Gregory that "the source of the ores appears to lie in a zone deeper than that of the ordinary igneous rocks" is thus largely confirmed, so far as lead ores are concerned. The data for peridotites are too few to justify the extension of this generalization to ultrabasic rocks and magmas.

Earthquakes off the Coast of Northern California

The coastal portion of California is one of the most interesting earthquake regions in the world. This is due to the connexion of many of its earthquakes with the remarkable San Andreas fault that traverses the whole length of the State. As Prof. Byerly points out in a valuable paper (*Bull. Seis. Soc. of America*, 27, 73-96; 1937), recent earthquakes cluster in three segments of the fault, a northern one in the counties of Del Norte and Humboldt, a central one from the Golden Gate to San Luis Obispo county, and a southern one in the Imperial Valley; while the regions of great displacement, such as that in 1906, occupy the intervening portions. The frequent occurrence of earthquakes with their centres at sea off Humboldt County has led to the suggestion that here may be another active portion along a linear extension of the fault beyond Punta Arenas. The greater part of Prof. Byerly's paper is devoted to the

determination by two methods of the epicentres of three earthquakes in 1934, 1935 and 1936. The positions obtained by the methods are in fair agreement. As, however, the distances of the points nearest the continued fault-line are about 23, 15 and 45 miles, the author concludes that there is no real connexion of the earthquakes with movements along the San Andreas fault.

Carbonization of Coal at Low Temperatures

THE Department of Scientific and Industrial Research has published a report issued by the Director of Fuel Research of a test made on the plant of the National Coke and Oil Co., Ltd., at Erith, for carbonizing coal at low temperatures. The process consists in carbonizing a paste of about equal parts of coal and oil in rotary cylindrical retorts, the oil produced by the plant itself serving as vehicle, after removal of spirit. About 15 cwt. of coke was obtained per ton, ranging in size from 4 in. downwards. It was dense, easily ignitable and easy to burn in open fires. About 10 cwt. of this was less than $\frac{1}{2}$ in. and was crushed and briquetted. 8.9 gallons of refined mixed spirit was obtained per ton of coal and, in addition, oil suitable for Diesel engines. Both caking and non-caking coals were carbonized in the plant, the retorts of which were externally heated, and for this purpose all the gas produced in the process is required.

Infra-red Absorption of Hydroxy Compounds near 3μ

MANY compounds containing the hydroxyl group have a sharp absorption band at 2.75μ and another wider band about 3μ , attributed to associated molecules. This association band diminishes on dilution with a non-polar solvent and on increasing temperature. An investigation of these bands for phenol and certain aliphatic and aromatic alcohols in solutions of carbon tetrachloride and other solvents is reported by Drs. J. J. Fox and A. E. Martin (*Proc. Roy. Soc., A*, 162, 419; 1937) and the results are characterized by the same interest, thoroughness and comprehensive treatment which has been a distinctive feature of previous infra-red work carried out in the Government Laboratory. Phenol has been investigated in several solvents, and the intensity of its association band is proportional to the number of molecules not contributing to the shorter wave length band. Equilibrium between single and double molecules is set up at moderate concentrations, and the forces acting between such molecules are considered on the basis of London's theory of inter-molecular forces. With chloroform as solvent, the intensity of the association band is reduced to about half the value with carbon tetrachloride. For both solvents association is reduced by increased molecular complexity in the series, PhOH , PhCH_2OH , Ph_2CHOH , Ph_3COH . Factors affecting the locations and intensities of the bands in these compounds are discussed. The effects shown by normal and tertiary butyl alcohols are compared and data for stearyl and cetyl alcohols are given. Influence of structure on the CH vibration bands has also been studied. Aliphatic CH bands for CH , CH_2 , and CH_3 groups have constant intensity for the CH linking in each molecule and it is distributed among the one, two, or three CH linkings attributed respectively to each group; whilst in aromatic alcohols the positions of the CH bands remain unaltered, but relative intensities are not always retained.

An International Conference on the Theory of Probability

THE Faculty of Science, University of Geneva, organizes periodical international conferences on various branches of mathematics. A special committee presided over by Prof. R. Wavre, chooses and invites lecturers. Visitors are also welcomed at these conferences, and invited to take part in the discussions.

This year it was the turn of the theory of probability. The Conference lasted the whole week, October 11-15. It was opened by Prof. R. Wavre and then addressed by its chairman, Prof. M. Fréchet, of the Sorbonne, who outlined the trends and conflicting tendencies in the recent history of the theory of probability. Next, fifteen other papers on various subjects and various modalities of the probability theory were read and discussed in the presence of fifty to one hundred listeners. It is hoped that the contents of the papers presented at the Conference, and also those of the authors who were prevented from attending, will be published soon, as separate numbers of the series "Actualités Scientifiques" (Hermann et Cie., Paris).

The purpose of these conferences is to mark and sum up the latest achievements in the particular branch of mathematics under discussion. Therefore the general tendency in papers presented was not necessarily to state and prove some particular theorems, but rather to describe the state of various theories, without going into details of proofs. It need scarcely be said that this contributed greatly to the interest of the proceedings, and it was possible to build up a general outlook on what is being achieved and what is being aimed at in the theory of probability. Below we give a subdivision which suggested itself to us. It will be realized that any such classification is only approximate and must be influenced by personal opinions. Therefore, while indicating the names of the authors of papers which seem to belong to one or the other of the described directions, we wish to emphasize that we ourselves could not recommend this classification as a totally objective one.

First of all we may mention three different directions of work concerning the very foundation of the theory, that is, the definition of probability. As is the case with many other mathematical sciences, the theory of probability is designed to provide a model of certain processes in the outside world. Here we have the first point of subdivision. There are theories aiming at representing primarily (a) the machinery of frequencies in repeated trials and (b) the changes in the state of mind of the observers. Theories of the first kind have for their object to use probabilities $p_1, \dots, p_k$ of some events, supposed to be known, in order to calculate the probabilities $P_1, P_2, \dots, P_m$ of some other events, but are totally indifferent as to how the values of $p_1, p_2, \dots, p_k$ can be obtained in practice. On the other hand, this is the very question which seems to be central in the other theory (B. de Finetti).

The theories of group (a) (W. Feller, M. Fréchet, J. Steffensen, A. Wald) are again subdivided. First of all there are what could be called the modernized classical theories, in which the probability is considered as an additive or an absolutely additive set

function. Next there are theories where the probability is being defined as a limit of a relative frequency, the existence of which is being postulated. All these directions were represented at the Conference, and there were lively discussions. The absence of F. P. Cantelli and that of R. v. Mises, who are important representatives of the directions mentioned and had promised to read papers, was much regretted.

Most of the work which did not directly concern the foundations was on the modernized classical theory. Here again several points of subdivision suggest themselves. One category represents the work on the perfection of the theory either by bringing in the mathematical accuracy in a field already more or less treated or by deducing new facts. Such were the papers on a new theorem concerning the law of big numbers (H. Cramér), on the probability problems in mechanics (E. Hopf), on the arithmetic of probability laws (P. Lévy), and on the conception of independence (H. Steinhaus). A paper promised by A. Wintner was greatly missed by the Conference.

The original programme of the Conference included a number of papers on what could be called random curves, which is a new and most important branch of the theory of probability connected with that of Markoff chains. It was much regretted that the respective authors (S. Bernstein, V. Glivenko, A. Kolmogoroff, V. Romanovsky and E. Slutski) were not able to be present, but it is hoped that their work will be published with the others. The only paper in this direction, on the chains with complete connexion, was given by O. Onicescu.

Further work concerned the applications. An extremely interesting paper was read by W. Heisenberg on the probability statements in the quantum theory of waves. His most remarkable conclusion was that modern physics seems to require a new branch of mathematics involving the conception of an absolute minimum of distance. G. Pólya discussed certain simple schemes of random experiments which by some ingenious passages to the limit, lead to partial differential equations and distribution functions applicable in physics and engineering. On similar lines also was the paper by B. Hostinsky. These were really papers solving problems of mathematical statistics as defined by Borel: to find a system of random experiments (by drawing balls or tossing coins) such that the most probable frequencies of their results would approach closely those observed in some field of application.

Papers of a still more statistical character were given by E. L. Dodd, on the estimates of regression coefficients based on the principle of maximum likelihood, by J. Neyman, on the theory of statistical estimation conceived as a problem in classical probability, and by N. Obrechhoff on the cases of convergence of the Charlier series. We regretted the absence of C. Jordan, who promised a paper on correlation.

The programme of the Conference included receptions and parties given by the Société de Physique et d'Histoire Naturelle, by Prof. Kurt Meyer, by the Faculté des Sciences and by the organizing committee of the Conference. During these reception

we were cordially welcomed by Prof. G. Tiercy, dean of the Faculté des Sciences, and by Prof. F. Chodat, voting for the president of the Société de Physique et d'Histoire Naturelle. The receptions were much enjoyed, and offered a precious opportunity of personal contacts and exchange of opinions and criticisms in private. When we were driven into the Jura and, having turned a corner, saw the Lake of Geneva far below the road, and in front of us, behind the Lake, the glittering tops of the Alps, the exclamations of delight were mixed with unfinished sentences concerning point sets, measure, Bayes, etc. The

cordiality of the hosts, among whom were Profs. H. Fehr, D. Mirimanoff, G. de Rham, and R. Wavre, culminated at the closing dinner on Friday night, after which the guests departed, carrying with them happy memories of the Conference and a feeling of gratitude to the hosts and hopes of future similar occasions.

It was announced that another conference on the theory of probability will be held soon in Geneva, and will deal more especially with problems of various applications.

E. L. DODD.

J. NEYMAN.

The Birch 'Forests' of Greenland

By Dr. Nicholas Polunin, Department of Botany, University of Oxford

DURING the past summer of general botanical work in the Julianashaab district—climatically the most favourable part of Greenland—special attention has been paid to the history and present-day ecology of the oft-mentioned but little known Greenland 'tree' birch (*Betula pubescens* sens. lat.).

In 1933 I was able to show¹ that in Lapland the roots of the nearly related (perhaps conspecific) *B. odorata* Bechst. are able to conduct water actively through at least half a metre of hard-frozen soil, and moreover that where the roots are unable to extend below the frozen surface layer, this generally dominant plant is absent or at least fails to attain proper 'tree' form². Much the same seems to be true of the Greenland *B. pubescens* which, however, scarcely attains the form or proportions of a real tree. Its 'forests', which are generally confined to the most sheltered fjord-head regions, consist for the most part of straggly bushes 2–4 metres in height. Moreover this scrub, at least in the district visited, appears almost always to be interrupted at more or less frequent intervals by patches of lower *Salices* or dry lichen or sward associations—most often due to biotic disturbance but sometimes, it seems, to natural edaphic or other environmental conditions. Occasionally an individual birch will be found reaching a height of 5½ metres or a little more, while the maximum stem diameter observed was 25 centimetres. These larger trunks and indeed almost all the 'trees' are gnarled and prostrate or obliquely ascending near the butts³, being often twice as long as they are high and generally growing several from a stool and away from the direction of the worst "foehns".

These peculiar winds, descending with gale force from the lofty ice-cap, may be so warm and lasting as to melt all the snow even in the dead of winter and kill whole patches of the shallow-rooted *Empetrum* and other 'heaths' by desiccation when the soil is frozen near the surface and water cannot be absorbed to make good that which is lost by transpiration from the aerial parts. The result is that the ground vegetation in many places consists largely of cryptogams which are temporarily able to withstand almost complete desiccation. But the dominant birches—and probably also the *Salices*—have roots going down far below the deepest level (80 cm.) to which, so far as I have been able to determine by digging in early summer and questioning the natives,

the soil is liable to be frozen in the areas of the largest birches in winter. (During the first week of August I was unable to find any ground-ice or temperatures below 2–3° C. even down to depths of nearly 2 metres in the bogs in Tunugdliarfik Fjord.)

There can be no reasonable doubt that the 'trees' are, as in northern Lapland⁴, limited to areas where the soil is only frozen superficially in winter, and that they can withstand the extremely inimical springtime foehns—which may cause the buds to swell and sometimes burst into leaf, yet even small twigs are rarely killed—only by absorbing water from lower levels and conducting it up through the frozen layers; for rootlets are to be found almost everywhere extending to 1–2 metres, at which depth sandy soil is in summer almost as warm as near the surface. Such regions, with relatively warm or at least unfrozen conditions of subsoil throughout the year and supporting tree or tall bush growth over considerable areas, are by the biologist to be classed as Subarctic rather than truly Arctic in type; for in the Arctic the soil is permanently frozen to a great depth, only the surface layer thawing out in summer.

The presence or absence of a permanently frozen subsoil, which itself depends upon local physiographic as well as general climatic conditions, may largely determine the northern limit of tree growth in the world, at least in regions of relatively oceanic climate; it may perhaps also afford a convenient standard for distinguishing between the Arctic and Subarctic where latitude and other criteria fail.

The theory propounded by Ostenfeld⁵ but already strongly refuted by Porsild⁶ that the 'tree' birch was introduced to Greenland from Iceland by the Nordic colonists of the tenth century is quite untenable on geobotanical, sub-fossil⁷ and even written historical grounds. The Greenland 'forests', the dominants of which often approach 100 years in age and harbour junipers 200–300 or even more years old⁸, appear instead to be relics of a more genial postglacial warm period that probably lasted until about 2,000 years ago, according to verbal information from Prof. Knud Jessen and Dr. J. Iversen of Copenhagen, who have each carried out independent investigations on the sub-fossil strata of different parts of south-west Greenland. These authorities and Dr. M. P. Porsild, who has spent most of the last thirty-one years in Greenland as director of the Danish Arctic Research

Station on Disco Island, moreover agree with me that there is no real evidence, either archaeological or otherwise, for the popularly supposed serious deterioration of climate since the time of the Nordic colonization.

What was probably the strongest suggestion of such a change resulted from the discovery of the coffins of some buried Norsemen permeated by roots of plants but all frozen in summer⁹; but that was only in one place far out on the exposed ocean coast and in a bad year and other quite unusual circumstances, as the late Fridtjof Nansen quickly pointed out in objecting to this suggestion; moreover, the presence or absence of frozen soil conditions depends on a number of factors of which aerial temperature is only one¹⁰. That the climate may have become somewhat drier and a very little cooler since the advent of the Norsemen seems quite possible, and indeed just around Eric the Red's estate at Qaqraarsuk where the birch 'trees' were extensively cleared by the Norsemen they have failed to reappear even in the 400-500 years since the dying out of the colony. But there is no evidence of a change great enough to have been, at the very most, more than one factor contributing in some degree to the downfall of their once flourishing civilization.

Thus the peat deposits show no signs of any important change in the summer temperature since long before the advent of the Norsemen¹¹, while even if the climate has become drier the conditions are still damp enough to support over large areas in this district luxuriant grassy herb communities that afford some of the best summer pasturage I have ever seen! Moreover the outlawed Eric, in what has wittily been termed 'the first real-estate venture', called the country *Greenland* 'the green land' merely in order that he might the more easily attract colonists from Iceland¹²—which suggests that the notoriously inhospitable aspect of the coast is no mere present-day phenomenon. Finally, and perhaps most significantly of all, the tree and bush communities in some places

show to this day what is with little doubt the same delimitation as they were given by cutting by the Norsemen and grazing by their domestic animals. It is inconceivable that the extremely fine equilibrium existing between these 'higher' communities on one hand and the luxuriant alternating patches of grass and herbs on the other could have been maintained in the face of any appreciable climatic vagaries, much less a profound change; while even if this remarkable community delimitation can only with fair certainty be stated to date from the final disappearance of the Norsemen, it seems highly probable that it is the result of long lasting biotic impress and hence dates from well before that time. Even the temperature of the earlier warm period, which presumably corresponded to the sub-boreal of Europe, may have been only slightly above that of the present day, for no evidence has yet been found of the occurrence in Greenland in post-glacial times of any plant formation or species which does not live there now.

Since the above was written Prof. Jørgensen has informed me (1) that he has found plentiful fruits of *Betula pubescens* s.l. in peat layers from south-west Greenland that were laid down long before the advent of the Norsemen, which finally proves that the plant is indigenous; and (2) that from the experience of many deep borings which he made in the summer of 1926 in the Julianehaab district it was obvious that ice was quite absent from the ground.

⁹ NATURE, 128, 313 (1933).

¹⁰ Oxford Univ. D.Phil. Dissert. 1935 (Abstract published at the Clarendon Press).

¹¹ cf. Rosenvinge, *Medd. om Grasl.*, 15, 135 (1896).

¹² Polunin, *J. Ecol.*, 24, 2 (1936).

¹³ *Kgl. Danske Vidensk. Selsk. Biol. Medd.*, 6, (3), 17 (1925).

¹⁴ *Medd. om Grasl.*, 23, (1), 57 (1933).

¹⁵ Trapnell, *J. Ecol.*, 21, (2), 311 (1933).

¹⁶ cf. Rosenvinge, *Medd. om Grasl.*, 15, 135 (1896).

¹⁷ Nordund, *Medd. om Grasl.*, 67, 237 (1924).

¹⁸ cf. Nansen, *Ash. sigt at Det Norske Vidensk.-Akad. i Oslo* nr. 3 (1926).

¹⁹ Iversen, *Medd. fra Dansk Geol. Forening*, 8, 4 (1934).

²⁰ cf. Jørgensen, "Greenland", 2, 353 (1923).

The Cyclol Hypothesis and the 'Globular' Proteins

DR. D. M. WRINCH has extended the cyclol theory of protein structure to account for the existence of space-enclosing or 'globular' molecules (*Proc. Roy. Soc., A*, 161, 505; 1937).

The cyclol theory showed that a molecular fabric could be formed on the basis of the polypeptide theory by assuming that the peptides did not lie fully extended but underwent rotation at the bonds to form hexagonal structures. A series of these containing 2, 6, 18 . . . $18 + 24n$ residues can form closed systems of regular geometrical form with three-way symmetry. The second member of this series, called 'cyclol 6', forms the basis of the 'cyclol fabric'. Other members of the series could, if it were desired, be used as the basis of geometrically regular two-dimensional fabrics.

Any theory of the structure of three-dimensional molecules containing several thousand atoms must take into account the mathematical possibilities of distributing these in space in such a way that the resulting model will account for the known chemical

and physical properties of the substance in question. The cyclol fabric can be folded along certain well defined lines to form space-enclosing models of regular geometrical form, without violating any of the fundamental requirements of the cyclol fabric; for example, truncated tetrahedra can be formed by bending round the cyclol fabric without any distortion of the cyclol net. The truncated tetrahedra form a series which contain 72, 288 . . . $72n^2$ residues. These tetrahedral models, like the original 'cyclol 6' allow for polymerization, so that one, two or more of them can be brought together by apposition of their plane faces to form a series of polymers.

The model containing 288 residues is of great interest for it would have a molecular weight approximating to 35,000, which Svedberg has found as a basic number for the molecular weights of globular proteins. For example, insulin and egg albumin (which on the cyclol theory consist of 288 residues per molecule) have molecular weights of approximately 35,000, while various other proteins have molecular

weights approximating to $35,000 \times 1, 2, 4$ or 8 . Many of these under conditions of varying pH can break up reversibly into segments which are simple submultiples of the original molecular weight. It is also interesting to notice that Bergmann and Niemann (since the above prediction) state that the chemical analysis of egg albumin enables them to deduce that this molecule consists of exactly 288 residues (*J. Biol. Chem.*, 118, 301; 1937).

A series of models based on the truncated tetrahedron formed from the cyclol fabric and simple polymers of this, thus accounts satisfactorily for the type of molecular weight series found in some 'globular' proteins, namely, simple multiples of a basic unit of 35,000.

The Problem of Leisure

WE have not infrequently insisted upon the problem of leisure as one of growing importance, and have emphasized the inevitable effects of the application of science to industrial processes—effects which have been put under the heading of 'technological unemployment'. As the machine lessens the volume of toil required from men and women, our social organization must be adapted to give the new services which will be demanded of it. Already the move towards a reduction in working hours is apparent and must bring with it a corresponding increase in the hours of leisure. How will that leisure be used?

The widespread interest in the possible answers to that question was shown on November 18 when more than two hundred bodies were represented at a conference arranged by the National Institute of Industrial Psychology and the British Institute of Adult Education. The problem of leisure was the problem which attracted that very large audience, and it was finally decided to set up a committee representative of bodies willing to co-operate in the carrying out of what might be called our first survey of leisure. It will consist in the first place of an investigation of the opportunities for leisure, for, clearly, any such survey will fail in its purpose if it neglect factors such as housing conditions, transport facilities, the extent to which poverty debars from participation in recreation; and other similar considerations.

The purpose of any report which may be drawn up as a result of the investigation will not be to interfere with or supplant the work of bodies already engaged in work affecting leisure activities, but to assist them.

The survey will be on broad lines and will recognize that, while many leisure pursuits require organization, resentment would arise from anything suggestive of coercion, patronage or intrusion on individual privacy.

The present suggestion is that the investigators should base their report upon a first-hand examination of the facts in certain districts which would be selected so far as possible as being typical of prevalent conditions. The following list of districts has been compiled as one where investigations would doubtless be most profitable: a town of varied districts where the factories, dwellings and recreational facilities are within easy reach of one another; a district where the workers' dwellings and their recreational facilities are distant from their work; a

developing district where the conditions of work and leisure have been planned, but where the population has grown up without local civic conditions; a developing, but unplanned, district; a district where varied industries are scattered amid rural surroundings; and a popular holiday resort, with special reference to the increasing extension of the holiday season beyond the summer months. The increase of holidays with pay, the raising of the age of entry, and the lowering of the age of exit, from industry and the incidence of shift work are all factors which must be taken into consideration as the investigation proceeds. Duplication of effort will be avoided and investigators will be asked to distinguish carefully between the collection of fact, the collection of opinion and their own conclusions.

Science News a Century Ago

Anniversary Meeting of the Royal Society

At the anniversary meeting of the Royal Society on November 30, 1837, the president, H.R.H. the Duke of Sussex, being prevented from attending by illness, his address was read by Francis Baily. In the report of the Council for the year, it was said: "The principal business of public interest which has occupied the attention of the Council relates to the extension of accurate magnetical and meteorological observations in different parts of the world.

"A communication having been made by Lieut. William Denison, of the Royal Engineers, of a proposal from General Mulcaster, Inspector-General of Fortifications, that the officers of engineers generally should be employed, under the direction of the Royal Society, in promoting the advancement of science, by carrying on connected series of observations relating to Natural History, Meteorology, Magnetism and other branches of physical science, and suggesting an application to Government for a grant of funds necessary for effecting so desirable an object; a Committee was appointed to consider the proposed measure, and of the means to carry into effect the recommendations contained in the letter of Baron Von Humboldt addressed in April last to the President. Conformably with the report the Council fixed on the ten following places, namely, Gibraltar, Corfu, Ceylon, Hobart Town, Jamaica, Barbados, Newfoundland, Toronto, Bagdad and the Cape of Good Hope as being the most eligible for carrying on magnetic observations . . . these places being permanent stations where officers of engineers and clerks are always to be found." A grant of £500 for instruments was afterwards obtained from the Government.

Award of Two Copley Medals

THE report of the Council also referred to the award of the various medals, two Copley Medals being awarded on this occasion, one to A. C. Becquerel and the other to J. F. Daniell. The award to Becquerel was "particularly for the production of crystals of Metallic Sulphurets and of Sulphur; by the long-continued action of electricity of very low tension. In the memoirs particularly referred to by the Council he has especially in view to explain, by the agency of electricity of very low tension, continued for an indefinite time, the occurrence of crystallised substances in mineral veins. By his work Mr.

Bequerel has thus opened up a new field for inquiry and discovery, in which he has himself gathered the first fruits, but which still offers to future labourers the prospect of an abundant harvest of knowledge as regards both the recombination of crystallised bodies and also the processes which may have been employed by nature in the production of such bodies in the mineral kingdom."

Antoine César Bequerel was born on March 7, 1788 and died on January 18, 1878. After passing through the École Polytechnique, he served in the French army for a short time but soon quitted the service and devoted himself to scientific research. He was one of the founders of electro-chemistry. He was admitted a member of the Paris Academy of Sciences in 1829. Bequerel was appointed to the chair of physics in the Musée d'histoire naturelle in 1837 and this post he held until his death. He was succeeded in the chair first by his son Alexander Edmond Bequerel (1820-91), and then by his grandson Antoine-Henri Bequerel (1832-1908), the discoverer of radioactivity. A statue of Antoine César Bequerel was unveiled at his birthplace, Châtillon-sur-Loire (Loiret), in 1882.

Level of the Caspian Sea

IN a letter written from Dorpat on December 1, 1837, to Alexander von Humboldt, Friedrich von Struve, the famous astronomer, referring to the geodetical operations carried out by the order of the Emperor of Russia to determine the level of the Caspian Sea, said, "Our travellers G. von Fues, Sabler and Sawitsch happily completed their laborious task on the 23rd of October. I have just received the reports and a copy of the journals from the village of Tschernoi-Rynof, near the station of Kolpitschja (on the road from Kialjar to Astrachan) dispatched on the 31st of October (N.S.). The rapid progress of the operations made it impossible to keep up the calculations at the same pace. Our travellers, however, have gone through the whole and are able by a preliminary calculation to state at once the following result as very near the truth:—*that the Caspian Sea is really considerably lower than the Buzine: viz., 101.2 Russian = 94.9 Paris feet.* This preliminary result is warranted to be correct within five feet" (*Athenaeum*, Dec. 23, 1837).

University Events

BIRMINGHAM.—At a special meeting of the Court of Governors held on November 18 the pro-chancellor (Mr. Walter Barrow) presiding, the resignation of the vice-chancellor (Sir Charles Grant Robertson) was accepted, the resignation to take effect on September 30, 1938. The appointment of the vice-chancellor has hitherto been made by the Crown and no age limit was attached, but by an alteration of the statutes (in 1927), future appointments were to be made by the Court and an age limit of sixty-five years was fixed. The pro-chancellor explained that, on approaching this age, Sir Charles voluntarily placed the continuance of his appointment in the hands of the Council, who expressed the wish that he should remain in office until the completion of the new Central Hospital and Medical School, which owed so much to his vision and patient work. As it is expected that both buildings will be finished by next summer,

Sir Charles desired that he should retire on September 30 next, when he would have reached the age of sixty-nine years.

The Court then proceeded, for the first time, to elect a new vice-chancellor, and the pro-chancellor proposed, on behalf of the Council, the name of Dr. Raymond E. Priestley, giving an outline of his remarkable achievements. The proposition was seconded by the vice-principal (Prof. J. G. Smith) and warmly supported by Sir Gilbert Barling and (from personal knowledge) by Mr. J. H. Reynolds, Prof. M. L. Oliphant and Prof. Lees. The Court unanimously elected Dr. Priestley.

After the meeting of the Court a portrait of Sir Charles Grant Robertson (by Mr. James Gunn), presented to the University by 225 subscribers, was unveiled in the Great Hall by the wife of the pro-chancellor.

Earlier in the afternoon Mr. T. E. Harvey, M.P. (Combined Universities), had formally opened St. Francis' Hall, a chapel given to the University by Mr. and Mrs. Edward Cadbury for the use of the undergraduates.

CAMBRIDGE.—A research studentship at Emmanuel College will be awarded in July 1938. Preference will be given to Candidates who have already completed one but not more than two years of research. The studentship has a maximum annual value of £150, is awarded and normally held for two years, but may be renewed for a third. The studentship is not tenable by a woman or by a member of the University of Cambridge. Further information can be obtained from the Master, Emmanuel College, Cambridge.

An appointment to a research studentship at Christ's College will be made at the end of July 1938. Candidates must be men who will have graduated before October 1, 1938, at some university other than Cambridge, and who have not commenced residence in Cambridge at the time of election. The studentship will be normally held for two years, but it may be prolonged for a third year in exceptional circumstances. It is of annual value not exceeding £200. Further information can be obtained from the Master, Christ's College, Cambridge.

LONDON.—Dr. J. W. Orr, lecturer in experimental pathology, was elected to the post of reader. Dr. Orr is also assistant director of cancer research.

The following appointments have been made: Dr. H. G. Garland as clinical lecturer in medicine and honorary demonstrator in medical pathology; Dr. J. A. Price as honorary demonstrator in medicine; N. Lissimore as honorary demonstrator in pathology; F. R. W. Hemsley and I. J. Koidan as honorary demonstrators in anatomy; Miss Florence O. Bell as research assistant in textile physics.

LONDON.—Prof. A. J. Allmand has been appointed as from August 1, 1938, to the Daniell chair of chemistry tenable at King's College. Since 1910 he has held the University chair of chemistry at that College.

The following have been appointed University readers: Dr. L. P. Garrod (St. Bartholomew's Hospital Medical College) in bacteriology; Dr. C. F. Goodeve (University College) in chemistry; C. W. Dannatt (Imperial College—Royal School of Mines) in metallurgy; Dr. H. J. T. Ellingham (Imperial College of Science and Technology) in physical chemistry.

Societies and Academies

Paris

Academy of Sciences, October 11 (*C.R.*; 205, 585-632).

PIERRE LEJAY: The absorption of solar radiation by the atmosphere in band A. From a discussion of the results obtained from the study of more than two hundred spectra taken over a period of two years, it is concluded that the oxygen band A is entirely of telluric origin. The view of W. H. J. Childs that the effective width of a line is proportional to the square root of the atmospheric mass is not supported by these observations.

LUCIEN DANIEL: Heredity in the descendants of *Helianthus Dangeardi*.

J. G. VAN DER CORPUT: A new generalization of the Goldbach-Vinogradov theorem.

JEAN DIEUDONNE: Continuous numerical functions defined in a product of two compact spaces.

HENRI CARTAN: The theory of filters.

ANTOINETTE APPERT: The effective definition of nearly isometric measurements and on the generalized limit of M. Banach.

CARLOS BIGGERI: The singularities of Laplace integrals.

ROBERT SILBER: The idea of traction and of the yield of the propelling screw and on the deviations existing between the internal and effective characteristics.

V. DOLEŽALSKÝ and M. TAYBIL: A focusing effect for X-rays by means of a crystal with variable incurvation.

MAURICE PARODI: The characteristic frequencies of chlorates, bromates and iodates. A comparison of the Raman and infra-red spectra gives data for deciding between the plane or pyramidal structure of the group XO_3 . The latter appears to agree better with the experimental facts.

RAYMOND DELABY, LÉON PLIAUX and ANDRÉ GUILLEMONAT: The application of the Raman effect to the study of some cases of allyl-propenyl isomerism.

ADRIEN PHERRÉ: Researches on the anhydrous cyanides and cyanamides of iron, cobalt and nickel.

JEAN ALBERT GAUTIER: The hydrogenation of some nitrogen substituted α -pyridones by means of Raney nickel.

MILLE Y. BOISSE DE BLACK: An outcrop of Cantal basalt subsequent to a glaciation of the valley.

E. SAURIN: The presence of the fossil-bearing Norian on the coast of South Annam.

GÉRARD WATERLOT and EDOUARD ROCH: The Gothlandian of the Haut-Atlas to the east of Marrakech.

FRANZ BARRIS and ROMAIN VANDEWIJER: The alkalinity of the ash and loss of chlorine on incineration. Experiments on the loss of chlorine with corresponding formation of potassium carbonate when solutions of sugar containing potassium chloride are incinerated.

ANDRÉ GORIS: A tear-producing principle in the roots of *Raminobus Thora*.

PAUL MATTHIAS: The evolutionary cycle of a trematode of the family Allocreadiidae (*Allocreadium augusticollis*).

HENRY SCHWAB: Changes in the hyperglycemic action of adrenalin by the addition of zinc salts. The hyperglycemia caused by adrenalin is increased and its duration increased when zinc chloride is simultaneously injected with the adrenalin. Similar effects have been previously noted for insulin and it is concluded that the effects in both cases are due

to a modification of the cellular substratum, probably a change in the colloidal structure.

ANDRÉ LWOFF and HISATAKE DUBI: Pyrimidine and thiazol, factors of growth for the flagellate *Polytomella coeca*.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 480-533, Sept. 15).

R. F. KIMBALL: Inheritance of sex at endomixis in *Paramecium aurelia*. The race found by Sonneborn to have sexes I and II was used. As found by Sonneborn for conjugation, sex is segregated at the first fission after the formation of the anlagen (the portions of micro-nuclei which will form the new mega-nuclei at endomixis). Sex ratios of 1:1, 1:2 and 2:1 were found.

L. C. DUNN: A third lethal in the *T* (brachy) series in the house mouse.

E. HADORN: An accelerating effect of normal "ring-glands" on puparium formation in lethal larvae of *Drosophila melanogaster*. In the mutation "lethal giant", no pupae are produced; puparium formation occurs, but at a later period than in the normal individual. Injection of "ring-gland", a small body located dorsally between the two hemispheres of the "brain", accelerates puparium formation, suggesting that this gland produces a pupation hormone.

B. P. KAUFMANN and M. DEMEREC: Frequency of induced breaks in chromosomes of *Drosophila melanogaster*. Cytological analysis of salivary gland nuclei shows that breaks occur with equal frequency in the Y-chromosomes, which are genetically inert, and in the autosomes, which are genetically active, suggesting that the structure of the chromonema is similar in all regions of the chromosomes.

F. D. MURNAGHAN: The direct product of irreducible representations of the symmetric group.

W. E. SEWELL: Degree of approximation by polynomials—problem α .

G. A. MILLER: Sets of independent generators of a finite group.

D. H. HYERS: On functional equations in linear topological spaces.

W. J. ROBBINS and F. KAVANAGH: Intermediates of vitamin B₁ and growth of Phycomyces. The thiazole and pyrimidine components of the vitamin appear to be utilized in molecularly equivalent quantities when offered as mixtures of varying proportions. This suggests that Phycomyces requires vitamin B₁ and synthesizes it from the intermediates.

P. W. WILSON and E. B. FRED: Mechanism of symbiotic nitrogen fixation. (2) The pO_2 function. Experiments in which the partial pressure of oxygen was varied lead to the view that molecular oxygen is not directly concerned in symbiotic nitrogen fixation. Indirectly it is important for its influence on the carbohydrate metabolism.

A. H. HOLWAY and W. J. CROZIER: The law for minimal discrimination of intensities (2). Experiments in which area of application on the skin is varied in extent and mechanical pressure is kept constant, support the findings with visual and auditory stimuli that least discriminable difference of intensity decreases with increase of stimulus.

W. J. CROZIER, E. WOLF and GRETCH ZERRAHL-WOLF: Specific constants for visual excitation. The mean critical illumination for response to flicker was measured as a function of flicker frequency for a number of teleost species. The results provide support for the theoretical objection to the practice of

averaging data from individuals not necessarily genetically alike as regards the property investigated.

J. G. HAMILTON: Rates of absorption of radio-sodium in normal human subjects. Radio-sodium was prepared by bombardment of ordinary sodium chloride with deuterons from the cyclotron. The radioactive salt was dissolved in water and given orally. The radioactivity of the hand was measured by a Geiger-Müller counter held in the hand, the hand and forearm being enclosed in a thick lead box to shield the counter from radiation from the body. Absorption of radio-sodium begins within a few minutes and is apparently completed in 3-10 hours in some subjects. The method offers a new means for the study of the metabolism of sodium and other elements.

S. F. COOK, K. G. SCOTT and P. ABELSON: Deposition of radio-phosphorus in tissues of growing chicks. Radio-phosphorus prepared from red phosphorus by the cyclotron was fed to growing chicks, which were killed at different periods after administration; the radioactivity of thirteen tissues was examined. The results were in general agreement with those of Hevesy and of the Italian workers under Segrè. Radio-phosphorus was found in all tissues examined, but particularly in the skeleton and musculature. Comparison of the activities at 4 days and 60 days after administration showed marked movement of radio-phosphorus from muscle and intestine to bone, bone marrow and brain. Spleen showed high content of radio-phosphorus at all times.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, November 29

UNIVERSITY OF LEEDS, at 5.15.—Prof. T. H. Pear: "The Place of Imagery in Mental Processes".*

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. C. Drummond: "Historical Studies of English Diet and Nutrition" (Cantor Lectures).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—L. Christensen: "Recent Reconnaissance Flights in the Antarctic".

Tuesday, November 30

ROYAL SOCIETY, at 2.30.—Anniversary Meeting.

Sir William Bragg, P.R.S.: Presidential Address.

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, W.1), at 6.—Prof. A. Freundlich: "Industrial Applications of Supersonic Vibrations".

Wednesday, December 1

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers), at 7.—Joint meeting with Institution of Heating and Ventilating Engineers.

H. L. Pirie and I. Lubbock: "Fuels for Heating and Hot Water Supply".

Thursday, December 2

CHEMICAL SOCIETY, at 5.—Discussion on "The Influence of Structure on the Action of Parasiticide Drugs" to be opened by Dr. T. A. Henry.

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. Chadwick, F.R.S.: "The Artificial Transmutation of Matter" (succeeding lectures on December 7 and 8).*

Friday, December 3

ROYAL INSTITUTION, at 9.—Prof. Irvine Masson: "Iodine".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

RESEARCH CHEMIST for the Bone Research and Development Association, Ltd.—Prof. W. A. Bone, Imperial College of Science and Technology, London, S.W.7 (November 29).

SCIENTIFIC OFFICERS AND ASSISTANTS in the Explosives Directorate and the Ballistics Directorate of the Research Department, Woolwich—The Chief Superintendent (December 3).

CHEMISTS for the War Department Chemist—The Under-Secretary of State (C. 5), War Office, S.W.1 (December 6).

PHYSICIST in the Research Laboratories of the G.E.C., Ltd., Wembley—The Director.

VETERINARY RESEARCH OFFICERS in Kenya—The Director of Recruitment (Colonial Service), Colonial Office, 2 Richmond Terrace, S.W.1.

RESEARCH PHYSICIST to the Printing and Allied Trades Research Association, 10 Robin Hood Court, London, E.C.4—The Director of Research.

Official Publications Received

Great Britain and Ireland

Friends of the Hebrew University of Jerusalem. Annual Report, 1936-7. Pp. 20. (London: Friends of the Hebrew University of Jerusalem.) [311]

Report of the Council of the Royal Institute of International Affairs, 1936-1937: Eighteenth Annual General Meeting of the Institute, November 2nd, 1937. Pp. 112. (London: Royal Institute of International Affairs.) [311]

West of Scotland Agricultural College: Plant Husbandry Department. Research Bulletin No. 5. Boron in Agriculture. By Dr. E. W. G. Dennis and Dr. D. G. O'Brien. Pp. 26+14 plates. (Glasgow: West of Scotland Agricultural College.) [411]

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academic Year 1936-1937. (Published by Authority.) Pp. 144. (Cambridge: Printed at the University Press.) [511]

Chemical Changes and Chances. By Sir Martin Forster. (20th Strausfeld Memorial Lecture) Pp. 21. (London: Institute of Chemistry.) [811]

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1936. Part I, with Report of the Geological Survey Board and Report of the Acting Director. Pp. in+90. (London: H.M. Stationery Office) 1s. 6d. net. [911]

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute. Report on the Work of the School for the Year 1936-37. Pp. xvii+115. (London: London School of Hygiene and Tropical Medicine) [1011]

Idly Year-Book, 1937. (No. 6) Pp. iv+153+25 plates. (London: Royal Horticultural Society.) Paper, 6s.; cloth, 8s. [1211]

Tropical Diseases Bulletin. Vol. 24, Supplement: Medical and Sanitary Reports from British Colonies, Protectorates and Dependencies for the Year 1936. Summarized by P. Graville Edge. Pp. 237. (London: Bureau of Hygiene and Tropical Medicine.) 7s. 6d. net. [1311]

Other Countries

Annalen van de Sterrewacht te Leiden. Deel 17, Stuk 1: A Study of the Double Cluster in Perseus, based on Photographic Magnitudes and Effective Wavelengths derived from Plates taken by H. Hertzsprung at the Potsdam and Mount Wilson Observatories. By P. Th. Couterhoff. Pp. 120+4 maps. (Leiden: Sterrewacht.) [611]

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 71: The Grazing of Sheep on Improved Pastures; its Effect on Superfine Wool. By I. Clunies Ross, N. P. H. Graham, Helen Newton Turner, H. B. Carter and H. Munn. Pp. 24+2 plates. Pamphlet No. 72: Needle Fusion of Species of Pines in Southern New South Wales; Progress Report, 1935-36. By Dr. W. V. Ludbrook. Pp. 25+3 plates. Pamphlet No. 73: Properties of Australian Timbers. Part 2: Brown Mallet (*Baccharis arbutifolia*). By Ian Langlands. (Division of Forest Products. Technical Paper No. 23.) Pp. 20+4 plates. (Melbourne: Government Printer.) [811]

Department of Education: Baroda State. Lecture Series, 1936-37, Lecture No. 2. Some Facts relating to Educative Employment. By Capt. J. W. Petavel. Pp. 14. (Baroda: Department of Education.) 1 anna. [811]

Union of South Africa: Department of Mines: Geological Survey. The Geology of portion of the Coastal Belt near the Gamtoos Valley, Cape Province, an Explanation of Sheets Nos. 151 North and 151 South (Gamtoos River) By Dr. S. H. Houghton, Dr. H. F. Frommance and D. J. L. Yimer. Pp. 64. (Pretoria: Government Printer.) 5s., including Maps. [1011]

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 154 (Agricultural Series, No. 40). Analyses of Special Jobs in Quality Milk Production; Procedures and Practices for Quality Milk Production on Farms. Revised edition. Pp. v+15. (Washington, D.C.: Government Printing Office.) 5 cents. [1211]

Division of Fish and Game of California: Bureau of Marine Fisheries. Fish Bulletin No. 50: Sizes of California Sardines caught in the Different Areas of the Monterey and San Pedro Regions. By J. B. Phillips. Pp. 32. (Terminal Island, Calif.: California State Fisheries Laboratory) [1311]

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Racial Doctrine and Social Evolution

IN the now not inconsiderable list of men of eminence in anthropological studies who have paid tribute to the work of Thomas Henry Huxley in the Huxley Memorial Lecture of the Royal Anthropological Institute, now approaching near to its fortieth year of delivery, no one, since the inaugural lecture in 1900 by Lord Avebury, the intimate friend of both Huxley and Darwin, has been more felicitous or more opportune in the choice and treatment of subject than was Prof. H. J. Fleure, when on November 9 he addressed the Institute on "Racial Evolution and Archaeology" (see page 981). In making the classification and distribution of races the basis of his argument, he dwelt on an aspect of the study of man with which Huxley was closely concerned, and at the same time, by associating racial studies with the results of archaeological and cultural research, he was able to draw certain inferences as to the forces making for the upward progress of mankind, which would have commended themselves to one whom Prof. Fleure and his colleagues without exception would regard as their master.

Prof. Fleure struck the keynote of his lecture when in his opening sentences, speaking of Huxley, he said : "His championship of the free conscience is more than ever needed to day, when in not a few countries the pursuit of the science of man is being seriously affected by non-scientific views." The evil, however, as Prof. Fleure went on to show at a later stage in his lecture, is even more grave than these words would suggest. It is not merely that racial theory is being constrained to lay false emphasis on the part played by the racial factor and by certain races in the advancement of civilization, as well as on the character and standing of those races, but also racial doctrine is made the

instrument of attack on that freedom of conscience, of which it was Huxley's conviction that the process of growth is in a very deep sense the essence of progress in the development of civilization. The call of the blood—in other words, the claims of the group—are made to transcend and override personal right to the exercise of individual judgment.

The conflict between authority and the right to individual judgment, in which Huxley and other great figures of the latter half of the nineteenth century were so long and strenuously engaged, had seemed to be won—fully in the field of science, where truth alone, without regard to prepossessions resting on extraneous consideration, was accepted universally as the acid test of validity. It is unnecessary to recall the course of events by which, since the Great War, science in certain countries has been harnessed to political ideals of varied complexion ; but the perversion of ethnological science to support the authority and supremacy of the group over freedom of thought and judgment has been tragic in its consequences, both socially and in the field of science.

In his survey, vast in space and time, of the evolution of races and of their migrations over the surface of the globe, and of the part played by these races, each in their turn, in the development of civilization, Prof. Fleure was in a position to demonstrate that the history of mankind is a story of the development of individuality and its emancipation from the chains of the social group, which, indeed, he suggested may perhaps be traced back as a relic of even pre-human days. In every phase of cultural growth, from the stage of the food-gatherer to the higher forms of

civilization, there is evidence of "an increasing purpose". So far from society being, as the political philosophers would have it, a system of restraints imposed upon the original freedom of man in his natural state, the history of human progress, as Prof. Fleure interprets the evidence, is the story of the emancipation of the individual conscience from the suppressive influence of group pressure, which favours mediocrity alone.

Nor does the theory of the superiority of the racially homogeneous group as a progressive force receive any support from racial history. As anthropologists generally hold, and as Prof. Fleure agrees, it is probable that no society, at least of any size, is composed of a racially homogeneous group, nor has been so composed since at least the days of the food-gatherers. Further, as Prof. Fleure went on to point out, in a society composed of racially heterogeneous groups, such as have been formed in the course of the kaleidoscopic movement of racial migration which has been taking place for thousands of years, there is evidence to show that adjustments and compromise have taken place between the different groups, each of which has had its own racial history behind it, and, possibly, each with its own characteristic mental attitude and outlook.

From the conflict, however, which thus arises, when the ritual of one part is set over against the ritual of another, discussion takes place, and as Prof. Fleure puts it, leads to the valuing of justice rather than ritual. This must have happened even with such a military caste as the Nordics, whom a perverted racial theory has elevated to a pinnacle which is less than deserved. For even in the larger groupings which seem to have come about through the domination of tillers by herders, especially when the latter have been of a militarizing tendency, the group developed with a diversity of tradition and with diverse ranks of a hierarchical society, and nearly everywhere the result has been that the immigrant rulers have had to accommodate themselves to the prejudices and customs of the subject masses.

It would appear, in fact, that the dogma of the political philosopher that the development of society is from status to contract, when interpreted in the light of the evidence of ethnology and archaeology, must be taken to mean that in the development of civilized society the line of progress has been, not a class conflict, but in the direction of an ultimate adjustment of rights and

privileges among those varied sections of society which may in fact be rooted in diverse racial origins and are certainly linked with differences of tradition and social outlook. Such an adjustment to be lasting cannot be imposed by superior authority but must be the result of free and unfettered discussion.

"What does not Britain owe", asks Prof. Fleure "to the fact that Celtic, Teutonic and Romance cultural contributions to the common life have intertwined without complete dominance by any one of them?" He points out that, in the instance of Holland, which welcomed the persecuted, we marvel at the richness of development of individuality in a society orderly above the average of its time and not particularly distinguished as a whole.

On a view of the history of human development such as has been put forward by Prof. Fleure, there cannot be two opinions but that the verdict lies in favour of the racially heterogeneous rather than the homogeneous group. But what of the future? Will the unity of purpose and action of a society, which exacts uniformity in composition, culture and social ideal, prevail over the weaknesses inherent in its denial of what history has shown to be the evolutionary trend? On such a question we cannot do more here than refer to the conclusion at which Prof. Fleure has arrived. If the group working towards 'autarky' by the suppression of thought and intellectual intercourse loses its perspective, throwing out its best workers, thinkers and artists in the interest of mediocrity, strongly tinged with jealousy, it loses the means of keeping in contact with the ceaseless process of change. Further, by the suppression of the principle of freedom of conscience, it becomes an anti-scientific authoritarianism, because it denies that "which is the life-breath of science."

Such, then, is the verdict of detachment—the view of the anthropologist, who from his survey of the trends of development in civilization throughout the great expanses of space and time of man's history, is brought to the conclusion that in freedom alone, freedom of development and freedom of expression, does truth, material, moral and spiritual, emerge. To this may be added as a legitimate corollary that the aim of society must be to ensure not its own formal permanence, which is the triumph of the machine, but the maintenance of such conditions as will best keep open a way for man to the attainment of his ultimate destiny, whatever that may be.

Physics of Music

(1) Science and Music

By Sir James Jeans. Pp. x+258+10 plates.
(Cambridge: At the University Press, 1937.)
8s. 6d. net.

(2) Music and Sound

By Ll. S. Lloyd. Pp. xiv+181. (London: Oxford
University Press, 1937.) 10s. 6d. net.

THE increase in the appreciation of music in Great Britain, and the importance of a knowledge of acoustics for such purposes as the control of noise and the design of public halls, make the appearance of two books on this subject extremely opportune. There is, however, a fundamental difference between them. Sir James Jeans approaches the reader who has no technical knowledge and interests him in music and its associated physics alike; but Mr. Lloyd addresses the musician, and leads him on to scientific principles for the sake of the understanding that he will thereby gain.

(1) It is true that "Science and Music" is eminently readable and contains no mathematical symbols; but that seems to impose no limitations on the author: his discussion of the physical principles is clear and satisfying. He is equally at home when discussing the countless details on which music depends, or the recent investigations into the measurement of reverberation. On the purely musical side the book is full of good matter, and could only have been written by an expert familiar with orchestral instruments.

The book begins with a fascinating account of the development of the ear, and then describes the fundamental facts about frequency, beats, resonance, the vibrations of a stretched string and harmonics. There follows an account of the factors which govern the tones of the piano and other stringed instruments. We have an analysis of the physical conditions which produce the Stradivarius quality of a violin; the author even hints that X-ray analysis may in time lead to its mass production.

After a study of the vibrations of air, we have a description of edge-tones and the way in which the eddies produced control the sound of a flute organ-pipe; reed pipes follow and then applications to the chief wind instruments of the orchestra. Interesting light is thrown on many of their problems, including their characteristic timbre and the way in which pitch can be varied by the player's lips. Perhaps in a future edition it may be explained how the sound of a clarinet, owing

doubtless to the reed, contains a second harmonic of 3.5 times the amplitude of the fifth (p. 150) and yet the instrument will overblow to the fifth harmonic and not to the second.

Another chapter is devoted to discord and the origin of the musical scale, with an account of the various attempts to overcome the difficulties of equal temperament; it is only when the reader finishes the chapter that he realizes that he has been taken through a series of subjects that in less able hands would have been very severely technical. (There is an obvious slip in the top line of p. 143, for the wolf-fifth contains about 7.4 semitones.)

The last two chapters handle the transmission of sound from its source to the ear-drum and its transmission from the ear-drum to the brain. In spite of a still current impression to the contrary, the problem of constructing a public hall with good acoustic properties has been solved, and we have a clear account of the effect of various materials upon absorption: incidentally, the marked musical superiority of wood over felt or canvas of equal absorbing power in the middle register is explained as due to less damping of the higher notes and of the harmonics; music will therefore sound brilliant and rich in a wooden room, but dull and dead when the damping is produced by felt and canvas.

When we come to the discussion of the processes in operation between the ear-drum and the brain, with their many subsidiary questions, we have the author at his best: among many interesting facts we learn how in many of our radio sets all frequencies below middle *C* are cut out; yet we hear the double-bass strings and male voices with absolute clearness.

The value and attractiveness of the book are increased by an exceptionally good series of photographs and diagrams. It will fascinate those interested in music and will be very useful to physical students for its account of the modern work upon sound.

(2) In the introduction to "Music and Sound", it is rightly pointed out that, while a knowledge of acoustics is useful to the musician, the scale has been developed by composers, and the indications from physics can only be accepted when they agree with what counterpoint teaches: a composer should learn to think in terms of the pure scale and must therefore study music of the polyphonic period, when music was written for unaccompanied voices.

The book begins with a satisfying investigation of major and minor scales and the effect of modulation in displacing the notes. Then come discussions of temperaments, mean-tone and equal; and of chromatic notes, decorating notes and intonation, a number of the results, such as the difference between $F^\sharp$ and $G^\flat$, being worked out in commas.

In Chapter iv, combination tones and beats are handled in an interesting way, from the point of view of the concert-room rather than the laboratory. But at first sight one point is rather puzzling. The author on p. 40 accepts Helmholtz's view and holds that combination tones are produced in the ear, yet he says on the previous page that experiment confirms a general observation denying it. The author next deals with consonance, dissonance and the effects of mistuning, and his specialist knowledge leads to some striking remarks. Thus on p. 64:

"the major chord of the 6/4 is acoustically the smoothest consonance, yet for centuries the art of music has treated this chord as a discord. There is a significant sentence in Helmholtz's work: 'The dispute as to the consonance or dissonance of the fourth has been continued to the present day'. This dispute is, in effect, whether

music is an art or a science. No room for controversy would have been left had the test of the disputants been that of the use of the 6/4 by Bach in his forty-eight preludes and fugues for the clavichord."

The handling of musical notes, audibility and resonators is on ordinary lines and is followed by an excellent chapter on the organ pipe and orchestral instruments. In spite of the limitations imposed by the holes and valves of the wind instruments of an orchestra, it is satisfactory to have it on Stanford's authority that in the orchestra the compromise of 'equal temperament' has no place.

The author lays stress on the drawing of graphs in order to obtain a concrete grasp of acoustic principles, and in the last chapter gives a good example of their value in discussing the vibration of strings. Having excluded from the text all but the most elementary mathematics, he provides for further information a number of short appendices, the last being an excellent note on auditoriums.

The book is obviously written by a trained musician; its style is clear and its mode of presentation fresh. It is strongly to be recommended to those for whom it is written.

G. T. W.

Recent Work in Enzyme Chemistry

Enzyme Chemistry

By Dr. Henry Tauber. Pp. xii + 243. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 15s. net.

CONSIDERING the complexity of the problems presented by enzyme chemistry and the remarkable achievements which have been made of late in this branch of biochemistry, there is little doubt that the appearance of a book describing accurately and concisely recent advances would be very welcome. Dr. Tauber has attempted this somewhat formidable task. His book, as the author states in his preface, "makes no claim to completeness", whilst theoretical considerations are intentionally reduced to a minimum. Presumably the book is to be read as an addendum to more complete works on enzyme chemistry.

After a short introductory chapter dealing very briefly with such topics as enzyme specificity, activators and inhibitors, reversible inactivation, the carrier theory, and the mechanism of enzyme synthesis, the author turns to the descriptive work which forms the main feature of his book. He deals first with esterases and then, more at length,

with the proteolytic enzymes. Here there is to be found a good description of the work of Northrop and his colleagues on the crystallization of members of the proteinase group (pepsin, trypsin, chymotrypsin, etc.), and a not too adequate description of the recent work of Bergmann and his associates. The author, for example, states (p. 87) that "it is not known whether papain is a single enzyme or a mixture of two or more enzymes", whereas Bergmann and Ross (*J. Biol. Chem.*, 111, 659; 1935) make it clear that there must be in natural papain two different proteolytic enzymes, a proteinase and a polypeptidase, the former of which is reversibly inactivated by oxidation and the second irreversibly inactivated (see also Bergmann and Ross, *J. Biol. Chem.*, 114, 717; 1936). The author then turns to the amidases, lightly touching upon such enzymes as asparaginase, aspartase and tyraminase, and giving more attention to the preparation and some of the properties of urease and arginase. Carbohydrases are next dealt with, and finally oxidizing enzymes and systems are described. Catalase, carbonic anhydrase and luciferase are distinguished by each having a separate chapter.

Dr. Tauber cites (p. 162) as the first experimental proof of the formation of an intermediary enzyme-substrate compound the reaction between catalase and monoethylhydrogen peroxide described by Stern. Keilin and Hartree, however, claim (*Proc. Roy. Soc., B*, 121, 173; 1936) that ethylhydroperoxide is not a substrate of catalase, no decomposition (to acetaldehyde) taking place with a weak solution of the enzyme free from other hæmatin compounds and from alcohol.

Dr. Tauber describes the dehydrogenase systems scappily and inadequately. Keilin is credited with the conclusion (p. 169) that "the succinic enzyme is a complete enzyme system consisting of a dehydrogenase, cytochrome, and the oxygen-activating indophenol (or cytochrome) oxidase". The finding of Banga, Laki and Szent-Györgyi that the oxidation of β -hydroxybutyric acid to acetoacetic acid is due to the same enzyme-co-enzyme system which oxidizes lactic acid (p. 172) is quoted without the additional statement that these authors (*Z. physiol. Chem.*, 220, 278; 1933) afterwards retracted this conclusion. It is now known that the two systems are distinct. There

is little mention of the properties of the amino-acid dehydrogenases.

Confusing and inaccurate statements and misspellings appear—evidence, doubtless, of hasty proof-reading. For example, we find the following sentence, "Tyrosine, monophenols and aromatic diamines are not attacked" by laccase (p. 186), whereas, of course, such monophenols as guaiacol and *p*-cresol, as the author has actually previously mentioned, are attacked by laccase.

There is a number of omissions of subjects which certainly should have found some mention in this book; for example, glyoxalase and the co-enzyme properties of glutathione, action of eserine on choline esterase, protective power of substrates and allied compounds on enzyme inactivation by dyestuffs, etc., equilibria established by xanthine oxidase, etc., recent concepts of constitutive and adaptive enzymes. Quite apart from these and other omissions, however, it is evident that Dr. Tauber's book requires some revision, and it is to be hoped that he will be able to accomplish this in the not too distant future.

J. H. Q.

Human Embryology

A Textbook of Embryology

By Prof. H. E. Jordan and Prof. J. E. Kindred. Third edition. Pp. xiv + 613. (New York and London: D. Appleton-Century Co., Inc., 1937.) 25s. net.

THIS text-book by two Virginian embryologists has served a useful purpose in the past and will continue to do so in the future. It deals more particularly with human development, and the comparative method in deducing and interpreting the progressive changes is used but sparingly, the authors preferring generally to fill in lacunæ in our knowledge by postulating hypothetical stages rather than by referring to data derived from the study of other animals. In special cases, however, and more especially in describing the development of the foetal membranes and their appendages, the comparative method is freely adopted. Furthermore, in the interpretation of vestigial and transitory structures full use is made of the 'law of recapitulation'. The separate section on "Laboratory Exercises" continues to be a feature of the work. The present edition does not differ materially from the last, but there are some additions, more particularly to the chapters on haemopoiesis and sex determination, and certain errors in other parts of the book have been corrected.

Of the errors which have been allowed to remain,

those relating to ovulation, the corpus luteum and the sexual cycle are perhaps the most noticeable. Thus, the corpus hæmorrhagicum is described as the mass of clotted blood which fills the cavity of the ruptured ovarian follicle and constitutes the first stage in the formation of the corpus luteum. The name 'corpus hæmorrhagicum' or 'blood follicle' is now reserved for degenerate undischarged follicles which have never ruptured, and in the figure such a one is shown in the *centre* of the ovary and duly labelled. The lutein cells can scarcely be said to "invade the corpus hæmorrhagicum" since they are actually formed from the undischarged follicular epithelium, and the cells which grow inward from the wall are connective tissue elements, these giving rise to a network surrounding the enlarged lutein cells.

Again, in dealing with the time of ovulation, the authors cite Siegel's statistical data pointing to the occurrence of the process about the tenth day after the beginning of the menstrual flow. They omit to mention the work of Shaw, Knaus, Ogino and others and the more recent work of Hartman showing definitely that in a normal menstrual cycle ovulation usually takes place about the fourteenth day. Moreover, the œstrous cycle is incorrectly described. The diœstrus is not simply a quiescent period, but is now known to be of the

nature of an abbreviated pseudo-pregnancy. The authors confuse the dioestrus with the prolonged period of rest known as the anoestrus and are wrong in stating that in monoestrous animals the dioestrus includes almost the whole year, for such species do not experience a dioestrous period. Monoestrous animals are not those which experience "only one annual heat period", for the dog is definitely monoestrous (that is, it has only one oestrus in a sexual season); yet the dog, as is well known, comes on heat and breeds, as a general rule, twice a year. Moreover, it can no longer be affirmed that the prooestrus of the lower mammal corresponds simply to the menstrual flow of the human female.

There is a paragraph describing Spemann's work up to 1924 on the process of differentiation

of the ovum, but we would have liked some account of the more recent advances in experimental embryology. In view of the great complexity which the study of the sex hormones has attained as a consequence of recent researches, it may be doubted if the Lillie-Minoura explanation of the 'free-martin' can be held in the simple form in which it was presented.

A word of praise must be added for the excellent illustrations, and the book as a whole may be recommended to medical students and practitioners who desire a clearly written presentation of the principal facts of human embryology. Such criticisms and suggestions as are made above have been put forward with a view to further improvement when the book reaches a fourth edition.

F. H. A. MARSHALL.

Aspects of Higher Mathematics

(1) *Leçons sur la théorie des espaces à connexion projective*

Par Prof. E. Cartan. Rédigées par Dr. P. Vincenzini. (Cahiers scientifiques, Fascicule 17.) Pp. vi + 308. (Paris: Gauthier-Villars, 1937.) 85 francs.

(2) *Differential Systems*

By Prof. Joseph Miller Thomas. (American Mathematical Society, Colloquium Publications, Vol. 21.) Pp. ix + 118. (New York: American Mathematical Society, 1937.) 2 dollars

(3) *Introduction mathématique aux théories quantiques*

Par Prof. Gaston Julia. (Cahiers scientifiques, Fascicule 16.) Première partie. Pp. vi + 220. (Paris: Gauthier-Villars, 1936.) 60 francs.

(4) *Éléments de géométrie infinitésimale*

Par Prof. Gaston Julia. (Cours de la Faculté des Sciences.) Deuxième édition. Pp. vii + 262. (Paris: Gauthier-Villars, 1936.) 60 francs.

(5) *Über einige neuere Fortschritte der additiven Zahlentheorie.*

Von Edmund Landau. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 35.) Pp. vii + 94. (Cambridge: At the University Press, 1937.) 6s. net.

(1) **P**ROF. CARTAN'S work on the theory of spaces with projective connexions is executed in accordance with a plan originally set forth in another work of his on generalized spaces. The present volume is divided into two parts, the first of which serves as an introduction to the second, and presents a survey of the different

methods employed in projective differential geometry with emphasis upon those which may be generalized in the theory of spaces with projective connexions proper. Prof. Cartan chooses the simplest of problems here; indeed certain of them are chosen only for their instrumentality in illustrating the different methods employed. Thus, as he says, the first part cannot lay claim to being in any sense an exhaustive treatise on projective differential geometry.

In the second half of the book Prof. Cartan passes on to consider spaces with projective connexions proper, and, as in Riemannian geometry, once the general theory is introduced, two kinds of problem arise. First, there are the problems which are consequent upon the consideration of the properties of these projective spaces themselves and their differentiation from the classical projective space; and secondly, there are those which arise from the consideration of the properties of the curves and surfaces in such spaces. Prof. Cartan does not, in this work, go into the latest developments in generalized projective geometry, but he includes an extensive bibliography of works expounding the most modern researches.

(2) In his extremely interesting treatise on differential systems, Prof. Miller Thomas is primarily concerned in developing the theory of partial differential equations and that of Pfaffian systems in such a way as to show clearly the relations between the two theories. He uses the postulational method as being the most conducive to generality and conciseness, and proceeds to take a few existence theorems and construct his theory upon them. He includes a consistency

proof by proving the postulates in particular cases. There is no systematic development of the theory of commutative polynomial rings in this book, but Prof. Thomas develops in detail the theory of the non-commutative ring known as the Grassmann ring from the postulates of Chapter iii, and in Chapters iii and iv he develops the ideas introduced by Grassmann and perfected by Cartan.

The treatment of the algebraic case is entirely the author's own, and an individual feature of the work which he considers most satisfactorily exhibited in the algebraic case, but which is employed throughout, is the admission of inequations on an equal footing with equations. Together with the use of resultants of all orders, he finds that this admission obviates the necessity of making the preliminary linear transformations of the indeterminates in the solution of algebraic systems.

(3) Of Prof. Julia's two volumes, that on the elements of infinitesimal geometry is a fairly straightforward treatise the substance of which originated in a course of lectures on the geometrical applications of analysis. Prof. Julia finds that the method of vectors provides greater simplicity in the establishment of generality in results. But, in particular problems he thinks that the utilization of Cartesian co-ordinates or some other canonical system of reference which is appropriate to the geometrical nature of the problem under examination, effects a simplification in analysis. A combined use of the geometrical and analytical methods is what distinguishes Prof. Julia's treatise from others of its kind. This second edition contains many additions and a few modifications of detail, all introduced in order to give greater precision and exactitude to the exposition.

(4) Prof. Julia's other work is the first 'fascicule' of a series which is to constitute a mathematical introduction to quantitative theories. In this introductory part of the work Prof. Julia investigates the properties of vector spaces of n dimensions and their linear transformations. Geometrically, a theory of linear operators is obtained which is translated analytically by a theory of matrices. The choice of co-ordinates appropriate for obtaining the simplest matrix of a given operator leads naturally to the reduction of matrices and to the study of the spectrum; in affine geometry the reductions of Jordan are obtained, and in metric geometry the reductions of Schur. This work is once more the result of the combination of analytical and geometrical methods.

(5) In 1935 Prof. Landau delivered the Rouse Ball Lecture in the University of Cambridge under the title "Solved and Unsolved Problems in the Additive Theory of Numbers". The progress which has been made since that date in the solution of some of the problems described by him, forms the subject of this little volume. The substance of three further lectures on "The Class-Number of Binary Quadratic Fields", in which Prof. Landau produced a full proof of Siegel's very important theorem on the class number of the quadratic forms of negative discriminants, is also included here. For the understanding of this summary of progress made, a knowledge of the elements of the classical theory of numbers excluding the theory of prime numbers, is sufficient. Prof. Landau is so well known an authority in this branch of mathematical theory that it is superfluous to say that any utterance of his is of great importance.

A. v. Z.

East Africa

Mountains of the Moon:

an Expedition to the Equatorial Mountains of Africa. By Patrick M. Synge. Pp. xxiv + 221 + 93 plates. (London: Lindsay Drummond, Ltd., 1937.) 15s. net.

"THE 1934-1935 British Museum Expedition to East Africa was organized for the purpose of studying the flora and fauna of the equatorial mountains in relation to their peculiar environment." This, the opening paragraph in Mr. Synge's book, succinctly describes the subject about which it is written, one not perhaps new, but fully deserving the attention it receives at the author's hands.

Ruwenzori, with its gigantic lobelias and senecios

and the other abnormalities distinctive of its extraordinary flora, was the main objective, but Mts. Elgon and Kenya, the Aberdares and several of the Birunga volcanoes were also visited, and although these are better known than Ruwenzori, the author contrives to present the botanical wonders that he saw and the events of the journeys to find them with a pleasing freshness.

The latter part of the book is devoted to a carefully recorded impression of Uganda—past, present and future—from the political and social points of view. This was Mr. Synge's first visit, but his remarks are well worth careful reading. He deals comprehensively with the subject. Greatly interested in the rise of European education in Africa, he concludes that the mental capacity of

the boys he saw at work, Baganda at Budo and Makerere, is equal to that of the average of European peoples, or the difference is extremely slight. Certainly he feels hopeful of the results; hints at possibilities of improvement, is sceptical of the wisdom of studying Coleridge, of questions on electric lifts and trams, thinks that the English language will eventually oust Swahili as the *lingua franca* of the country, speculates whether the art of Epstein would not appeal more to the native mind than that of Raphael, and is convinced that "Territory can only justifiably pass from one mandatory power to another by a plebiscite of its population."

Appendixes deal first with the legends relating to the sources of the Nile and the Mountains of the Moon, and secondly, with the possibility of the acclimatization in Britain of some of the African mountain plants the author saw.

The illustrations are varied and striking: partly taken from oil paintings and drawings by Stuart Somerville, two in colour; and partly from photographs taken by various members of the expedition. They are by no means the least noteworthy part of the work. Two maps and an index are provided. One alip may be mentioned: the duiker is an antelope, not a deer.

J. P.

Oyster and other Fisheries of Great Britain

(1) Oyster Biology and Oyster Culture:

being the Buckland Lectures for 1935. By Prof. J. H. Orton. Pp. 211. (London: Edward Arnold and Co., 1937.) 5s. net.

(2) The Nation's Sea-Fish Supply:

being the Buckland Lectures for 1936. By E. Ford. Pp. 112 + 4 plates. (London: Edward Arnold and Co., 1937.) 3s. 6d. net.

(1) **T**HE earlier course of Buckland Lectures is devoted to the oyster, a full investigation of which was subsidized for some years, commencing in 1919, by the Empire Marketing Board acting through the Ministry of Agriculture and Fisheries. There was at that time an immense mortality amongst the oysters of the east coast of England, and it was suggested, rather hysterically, that this was due to the dumping of trinitrotoluene in that region—an obvious impossibility. The real cause has never been explained, but the researches of Prof. J. H. Orton and the information obtained by him and here presented will save a second such waste of public money.

Of this presentation we can scarcely write too highly both as to its form and substance—the complete life-history of the 'Native' and an excellent account of its culture. This oyster is shown to be protogynous, changing its sex to the male immediately after spawning and again evicting its gametes. Then, many of the oysters in winter become female and afterwards again revert to male—four changes of sex in thirteen months. Spawning takes place on the beds when the temperature of the water rises to about 60° F., but the causes of good and bad spawning years is still unknown.

(2) In the second course of lectures, Mr. Ford examines our fish supply, stimulated thereto by the profound change effected in the industry by

the Sea-Fishing Act of 1933, followed up by the formation of a Herring Industry Board of Control in 1935, probably the prototype of a Whitefish Board in 1938. Previous to this, British vessels were subject to little or no regulation either as to catching or marketing, but few will be prepared to contest the necessity for this somewhat socialistic measure.

To understand the matter it is essential to appreciate the change that has come over Great Britain in recent years, the greatly increased provision of meats, fruit and vegetables at standard prices and so put up that they can be served without further preparation, each purchase 100 per cent nutritive. At present, at least half the fresh fish sold is from the counters of the fish friers, fish otherwise being largely a luxury product, as can be seen from the fact that it has little or no interest to co-operative societies. In consequence, the industry, while formerly thinking largely in terms of fish-bulk, now has to deal mainly with the demand for species in economic quantities. Before the Great War there was a question of overfishing of grounds induced partially by thoughts of lessened catches, these met later by geographical boundaries being extended and improved methods of fishing.

Still the question of a holocaust of undersized fish is with us, but the researches of the western nations of Europe in the International Council for the Exploration of the Sea, reconstituted in 1919, now make possible the free acceptance of international regulations, such as sizes of mesh of nets and size limits for each marketable fish. The author is an acknowledged expert whose discussion is always both of value and of importance—and above all he bids us to remember that "fish are livestock which need to be exploited with reasonable care and caution".

Gmelins Handbuch der anorganischen Chemie
Achte völlig neu bearbeitete Auflage. Herausgegeben
von der Deutschen Chemischen Gesellschaft.

(1) System-Nummer 36: Gallium. Pp. xviii+iv+100. 13.87 gold marks.

(2) System-Nummer 37: Indium. Pp. xviii+iv+116. 15.75 gold marks.

(3) System-Nummer 23: Ammonium. Lief. 2: Verbindungen bis Ammonium und Kalium, Hydrazonium, Hydroxylammonium. Pp. 243-602. 44.25 gold marks.

(4) System-Nummer 59: Eisen. Teil A, Lief. 8: Fe-C (Fortsetzung); mechanische und thermische Eigenschaften; Systeme Fe-C-H bis Fe-Be-K. Pp. 1635-1818. 24.37 gold marks.

(5) System-Nummer 59: Eisen. Teil D: Magnetische und elektrische Eigenschaften der legierten Werkstoffe. Pp. xlviii+466. 57.75 gold marks.

(Berlin: Verlag Chemie, G.m.b.H., 1936.)

(1 AND 2) The metal gallium was rather neglected until about 1915, when advantage was taken of the long interval between its low melting point and high boiling point to use it either alone or alloyed with five per cent of indium for filling high-temperature thermometers. Gallium has also been used effectively by Bates for alloying with cadmium in the construction of an enclosed cadmium arc lamp. The alloy has a much lower melting point than pure cadmium and does not adhere to the silica on cooling, so that the risk of fracture is greatly diminished. Moreover, the arc spectrum of the cadmium is scarcely affected by the presence of gallium. Indium has as yet found very little commercial application. It was formerly obtained exclusively from zinc-blende, but is now a by-product in the cadmium residues of the lithopone industry. Recently, Brewer and Miss Baker have discovered unusually large amounts of it in cylindrite, a lead-tin-antimony sulphide from Bolivia, and also as a general impurity in tin.

(3) The volume on ammonium contains an account of the salts of the radicals ammonium, hydrazonium and hydroxylammonium. Of the numerous ammonium polysulphides mentioned in the literature, only one, the pentasulphide, is definitely known. The two amino-groups in hydrazine are unequally basic since only one series of salts is stable, except in the case of the halogen hydrides. The stability of the hydroxylammonium salts towards acids, alkalis and oxidising and reducing agents is set forth.

(4 and 5) Section 8 of Part A of the volume on iron deals with the mechanical and thermal properties of the metal and with heterogeneous equilibria between iron and the elements oxygen, nitrogen, sulphur, silicon, phosphorus, arsenic, antimony and the alkali metals. Part D gives a complete account of the magnetic and electrical properties of iron alloyed with numerous elements, other than carbon, these having been separately dealt with previously. The usefulness of this part is greatly enhanced by the inclusion of more than three hundred phase rule diagrams.

Elektronentheorie der Metalle

Von Dr. Herbert Fröhlich. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, herausgegeben von E. Hünd und H. Mark, Band 18.) Pp. vii+386. (Berlin: Julius Springer, 1936.) 28.80 gold marks.

THE electron theory of metals is now so far developed that it can provide adequate explanations of a very large number of the experimental facts concerning the electrical, magnetic and thermal properties of normal metals, and can help us considerably in our understanding of the behaviour of abnormal ones. It is therefore essential for a physicist to have at hand an authoritative and up-to-date survey of the subject. Dr. Fröhlich provides such a survey, starting with a discussion of the fundamental principles of wave mechanics and leading on to a discussion of problems in the emission of electrons, photo-electricity, optical and magnetic properties, the latter being set forth with pleasing clarity. Then follows a sound treatment of electrical conduction and allied phenomena, succeeded by articles on semi-conductors and on the metallic state in general. The last two chapters, which give an account of ferromagnetism and a systematic examination of the properties of individual metals, are well worth reading.

Fundamentals of Vacuum Tubes

By Prof. Austin V. Eastman. Pp. xv+438. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24s.

THERE seems no limit to the number of large textbooks recently devoted to the operation of practical thermionic devices. The present one aims at combining theory and practice for senior engineering students, not attempting to appeal to the specialist. It assumes a working knowledge of the simple calculus, but emphasizes practical ends in developing the fundamental theoretical aspects. Although thermionic tubes find most varied use in radio transmission circuits, these are not allowed to swamp the increasing importance of industrial applications. Gas tubes and photo-electric devices are naturally included in the general discussion. Both the method of comprehensive treatment and clarity of expression are to be commended.

L. E. C. H.

Biology and the New Physics:

a Plea for a Consistent Philosophy of Life. By C. J. Bond. Pp. 67. (London: H. K. Lewis and Co., Ltd., 1936.) Paper covers, 1s. 6d. net; cloth, 2s. 6d. net.

THE rapid changes in the theory and practice of science call more and more for a synthetic adjustment of the complete universe of knowledge. However difficult this task is, one should welcome any genuine attempts towards its completion, as each one of them may open new perspectives which may serve a wider and more comprehensive synthesis. Mr. Bond's forceful and brief plea for a consistent philosophy of life is most interesting from this point of view, and should be read with profit by all those who place values in the forefront of their speculations.

T. G.

The Grain-like Structure of Solids*

By Sir William Bragg, O.M., K.B.E., P.R.S.

A CURSORY glance over the research work described in the scientific publications of to-day shows that remarkable interest is concentrated on magnitudes which are too small to be examined in detail under the microscope and too large to be studied conveniently by X-ray methods. Such magnitudes are to be found in all lines of research, medical, industrial, and purely scientific. Their behaviour presents numerous problems of great interest, and also of considerable difficulty. Solutions are of pressing importance, because the want of knowledge is in all cases a hindrance to progress. When in the course of our work we arrive at these magnitudes we realize that we are facing a key position.

The microscope makes it possible to detect objects as small as a few hundred angströms in diameter, but it is far from revealing the details of objects so small as this. There are other optical methods of detecting such magnitudes. Thus Langmuir has recently shown how the polarization effects of films no more than a few dozen angströms thick can be made visible: but again this method does not supply a means of examining detail.

The X-rays in a sense go too far. Their wavelengths are such that the crystalline arrangement of atoms and molecules can be measured with very great accuracy, but their field of view is too narrow to take in the details of larger structures. Thus there is a gap in the means of inquiry, and it is remarkable how consistently the particular deficiency has inconvenient results.

Magnitudes of this order occur, for example, in the metallurgical field. Their importance is more obvious now that the structures of metals and their alloys are better known. The X-ray methods determine with accuracy the details of the crystal structure of iron and its alloys, but such information is insufficient for a prediction of the behaviour of a specimen of steel. As Smekal has observed, there are certain properties which are clearly connected with structure; and are 'insensitive' to any treatments to which the steel has been submitted in its previous history. But there are other properties, to be described as 'sensitive', which can be modified profoundly by treatment, such as tensile strength, plasticity and hardness, as well as electrical and magnetic properties, and these are most important qualities in practice.

Long ago the microscope showed the metal to be an assemblage of grains; and the conditions of the assemblage are clearly connected with the 'sensitive' properties. But the exact details of the connexion are difficult to investigate because they fall within the region in which direct illumination fails.

Metallurgical theory hovers continually over the idea that a metal or an alloy contains minute groups of atoms, or is even a compound of such groups, which may be called crystallites, since the arrangement of the atoms within each one is perfectly regular. The X-ray diffraction is regular, and the lines of a 'powder diagram' are clear and sharp. Thus Gough and Wood in their examination of the fatigue of metals due to the cyclic repetition—sometimes to millions of times—of an imposed stress, found that the visible grains gradually broke up to an extent which in any one experiment depended on the magnitude of the stress. Fracture in any one region occurred when the break up into crystallites was complete. It did not imply the disruption of atom from atom, resulting in complete disarray, but merely a separation into minute crystals the magnitudes of which were arranged more or less closely about some average. This was shown by the form of the X-ray photograph. A definite stage had been reached in the break up of the material. The existence of such an average would imply that the dimensions of the crystallite are in some way referable to numerical relations between the form or dimensions of the atoms of the metal: analogous to, but far more complicated than, the formation of the benzene ring of definite form and size from atoms of carbon each of which has tetrahedral qualities.

The discussion as to the specific existence, nature and effect of crystallites has been conducted with great eagerness; very much research on the mosaic structure of crystals in general has been undertaken, and several interesting theories have been put forward. At first, theories were suggested which would have provided a super lattice, consisting of a regular arrangement of crystallites, even in the case of a pure metal. But this suggestion could not be maintained, as it evolved a second linear dimension out of a first. Buerger has suggested that the grain-like structure of a metal is due to conditions of growth, various crystalline processes meeting and joining together in irregular

* From the presidential address to the Royal Society, delivered on November 30.

fashion during the formation of the whole mass. This, however, would lead to a casual formation which does not seem to be in accord with metallurgical experiment. G. I. Taylor's ingenious theory of the hardening of a metal by working requires the existence of crystallites of some form. The whole question is still obscure, yet it is extremely important because the properties of metals and alloys depend to a large extent on the grain-like structure which they possess. Whether so-called 'crystallites' are formed under some law governing their size or are merely accidental assemblages, they are a centre of interest in the examination of metallic properties.

Similar conditions prevail in other cases where the behaviour of materials is under consideration. In April of this year the International Association for the Testing of Materials met in London. The work of the conference was closely connected with pure scientific research, depending on results already obtained and suggesting numerous opportunities for the increase of knowledge. It was remarkable that in the case of one material after another the discussion directed attention to the importance of grain-like structure, and showed that the 'grain', if I may extend the word widely from its general use in metallurgy, was the object of attack. Thus in the vast variety of fibrous materials, the fibre corresponds to the metal grain, and its study is quite as interesting and important. In all colloidal problems the condition and properties of the minute particle are fundamental. In materials derived from living organisms, the cell and its parts are the centre of interest; and of course somewhere in the region of which I am speaking are the outposts of life itself. Even in dielectrics and lubricants, the groupings of atoms and molecules determine the general behaviour.

Moreover, a very considerable change in the use of materials for construction has come about in recent years in consequence of the fact that the gradual changes due to time have become really important. The so-called 'creep' of materials is now one of the chief pre-occupations of the engineer. Its new importance is due to two causes. In the first place, the development of machinery has necessitated more perfect fitting, and less allowance for clearance than was at one time the case, as for example in modern turbines and internal combustion engines. In such fine adjustments a creep of one part in a thousand is a very serious matter. In the second place, the working temperatures have been greatly increased, and creep is thereby encouraged. There is no doubt that in any specimen but a perfect crystal slow changes take place continuously. At every moment molecules are being helped over the barriers which have

kept them from positions of greater equilibrium. In this way new crystallizations are set up, or older crystallizations extended. Strain may encourage transfer from one position to another. One might almost say that every portion of a solid is a liquid for a certain fraction of its time, and that the atoms in that portion are capable of a movement which is restricted and guided by the stabilizing action of their surroundings.

The laws which govern these movements are very complicated, and detailed knowledge is scanty though badly wanted. Thus, for example, Dr. Bailey, a pioneer in these matters, finds that the addition of 1 per cent chromium to a 0.5 per cent molybdenum steel increases its initial resistance to creep below a certain temperature and lessens it above. It is probable that the addition of chromium atoms locks the grain structure so long as they stay where they are: but heat facilitates their moving, all the more readily because the complicated alloy has the looser structure. Once they have moved, the material would be better without them. But such a rough explanation would be well set aside for a detailed knowledge of the processes involved. Here are very interesting problems of physics and chemistry.

The careful examination of a visible cellulose fibre shows, it is said by some, that it is built up of lesser fibres, fibrillae or fibrils which again consist of ellipsoidal objects of dimensions roughly 1.5μ and 1.1μ . Each such object may contain many millions of cellulose chains, but very little is known of the structure of the contents or of the sheath that encloses them and seems to be the source of their characteristic influence. Chemical analysis and X-ray examination give a satisfactory picture of the cellulose chain-like molecule, and some information also of the details of the molecular assemblages. But information is wanted respecting the larger groups and the fibril formation on which the fibre properties obviously depend. If the fibre belongs to a living organism, change with time may be synonymous with growth. If the fibre is an element of some material in use, it is still subject to change which may seriously affect its quality.

Change may be external or internal. The slow rearrangements of recrystallization or devitrification are due to internal forces: but surface changes due to reactions with surrounding atoms such as corrosion or hydration may also affect behaviour. Naturally such surface changes are the more important the smaller the particle of the substance, as the colloid chemist points out. Thus, for example, it is a much discussed question as to how clay holds the water that is associated with it. The X-ray analysis supplies a very reasonable picture of the clay crystal; the positions of the

atoms of oxygen, silicon, aluminium, magnesium, iron and the rest are known with considerable accuracy. But the remarkable properties of clay are dependent on the behaviour of the larger flake-like assemblages of colloidal dimensions, which lie between the direct observation of the X-ray methods and those of the microscope.

In dielectrics the slow changes of time bring about rearrangements, hastened by the electrical tensions to which the material is subjected. The electrical forces look for the weakest point for a break-through, just as a stress discovers the weakest point of a chain or any member of a structure. Changes are therefore important. One would wish that a structure was like the "Deacon's shay", which was so designed that every part was as strong as every other so that when the shay came to its end, it became a heap of dust upon the road. Unfortunately, that is not the case with any material in use: and whatever its structure an equal balancing is apt to be destroyed by changes in its grain-like condition.

Perhaps the structure of the huge protein molecules may suggest a way of closing the gap in our knowledge and our means of inquiry. It is a very striking fact that their magnitudes tend definitely to group themselves about certain values, which, moreover, are simply related to one another. They are not mere groups of atoms thrown together without design. Their definite formation implies obedience to rules which must be in force at the beginning of the assembling, and are in force until an unavoidable result is reached. This would mean, as indeed a vast number of observations already imply, that the junction of carbon atoms is

governed by strict geometrical laws of distance and orientation. It has indeed been pointed out by Dr. Wrinch and others that the long chains consisting of two carbons and one nitrogen in regular succession can be formed, under the guidance of the rules mentioned, into space-enclosing sheets presenting an external appearance of linked hexagons, and the number of sizes to which these assemblages can attain is limited. Possibly we have here an example of a form of procedure from the groupings of a few atoms to the larger assemblages of thousands, the process depending on a certain obedience to laws of building which have been shown to hold in the simpler case. We are encouraged to hope that this may be so, by the unexpected strictness and definiteness of the building rules in the cases which fall within the scope of the X-ray methods.

The constitution of the solid body is being examined now as it has never been possible to examine it before. We are not surprised that it is found to possess a grain-like structure, or that this structure is of first-rate importance. It is not only of interest from the purely scientific point of view, but also it turns out to be of fundamental importance to all the constructive work of industry and to all the examinations of living constructions within the domain of biology. In the effort to know its details and to understand their significance a host of interesting scientific inquiries make their appearance, so that industry and science more than ever play into each other's hands. It is certainly to be expected that from these tempting labours there will result much improvement of natural knowledge.

Progress in the Transport and Storage of Foodstuffs

THE work of the Food Investigation Board is carried out in the interests of the general body of consumers in Great Britain and is directed to reducing waste and improving the variety and quality of foodstuffs generally available by the application of scientific knowledge to the problems of storage and transport. The annual report of the Board*, besides describing the Board's activities, includes, in the report of the Director of Food Investigation, a concise statement of the progress of the investigations carried out during the year under review, many of which have not yet reached the stage at which full publication of the results

is feasible. The keynote of the Board's activities in 1936 was its co-operation with other bodies interested in similar problems of food preservation in different parts of the world. The British Commonwealth Scientific Conference met during September 1936, and the members visited the various experimental stations maintained by the Board, namely, the Low Temperature Research Station at Cambridge, the Torry Research Station at Aberdeen, and the Ditton Laboratory at East Malling in Kent. The seventh International Congress of Refrigeration was held at The Hague in June 1936 and was attended by several members of the Department of Scientific and Industrial Research. A number of visits abroad were paid by members of the Food Investigation staff: thus

* Report of the Food Investigation Board for the Year 1936. Department of Scientific and Industrial Research. Pp. 236 + v. (London: H.M. Stationery Office, 1937.) 3s. 6d. net

Dr. A. J. M. Smith proceeded to South Africa to consult with the authorities there on a number of questions relating to the export of foodstuffs; Dr. R. G. Tomkins went to Palestine to discuss questions relating to the transport and storage of citrus fruits; Dr. E. C. Smith was present at the opening of the new laboratories of the Kältetechnische Institut at Karlsruhe, and finally Dr. F. Kidd, superintendent of the Low Temperature Research Station, proceeded to South Africa to act as chairman of a commission set up by the Government there to inquire into matters connected with the export of deciduous fruits.

A 'refresher' course was held at Cambridge, in co-operation with the National Institute for Research in Dairying, the Fruit Preservation Research Station, Chipping Campden, and the Torry Research Station, and was attended by members of the Services, of research associations and of the scientific and technical staffs of various firms. Members of the Engineering Committee attended meetings of a consultative group, consisting of representatives of the manufacture of refrigerating plant, and of the consultative group which represents the shipping industry, thus having brought to their direct notice the actual problems encountered in commercial practice.

The Board has arranged for the preparation of a report dealing with the application of thermodynamical methods to the equilibrium state in biological systems, including industrial applications of the biological sciences, and also of a report summarizing our present knowledge of the chemistry of the apple.

The Board makes a special reference to its relationship with home agriculture, pointing out that the distinction between production, on one hand, and transport and storage, on the other, is justified on the grounds of expediency alone. It is obvious that where the agricultural product is to be stored or to receive other special treatment, production and research in production must have that end in view. Producers require a specification towards which to work; the preparation of that specification is the task of the Board. Although research has not gone far enough to make such specifications possible yet to any great extent, still it is already possible in some measure to specify, in scientific terms, what is required of the producer in an apple for storage, in a fish for smoking, and in a pig for the manufacture of bacon. Such specifications will increase in scope and accuracy as research progresses.

It is possible to refer here only to a few of the results obtained in the many scientific researches carried out by the members of the Food Investigation staff. Some of those with a probable immediate practical application will be selected. From the

results of investigations at the Ditton Laboratory during the past few years, it appears that the pear responds even more favourably than the apple to gas-storage; Conference and William's Bon Chrétien varieties can be stored successfully for several months at 34° F. in atmospheres containing 2.5–10 per cent oxygen and 5–10 per cent carbon dioxide. It appears that the successful achievement of long periods of storage depends to a great extent upon bringing the fruit to gas-storage at a low temperature with the minimum of delay after gathering. After removal from the store the fruit ripens more slowly and therefore allows more time for marketing than fruit that has not been stored in this way. It is hoped that this new knowledge will lead to a considerable increase in home production.

The condition known as 'storeburn' is due to excessive evaporation of water and can be prevented if the foodstuff is suitably wrapped. Aluminium foil covered with waxed paper has been shown to be a suitable wrapping for both frozen lambs' kidneys and Sussex poultry, when stored at –10° C. The birds were trussed and allowed to cool and set (with the heads down) for 16–20 hours at room temperature before storage; after five months the fowls were thawed and drawn. The guts, including the liver, were found to be firm and perfectly wholesome; the birds were cooked and eaten and found to be indistinguishable from freshly killed chickens.

Last year it was reported that muscular tissue from the carcasses of pigs that had been overheated before slaughter had an abnormally high electrical resistance; it has since been found that hams made from these carcasses showed an unusually high incidence of taint. Farm-killed pigs give low values for electrical resistance and a low incidence of taint. The electrical resistance of factory-killed pigs can be reduced to a certain extent by resting the animals before slaughter. The high electrical resistance is associated with a rise in the ultimate pH of the tissue after death—presumably due to loss of glycogen during the exercise taken just before death—and a decrease in the rate of penetration of salt during curing, two factors which predispose to bacterial spoilage.

Other interesting results have been obtained on the retention of fertility in eggs during storage, on the storage of potatoes and broccoli and on the corrosion of the tinplate container used for canned foodstuffs, but for the details of these the original report must be consulted. The extracts already given must suffice to indicate the activities of the Food Investigation staff during the past year.

The Sex-Ratio

AT the recent Nottingham meeting of the British Association, the first morning was devoted by Section D (Zoology) to a symposium on the sex-ratio. This was introduced by Prof. F. A. E. Crew's presidential address, which reviewed the subject in detail and formed an essential part of the discussion as a whole. A number of the facts brought forward by the speakers, and the conclusions drawn from them, merit the attention both of general biologists and of those interested in the various aspects of the population problem.

In man, the secondary sex-ratio, being that which obtains at birth, approaches equality, with a small but definite excess of males. At the present time in England it is approximately 105.6:100. There is no doubt that this is derived from a much higher sex-ratio at conception (the primary sex-ratio) by a differential elimination which favours the female. A continuance after birth of this lower male viability reduces the sexes to equality in late adolescence. Afterwards it reverses the ratio, leading to an excess of females which steadily increases in the higher age groups until there are more than twice as many women as men amongst those aged eighty-five years and more.

The effect of this constitutional difference in vigour is expressed in varying degree. Unsuitable conditions, both before and after birth, tend to enhance it, and a favourable environment will partially, but not completely, obscure it. Furthermore, Dr. W. O. Kermack pointed out that it is subject to secular trends which are reflected in the sex-ratio when studied over long periods.

Two fundamental difficulties are encountered in explaining these facts: the lower viability of the male sex, and its excess at conception. The latter condition is especially remarkable, for the simple chromosome mechanism by which the sexes are controlled seems adapted to ensure their initial equality. Prof. Crew rightly stressed that these two problems can only be interpreted by a comparative study of a wide range of organisms.

The differential viability of the sexes is the more easily approachable subject. Now it may seem that the sex-determining mechanism is itself sufficient to account for this phenomenon, as one of the sexes (the heterogametic sex) possesses but a single X-chromosome. Its partner is the Y-chromosome. This retains a homologous pairing, as well as a non-homologous differential segment; a feature discussed by Dr. P. C. Koller, who showed that it secures the separation of the sex-

determining regions. However, the genes carried in the non-homologous part of X, which is often large, are without corresponding factors, or allelomorphs, in Y. Thus their action, even when recessive, and therefore disadvantageous, cannot be obscured by normal allelomorphs. These, however, prevent the expression of such recessives in the other, or homogametic, sex; for this lacks the Y, being provided with two X-chromosomes. Even here they will occasionally operate, but only when present in double dose, and this is a rare event. There is thus a tendency towards lower viability in the heterogametic sex, which is the male in the human species and other mammals. However, it was shown during the present discussion that this attractive theory is in fact inadequate to explain the departure of the sex-ratio in favour of the female.

This is a conclusion of considerable importance. It was reached by a consideration of the sex-ratio in those forms in which the chromosome mechanism of sex-determination is reversed, the female being the heterogametic sex. If the theory just outlined were an adequate explanation of the facts it seeks to explain, the bias of viability should here favour the male. Two groups of this kind are available for study: the birds and the Lepidoptera. The data on their sex-ratio, supplied respectively by Prof. Crew and Mr. E. B. Ford, indicated that, contrary to expectation, the male still remains the less hardy in these forms.

We must therefore regard the lower viability of this sex rather as an outcome of maleness itself than as a result of a particular chromosome constitution. It has been demonstrated that the metabolic rate of the male, whether heterogametic or homogametic, is higher than in the female, and it appears to be in this greater expenditure that the explanation of his lower viability is to be found. The chromosome mechanism must indeed play a part, in the way outlined, but it seems to be a subsidiary one. It was also suggested that agents such as calcium salts may play a part in determining the sex-ratio, through a differential elimination of the sexes. Further information appears to be necessary before this view can be sustained.

Prof. Crew directed attention to the circumstance that, at least in man, the period when the falling sex-ratio brings about transient equality is that of early sexual maturity. It appears, then, that the various factors controlling the sex-ratio are adjusted by selection to procure an equal number of males and females at the time when, in a primitive

society, reproduction is affected. Dr. J. R. Baker and Mr. A. J. Marshall maintained that the sex-ratio is non-adaptive, a conclusion reached by their studies in the New Hebrides, for their figures indicated an excess of males in most of the species examined there. The sex-ratio of the nestling birds, however, approached equality, and we may perhaps question if the subsequent disparity is not to be accounted for, at least in part, by sexual differences in habit among the adults.

Prof. Crew pointed out that the high sex-ratio

at conception may be explained by the selection of genes tending to produce an excess of Y-bearing sperms, and that such are, in fact, known to exist. Clearly selection would favour a primary sex-ratio high enough to counterbalance, as far as requisite, the lower viability of the male. As explained by Dr. A. Walton, the ease with which the sperms can be subjected to experimental treatment, together with the different physiology of the X- and Y-bearing types, give ground for hope that means may be found for separating them. The artificial control of sex would thus become possible.

Obituary Notices

The Right Hon. Sir Herbert Maxwell, Bt.,
K.T., F.R.S.

SIR HERBERT EUSTACE MAXWELL, Bt., of Monreith, died at his home in Wigtownshire on October 30 at the age of ninety-two years. Notwithstanding his great age, and the predecease of nearly all his contemporaries, he retained to the end a mind and spirit refreshingly youthful. His energy, too, was surprising, and, irrespective of weather, he continued to pay his regular fortnightly visits to Edinburgh, leaving his home at an early hour of the morning, to attend a business meeting.

Neither at Eton nor at Oxford did Maxwell distinguish himself; in fact at neither public school nor university did he complete the normal course, yet notwithstanding his lack of application in his earlier years, a lapse which afterwards he bitterly regretted, such was his natural ability and concentration that he lived to be one of the most brilliant Scotsmen of his age and generation.

On leaving Oxford, Maxwell studied for a time at South Kensington with the intention of taking up painting as a profession, but this aim he relinquished when he married and settled down in the country. To the end of his days, however, he continued to use his talent for painting, and has left behind him a large collection of flower studies, executed with remarkable fidelity, charm and skill. Specimens of his work were exhibited at the Royal Horticultural shows in London and elsewhere in recent years.

In 1880 Sir Herbert was returned to Parliament for his native county of Wigtown, and thereafter he continued as its representative until 1906. He accepted the office of Junior Lord of the Treasury in Lord Salisbury's administration of 1886, and at the same time he was appointed assistant Scottish Whip, a post which he continued to occupy for the nine succeeding years. Though eager for promotion to Cabinet rank, fortune did not favour him, and this he attributed to the fact that his duties as a Junior Lord of the Treasury deprived him of the opportunities of taking any part in debate. Though he was offered various appointments to Colonial

governorships when in the House, he declined them. Not only was he one of the most popular men, but also he had the reputation of being the best dressed man in the House of Commons.

It was not until he was a man of forty that Sir Herbert turned his attention to writing, but from that date onwards anything he wrote readily found a publisher, and his output was exceptional. Works on history, biography, philology, natural history came from his pen, and he will long be remembered by the brilliant series of essays, "Memories of the Months", dealing with every aspect of country life throughout the year. The personality of the author is vividly revealed in the pages of these essays. His keen powers of observation, his sensibility, his knowledge of natural history, his ideals of sportsmanship, his scholarship and his love of the country and the country folk fill the pages. So popular are these essays, and so perennial their interest, that quite recently a fresh issue was made, nearly twenty years after their first publication.

His distinction as a horticulturist was recognized by the Royal Horticultural Society when in 1917 it conferred on him the honour of V.M.H. Besides being the author of "Scottish Gardens", "Trees" and "Flowers", he was a frequent contributor to horticultural periodicals. A singular honour was his election as a fellow of the Royal Society under Statute 12, "in the interests of advancement of natural knowledge".

Archæology appealed to Sir Herbert's mind—the desire to penetrate into the history of his native land behind the written record. The draining of the Loch of Dowalton on the Monreith estate when he was still a comparatively young man and the exposure there of a group of lake dwellings afforded him an opportunity. These and other crannogs were excavated with a party of friends, and were the first structures of their kind to be explored systematically in Britain. A notable collection of relics was recovered which Sir Herbert Maxwell presented to the National Museum of Antiquities of Scotland. At a later date, a valuable collection of relics brought

together by himself was also presented to the same Museum.

As a fellow of the Society of Antiquaries of Scotland, Sir Herbert always took an interest in its proceedings, and in 1901 he was elected president of the Society, a post he occupied until 1918. He was on two occasions, in 1893 and 1911, Rhind lecturer in archaeology. When in 1885 an Archaeological Society was founded to publish accounts of the archaeological and antiquarian remains in the counties of Ayrshire and Wigtown, Sir Herbert was one of the vice-presidents, and for a number of years took up the duties of an honorary secretary. His contributions included an article on the heraldry of Galloway, illustrated with coloured plates prepared by himself.

With these tastes, it was but natural that Sir Herbert should be offered the chairmanship of the Royal Commission on Ancient and Historical Monuments (Scotland) when it was appointed in 1908, an offer which he gladly accepted. For twenty-seven years he presided over the Commission until to the great regret of his colleagues, on the plea 'that it was better to anticipate the failure of his faculties than to outlive it', he resigned. In his parliamentary days he had presided over other Royal Commissions, including that on tuberculosis in 1897. When the Scottish National Library was finally established, Sir Herbert Maxwell, though then eighty years of age, was chosen by the Trustees to be their first chairman. He was appointed lord lieutenant of his county in 1903, and in 1933 he was created a knight of the Order of the Thistle, an honour rarely bestowed on a commoner, and one which gave delight to himself and to a large circle of his fellow countrymen.

It may truly be said that few men by their passing leave such a pleasant memory behind to such a large number of friends as has Sir Herbert Maxwell. He was laid to rest at the little kirk of Kirkmaiden beside the sea, where many of his forebears for three hundred years had preceded him. The procession that followed him to his grave is said to have extended for two miles along the country road, notwithstanding the remoteness of the spot, an indication of the esteem in which he was held.

A. O. C.

Dr. Adolf Lehmann

ADOLF LEHMANN was born in 1863 at Orillia, Ontario, of German parentage. He died in Kingston, Ontario, on September 27, after eight years of invalidism, brought on by a paralytic seizure. His unflinching courage and optimism did not leave him during those long years of inactivity and helplessness.

Dr. Lehmann studied agricultural chemistry at the Ontario Agricultural College, and organic chemistry under Wislicenus at Leipzig, where he worked on the reduction of dibenzene diphenylbutadiene to tetraphenylbenzene. He acted as assistant chemist at the Dominion Experimental Farm at Ottawa, and as chemist at the Agricultural Experimental Station

in New Orleans. In 1898 he went to India to establish a State department of agriculture for the Government of Mysore. His training at Ottawa and New Orleans fitted him for his work at Mysore. His nine annual reports to the Government of the State are filled with data on the growth of such crops as sugar-cane, rice, coffee and sweet potatoes under different conditions of rainfall, amounts of fertilizers, time of planting and harvesting. Analyses of soils, fertilizers, feeds and foods were carried out in great numbers. During this time he developed a method for the estimation of phosphorus in plant and animal material.

On returning to Canada, after a short period as a teacher of organic chemistry at Queen's University, Dr. Lehmann was called to the new University of Alberta to organize the Department of Chemistry. Here he spent his most fruitful years, not only as professor of chemistry, but also, in the earlier years, as provincial analyst and professor of soils. In the new province he stimulated an interest in scientific agriculture by his work in the laboratory and in his contacts with all classes and conditions of people. He made the earliest systematic examinations of the bitumen in the bituminous sand deposits of the Athabasca River, which have intrigued men of science and entrepreneurs for many years. He saw his department grow from a mere handful of students to more than 700 in the eighteen years of his work in Alberta.

Dr. Lehmann was an active and valued member of many scientific societies. Even after soil chemistry came into other hands in the development of the University of Alberta, he maintained his interest in agricultural science and agricultural organizations. But his great service was done in the classroom and with his students and colleagues, whom he inspired by his scrupulous exactness and his devotion to his work. The present writer, who knew him as a colleague, is indebted to a fellow worker with Dr. Lehmann, Dr. O. J. Walker, for much of the above details. In Dr. Walker's words: "His many graduates speak for the interest he gave them in science, for they are scattered over the North American continent, engaged in teaching and in industry. They were always able to feel that their mentor was interested in their activities, and shared in their successes and failures."

We regret to announce the following deaths:

Dr. G. A. Boulenger, F.R.S., formerly in charge of the Reptile Collections in the Department of Zoology, British Museum (Natural History), on November 23, aged seventy-nine years.

Prof. Edward L. Nichols, emeritus professor of physics in Cornell University, on November 10, aged eighty-three years.

Mr. C. G. Rogers, C.I.E., formerly chief conservator of forests, Burma, on November 18.

Sir Seymour Tritton, K.B.E., past president of the Institute of Locomotive Engineers, also known for his work in connexion with the British Standards Institution, on November 19, aged seventy-five years.

News and Views

Pilgrim Trust Lecture

TIME and again in these columns it has been urged that the international character of science gives its disciples a special mission at the present time in promoting co-operation among the nations. Indirectly, by correspondence with other workers and by international congresses, something has been accomplished; individuals of different nationalities have been brought together and have learned to appreciate something of each other's points of view and mode of approach to a problem. There is, however, plenty of scope for further movement on these lines, and we therefore welcome the announcement in the annual report of the Council of the Royal Society that the Pilgrim Trust has agreed to provide 250 guineas a year for six years for an annual lecture, to be arranged jointly by the Royal Society and the U.S. National Academy of Sciences and to be given alternately in London and Washington (p. 979). The fact that a body of the character of the Pilgrim Trust has supported the proposal, and that it was put forward jointly by the two leading scientific bodies of Great Britain and the United States, is of great significance. The foundation of the lecture, coming almost simultaneously with the announcement that negotiations of an economic character are to take place between the two countries, should make even stronger the link binding together the English-speaking peoples of the world in peaceful progress. The first lecture will be given next summer, in London, by an American man of science.

SIR WILLIAM BRAGG made special reference to the Pilgrim Trust Lecture in his presidential address. As he rightly pointed out, these lectures, from the circumstances of their origin, might well be used to mark the progress of science rather than to honour particular scientific workers. They should not be summaries of past work, however important that may be, for other provision already exists for its recognition; rather they should serve to transmit new ideas which have already begun to bear fruit and give promise of wide expansion in the future. By means of the lectures, it will be possible to convey the personal character in the work of a man who opens up a new field of advance, which can only be done adequately by the man himself. Sir William also expressed the hope that the universal wish to promote peaceful relations between the nations of the world may induce other bodies to establish similar lectures. The regular exchange of men able to transmit to other nations the new knowledge which is being gained should indeed be firmly established and recognized by learned academies and by States as a substantial means of promoting progress in all

fields of knowledge, as well as the conditions of peace necessary to secure it.

A Lost Neanderthal Tooth

AMONG the recent accessions to the British Museum (Natural History), South Kensington, some of which are referred to later in these columns, is a molar tooth of Neanderthal man. This tooth has been identified as a 'milk tooth', which originally formed part of a series of palaeontological specimens collected in Gibraltar by Capt. F. Brome, governor of the military prison, and forwarded by him to England in 1865. The tooth was mentioned by Mr. George Busk in 1868, after which date it disappeared and had been lost to science for nearly seventy years. Its recognition is due to Dr. A. Tindall Hopwood of the British Museum, who furnishes the following particulars of the identification. An unworn human tooth, fastened to a small square of blue paper and contained in a cardboard pill-box without lid, was received some months ago in the Department of Geology with various specimens from the Royal Dental Hospital. This, with some others, was passed to Dr. Hopwood for examination. His interest was aroused by a small printed label gummed to the paper and identical with labels on specimens from Gibraltar already in the Museum. This suggested that the tooth might be the one reputed to have been found by Brome, and examination disclosed the correct date (24.2.65) written in ink in the lower left-hand corner and on the back of the blue paper "I'm under six years"—evidently the ground for constant reference to a milk tooth, and leaving little doubt as to the origin of the specimen. Capt. Brome's investigations in the Genista cave, from which the specimens came, lasted over a period of years in the 'sixties of the last century. The cave, which was named "Genista" in his honour, was discovered when the prison, of which he was governor, was being enlarged, and in the course of digging a new tank, fissures were observed in the limestone.

Gibraltar Man

THE gift of this historic tooth of Neanderthal type from Gibraltar to the British Museum (Natural History) serves to recall the fact that it is only by little more than an accident that a certain primitive type of *Homo* is now known specifically as "Neanderthal" and not as *Calpious*, from Calpé, an ancient name for Gibraltar; for the first known example of Neanderthal man came to light in a rock-shelter, or the remains of a cave, in Forbes' Quarry, Gibraltar, in 1848, nine years before the discovery of the type skull in the valley of the Neander in Germany. The history of the discovery was found by Col. E. R.

Kenyon in 1910 in the minutes of the long defunct Gibraltar Scientific Society. The skull was presented to the Society by the finder, Lieut. Flint, its secretary; but its remarkable and peculiar character was not appreciated until long after, when in 1862 it was sent to England by Capt. F. Brome, governor of the military prison, with a quantity of paleontological material which he had obtained from the Genista cave, where he carried on investigations for some years. It was then examined by Mr. George Busk and Dr. G. H. Falconer, who immediately recognized its importance as a new and distinct type of *Homo*, the latter wishing to give it, as already mentioned, specific rank in classification. The skull has since been the subject of study by almost every anthropologist of note from Huxley to Keith; and although it differs from the type in certain respects, and its age is not precisely determinable, all are agreed that it is a pleistocene skull belonging to the Neanderthal group. While some would regard the differences from the type as due to its sex (female) others hold that they are marks of an early and primitive character, such as have since been found in the Neanderthaloid skulls from Palestine. A similar skull, but of a child of five years of age, was found in 1926 by Miss D. Garrod in a recently discovered cave; and in the same stratum were flint implements of late Mousterian type. The original Gibraltar skull was presented by Mr. G. Busk to the museum of the Royal College of Surgeons of England, where it is now exhibited.

Prof. P. M. S. Blackett, F.R.S.

PROF. P. M. S. BLACKETT, of Birkbeck College, University of London, who succeeds Prof. W. L. Bragg in the Langworthy chair of physics at Manchester, is engaged mainly in work on cosmic rays, and it is fair to say that nearly all the cosmic ray research in Great Britain has been done with his advice or under his direction. Blackett's first important scientific work was the development of the Wilson cloud chamber into an automatic instrument for the study of rare events such as close nuclear collisions and nuclear disintegrations. He investigated the energy and momentum relations in these processes in the Cavendish Laboratory between 1922 and 1932. Following the discovery, by Skobelzyn, of tracks ascribed to cosmic ray particles, Blackett devised the counter-controlled cloud chamber in which the expansion is initiated by the passage of the cosmic particle and the track is formed and photographed before the ions are diffused. The counter controlled chamber placed in a magnetic field allows the measurement of the energy of the particles, and Prof. Blackett has been occupied with this method of investigating the cosmic rays since 1933, using latterly the large magnet erected for the purpose for the Royal Society. He had established a school of cosmic ray research at Birkbeck College, and several of his collaborators will continue their work at Manchester. In addition to this main interest, Prof. Blackett has worked on the production and properties of positive electrons and on the specific heats of gases.

Improvements in Television Equipment

It is natural to expect that the continuous operation of a public television broadcasting service in Great Britain will be accompanied by steady improvement in technique and equipment. An outstanding advance in the latter has recently been achieved by the production of the Super-Emitron camera in the laboratories of the Marconi-E.M.I. Television Co., Ltd. This new camera has already reached the stage of practical application, since it was used recently by the B.B.C. in television broadcasts of the Lord Mayor's Show, and of the Cenotaph ceremony on November 11. A brief technical description of the new camera, published in the *Wireless World* of November 18, shows that the major improvement depends upon the separation of the photo-electric screen and the mosaic screen which is scanned by the cathode ray beam. As a result of this separation, the photo-electric surface, upon which the visual image of the scene being transmitted is focused, may be made transparent. In this way, certain limitations placed upon the optical projection system of the present Emitron cameras have been removed; lenses of shorter focal length and wider angle may be used, and even telephoto lenses when required. Further, the separate mosaic screen may be made from substances having high secondary emission, and consequently considerable electron multiplication may be obtained in the tube itself, thus giving additional overall sensitivity. With the new camera, therefore, less illumination of the subject is necessary for the attainment of a good picture if the normal aperture lens system is retained. This is a valuable feature in outdoor broadcasts on dull days, or when using a telephoto lens for the reproduction of distant scenes. If the normal illumination is retained, however, as in studio work, the aperture of the lens can be reduced with a consequent gain in depth of focus.

ALTHOUGH in the United States of America regular television broadcasts have not yet commenced, a considerable amount of research is in progress in the development of television technique and equipment. An additional stage towards the inauguration of a commercial service has been achieved recently by the installation of a high-frequency coaxial cable between New York and Philadelphia, a distance of ninety miles, by the American Telephone and Telegraph Coy. A note from Science Service dated November 10 describes a demonstration in which 240-line television images were transmitted over this cable, which is designed for operation at 1,000 kilocycles per second. Starting in New York, the signals pass through amplifiers about every ten miles. The power for these amplifiers is transmitted through the cable along with the signals, thus making the system independent of any local power source. Special equipment has been designed to prevent the distortion that would otherwise result from the varying velocity of the different signal frequencies along the cable. In the demonstration described, the image reproduced on the cathode ray tube receiver was about eight inches square, and news reels and animated scenes were transmitted over the cable with no important loss of detail.

Marconi and Radio Communication

At a meeting of the Royal Society of Arts on November 10, Sir Ambrose Fleming presented a paper entitled "Guglielmo Marconi and the Development of Radio Communication". The object of the meeting was to commemorate the achievements of the Marquess Marconi, whose work on the practical use of electro-magnetic waves has laid the foundations of a great industry, and provided a means of inter-communication of great importance and advantage to the human race. Sir Ambrose took the opportunity of tracing the early history of electric wave telegraphy, starting with the theoretical work of Clerk Maxwell published in 1865. The experimental demonstration of the existence of electromagnetic waves was provided by H. R. Hertz some twenty years later, and rapid progress was afterwards made by the investigations of Sir Oliver Lodge, Admiral Sir Henry Jackson and other workers.

CONTEMPORANEOUSLY, Marconi was experimenting in Italy and, at about twenty years of age, he came to Great Britain and applied for his first British patent in June 1896. Marconi had a special flair for the practical application of the principles established by others and for overcoming the many and various difficulties encountered in this application. Under his guidance and inspiration, wireless communication advanced rapidly with a continuously widening scope. Sir Ambrose Fleming was personally associated with much of this pioneer work, and he has drawn on this experience with advantage, in presenting an accurate and interesting outline of the progress of radio communication during the past forty years. When the paper is published in the *Journal of the Royal Society of Arts*, it will form a useful historical document, which should prove of great value to the large and rapidly extending class of young radio engineers who are only dimly acquainted with the course of events in the early years of this art.

Science and the Unobservable

At his Friday evening discourse before the Royal Institution on November 26, Prof. H. Dingle discussed "Science and the Unobservable". An outstanding characteristic of modern physics is the application of the principle that only that which is observable is significant. The first example of such application to arouse general discussion was the abandonment by Einstein of the idea of the absolute simultaneity of events at different places, because of the discovery that it was impossible to determine absolutely whether such events were simultaneous or not. This step met with the criticism that since absolute simultaneity in itself was independent of the means available for observing it, it was illegitimate to call the idea meaningless merely because of the limitations of physicists. On the other hand, the followers of Einstein maintained that if the physical world were regarded as including entities or conceptions which were unobservable either directly or indirectly, there was no criterion for distinguishing the real from the unreal.

An analysis of the process of observation shows that unobservables fall into three classes: (1) the *logically* unobservable, namely, that which cannot be said to be observed without breaking the laws of reason, for example, a round square; (2) the *physically* unobservable, namely, that which cannot be observed because no physical means exists by which the observation could be made, for example, absolute motion; (3) the *practically* unobservable, namely, that which cannot be observed because of lack of technical skill, for example, the far side of the moon. The last two classes, however, cannot be distinguished in practice unless we assume that we know completely all the physically possible means of observation which exist. The practice of physics is to reject the logically and the physically unobservable and to accept the practically unobservable. Hence, since physics distinguishes between the physically and the practically unobservable, it must assume that we know completely all the physical means of observation which exist. From the realist point of view, therefore, we are in the dilemma that we must either assume omniscience in this sense, or else confess that we have no guarantee that what we observe has any importance when compared with the equally real physically unobservable part of the universe. The dilemma disappears if we adopt the idealist doctrine that the physical world is a mental construct formed to give rational meaning to our observations. In that case we reject the physically unobservable because our aim is to construct the world out of observation and not out of fancy, and we do not presume omniscience because we erect no barrier against further observations of any conceivable kind. It follows that modern physics is justifiable only in terms of an idealistic philosophy.

Water Supply and Public Works

A SERIES of papers at the recent Public Works Congress dealt with water supply. The connexion between water supplies and town planning was discussed by Mr. G. H. Threlton-Dyer, who pointed out that, with few exceptions, sources of water supply are suspect or actually polluted, and that it is doubtful whether even those which are regarded as safe will remain so under the changing conditions of modern life and the scrutiny of the bacteriologist, who can now detect evidence of contamination which was not revealed by older methods of analysis. It was also remarked that it appears to be inexpedient to use the Town and Country Planning Act of 1932 to reserve areas in town planning schemes with the view of preventing pollution, unless the schemes provide for the payment of adequate compensation to the affected landowners. The possibilities of the Lower Greensand as a source of water supply for Greater London was discussed by Mr. H. Dewey, who concludes that no great reliance can be placed upon this source for such a purpose, although use might be made of it as a source of auxiliary supply. The geological section across the London Basin which was included in the paper would have been enhanced in value had the lower limit of the Lower Greensand been shown on it.

RECENT water shortages in various parts of Great Britain lend significance to the paper by Mr. E. G. Bilham on weather and water supplies, in which it is suggested that although the primary source of our water supplies is rainfall, loss of rainfall by evaporation and by seepage is of major importance, and that it is only possible to study this loss by comparing accurate values of rainfall with similar values of run off. So far, this has only been attempted in the case of the Vyrnwy catchment area. Studies of factors affecting the corrosion of water mains and services are given in a paper by Dr. W. H. J. Vernon and Dr. F. Wormwell, the first portion of which deals with methods of protection of the interior of the pipes, a suggested possibility being treatment of the water conveyed with a view to the elimination of corrosion, and a second method being the application of protective coatings. External corrosion by soil and other causes is also dealt with, together with methods of protection in this instance also.

Fifth Annual Exhibition of Kinematography

THE fifth Annual Exhibition of Kinematography arranged by the Royal Photographic Society was held in the Society's house at 35 Russell Square on November 13-27. The Exhibition included examples of the latest types of kinematographic apparatus, a series of interesting exhibits arranged by technical firms within the industry, together with a comprehensive display of still pictures from recent productions. It was opened by Colonel J. T. C. Moore-Brabazon. In his address, Colonel Moore-Brabazon stressed the importance of kinematography in education, research and in the preservation of records, and paid tribute to the progress which has been made, particularly on the mechanical side and in the general design of apparatus. An interesting series of lectures and demonstrations was arranged to run throughout the course of the Exhibition, on technical subjects connected with kinematography, standard and sub-standard.

It is true to say that this Exhibition succeeded in demonstrating how close is the relationship between the Royal Photographic Society and the kinematograph industry, and how many and great would be the advantages to both of a closer association. In the past a limit has been placed upon the activities of the Royal Photographic Society by the size of the premises at 35 Russell Square. New premises have, however, recently been acquired in which, after reconstruction, there will be three lecture halls, a library, museum, a council room, meeting rooms and a members' lounge, and under these conditions the way will be made easy for further developments. The expense entailed in connexion with the acquisition and reconstruction of the new premises is, of course, very great, and an appeal for funds has lately been launched by the Society. It is hoped that the response will be adequate; science and industry have profited greatly by the advances made in photography, and the premier photographic society in the world deserves well of the community.

The Newcomen Society

AT the annual general meeting of the Newcomen Society, held at the Institution of Civil Engineers on November 17, Engineer Captain E. C. Smith was elected president for 1937-38. In the report of the Council, it was stated that there has been an increase in membership during the year of 149, the total membership now standing at 576, more than half the members residing in the United States. The 300 signed copies of the "Collected Papers of Rhys Jenkins" have nearly all been sold, and *Extra Publication No. 4*, "John Smeaton's Diary of his Journey to the Low Countries 1755", is in the Press. The financial position of the Society is very satisfactory. After the conclusion of the business a paper was read by Captain F. B. Ellison on "The History of the Hay Railway, 1810-1864". This line, more than 25 miles long, was one of the longest of the pre-steam railways. It was built mainly for the conveyance of coal to a district north of Hereford, hitherto served by pack horses. Its terminus was on the Usk at Brecon, to which a canal had recently been made. First surveyed in 1810, the proposal for a railway, or rather tramway laid with iron rails, met with immediate support, among the contributors to the funds being the Earls of Oxford and Ashburnham, the Duke of Beaufort and Viscount Hereford, who was the chairman of the company. An Act of Parliament for the line was obtained in 1811, and tenders were soon afterwards accepted for 2,800 tons of "Cheltenham tram road plates of strong bodied pig iron to be 50 lbs. per plate" and for 20,000 stone blocks weighing 168 lb. each for sleepers. There were several bridges on the line and one tunnel 600 yards long, this being constructed by a miner of Newnham, Gloucestershire. The tramway continued to serve the district until the formation of the Hereford, Hay and Brecon Railway, which bought up the line, sold the tram plates and used the stone sleepers in its bridges; but recently some of the material has been found in good preservation, and many old documents and plans have been brought to light. These are now being preserved in Hereford Museum.

University College, London: Extension of Buildings

UNIVERSITY COLLEGE, London, by the official opening of a further portion of the Foster Court buildings, has reached another milestone in its development. A previous stage of the Foster Court scheme was marked by the opening of the new Department of Zoology by the Chancellor of the University, the Earl of Athlone, in 1933. The chairman of the University Court, Lord Macmillan, opened on December 1, the sections of the general scheme which have recently been completed. These comprise primarily the housing of the Faculty of Laws, the Department of Geography, the Junior Laboratory of the Department of Physics, the East Gallery of the Department of Archaeology, and a library centre for the Foster Court departments. By the terms of the endowment of the Yates-Goldsmid chair of geology and physical geography, the work in physical geography is undertaken in the Department

of Geology. The special task of the Department of Geography is to promote the study of regional and human geography. Hence, the main feature of the design and equipment of the new department is the emphasis placed on maps and on facilities for their study. The Map Laboratory is a spacious room, with natural lighting on three sides, and artificial lighting provided both by ceiling and by adjustable drawing-bench lamps. Adjoining the laboratory is the map store, where the 3,000 maps which form the existing collection of the Department are conveniently housed. A large lecture room, with epidiascope, a smaller classroom, and a small research room with mapping frames, are all on one floor. The private rooms of the staff and the library are on lower floors. The removal of the Departments of Botany and Geology to the parts of the Foster Court territory which have been allocated to them is still a task of the future.

Pontifical Academy of Sciences

THE first annual report of the reconstituted Pontifical Academy (*Annuario della Pontificia Accademia delle Scienze*, 1; 1936-37) has been received. The origin of this Academy, in common with that of the Royal National Academy of the Lincei, can be traced back to the foundation in 1603 by Federico Cesi of the ancient Accademia dei Lincei. Founded in Rome with the object of uniting together those interested in the study of the sciences, the Academy adopted the title "of the lynxes" from the supposed sharp-sightedness of those animals. Many of the most famous men of science of the period became members, amongst them Galileo, who received much support from the Academy. Soon after the death of Cesi in 1630, the activities and influence of the Academy declined, but several attempts at revival were made during the next hundred and fifty years. These efforts had no lasting success, however, until about 1800, when there was a greatly increased activity due mainly to the exertions of Abbot Scarpellini, encouraged by Papal support. Shortly after Scarpellini's death the Academy came under the direct control of the Pontiff, and in 1847 received from Pius IX the title of Pontificia Accademia dei Nuovi Lincei.

WITH the capture of Rome in 1870, the new Italian State took over the major part of the Academy's activities, including its library, and formed the Reale Accademia dei Lincei. The Pontifical Academy continued to exist as a separate body, but with greatly decreased influence. In 1936, Pius XI decided to restore the importance of the Academy and reconstituted it under its present title. The Papal Academy of Sciences now consists of seventy academicians, chosen from among the most distinguished men of science, irrespective of nationality and of religious profession. Actually thirty-six of the members are non-Italian and are representative of thirteen nationalities. The British members are Sir Charles Sherrington and Prof. E. T. Whittaker; the late Lord Rutherford was also a member. The Annual,

which extends to more than 800 pages, contains a brief survey of the Academy's history, a description of its headquarters, the Villa Pia, in the Vatican, and biographical notes and portraits of each of its seventy members.

Agricultural Education

BOTH the need and the difficulty of instructing the farmer in the practical results of scientific research are well appreciated by many agricultural authorities, but few seem to have been so enterprising as the Bacon Development Board, which has sent to us some specimens of its recent publications. The Board has realized that it is at least as important to 'put over' new information to those concerned with advising and educating the farmer as to approach him directly. The agricultural county organizer, like many other expert technical men, is far too busy to read all the original literature, to select from it and make the necessary summaries, and it must therefore be a great boon to him to receive ready-made such summaries and abstracts as are now provided by the research department of the Bacon Development Board. These abstracts, which are issued yearly by the Board in the form of a report, are exceedingly well done: clear, concise and well selected. There are only about one hundred of them, but they are all to the point and make attractive reading, even to the non-expert. Included in the volume (Report No. 7, *Selected Abstracts on Pig Production*, Bacon Development Board, Sept., 1937, price 2s. 6d. post paid) are a thumbnail summary of recent developments, a classified table of contents, and lists of the publications of the Board and of the journals from which the abstracts have been made. Reprints of two outstandingly important scientific papers on pig production have been circulated, as well as brochures on round-worm (*Ascaris lumbricoides*) and the ineconomy of feeding too much protein to pigs. These brochures are not written to 'boost' any product or to subserve any private gain, and therefore they are far more likely to hit the mark than the propaganda efforts of commercial undertakings.

The Norman Lockyer Observatory

IN presenting the annual report and accounts (1936-37) of the Norman Lockyer Observatory, the council thanks the new director (Mr. D. L. Edwards) and his small staff for the work carried out under the difficult conditions consequent upon the death of the late director, Dr. W. J. S. Lockyer. Reference is made to the new sensitometer recently added to the equipment of the Observatory, which will make possible the development of quantitative work at Sidmouth over a wide range of the spectrum. Through the generosity of Sir Robert Mond, Prof. F. I. Blumberg is working at the Observatory as a research associate. The council expresses its view that the best tribute that could be paid to Dr. Lockyer's devoted services would be in the development of the Observatory, which retains so many marks of his attention, care and vision.

Acquisitions of the British Museum (Natural History)

THE Department of Geology has recently acquired, through the generosity of the Medical Committee of the Royal Dental Hospital, a molar tooth of Neanderthal man discovered in Genista Cave, Gibraltar, in 1885 by Capt. F. Brome, governor of the Military Prison. The most interesting recent acquisition in the Department of Minerals is a gilt brass model of a gold nugget from the foot of Croghan, Kinshela, near Arklow in County Wicklow. The original nugget was found in 1795. It was said to have weighed 22 ounces and to have been given to King George III by Abraham Coates in 1796. A model is preserved in Trinity College, Dublin, and a plaster model was presented to the British Museum in 1910. The new model is presented by Lord Seaton. Two fine specimens of hydromuscovite with pyrite and arsenopyrite from the Roman Deep Mine, Ogofau, Carmarthenshire, and specimens of a New British mineral, russellite, a mixed crystal of bismuth and tungstic oxides, from Cornwall, are the most interesting of the other British additions. Natural glasses of problematical origin generally classed as tektites continue to appear in various parts of the world. Through Dr. Spencer, forty-eight specimens of natural glass from Java have been presented by Dr. G. H. R. von Koenigswald. Prof. Sauer of Vienna has presented a piece of the so-called köfelsite—a fused gneiss from the supposed meteorite crater at Köfels in the Austrian Tyrol. The Department has acquired by purchase some fine groups of cassiterite from Bolivia from Messrs. Gregory and Bottley and has also secured the greater part of the collection of Hugh Septimus Gordon, who specialized in collecting and studying the minerals of the rare earths.

Excessive Marine Growth in Shoreham Harbour

A SHORT time ago a letter appeared in the Press stating that coral was growing in the Southwick basin of Shoreham Harbour, Sussex, and was causing considerable trouble by fouling the bottoms of yachts and small boats lying in this part of the harbour. The Southwick canal, or basin, is locked off from the rest of Shoreham Harbour, its waters being kept at a constant level and free from tidal rise and fall. The sea water in the basin is used to cool the condensers of the Brighton and Hove electric power station, which is situated on its seaward side with coal wharves on the basin. Being of limited area, the water in the basin is appreciably warmed by this means, and is said not to fall below a minimum of about 65° F. At first this growth was thought to be a tropical reef-building coral which had somehow managed to survive the passage from Pacific or West Indian seas on the bottom of a yacht about a year ago, and was able to thrive in the comparatively warm waters of the basin.

THE British Museum (Natural History) was asked to investigate, and Mr. Dilwyn John is at present collecting specimens of the local marine fauna and flora living under the peculiar conditions occurring in the Southwick basin. The 'coral' turned out to

be an excessive growth of a polychaete worm, closely resembling *Hydroides norvegica* Gmnerus (Serpulidae), which lives in tubes of a calcareous nature. It is possibly a species new to science, and is being described by Mr. C. C. A. Monro of the British Museum (Natural History). The growth consists of dense brittle clusters of the white tubes of this worm, which grow to approximately 9 cm. long and average 1 mm. in diameter, and are usually cemented one to another. It occurs more frequently around the water-line of floating objects than on piles or the keels of boats, which appears to indicate that light and aeration are favourable to its growth; but the warm water of the Southwick basin seems to be the chief cause of its present excessive development. Perhaps after a full investigation other less conspicuous marine organisms may be found to be behaving in a peculiar manner on account of the interesting conditions occurring in this part of Shoreham Harbour.

Registration and Population Trends

A PAPER read by Dr. R. R. Kuczynski before the Eugenics Society on future trends in population is published in the *Eugenics Review*, 29, No. 2. He points out that in 1837 an Act was passed for registering births, deaths and marriages in England, more than sixty years after such demographic data were recorded in Sweden. His address is mainly devoted to showing the inadequacy of the records as kept in Great Britain compared with those of various other countries, our original birth and death registration forms having remained unaltered up to the present time. The age of the mother at the birth of each child was recorded in Sweden so early as 1774, and in 1839 the Compiler of Abstracts in the General Register Office wrote a letter to the Registrar-General pointing out two grave defects in the records, but nothing has been done. The need is stressed particularly for recording the age of the parents, especially the mother, at the birth of each child, the order of birth and the duration of the marriage, as well as the date of birth. Without such data it is impossible to determine questions of differential fertility and population growth or decline. Various suggestions are made, including that of a special fertility census in December 1938. We should then have within three years a fair knowledge of present fertility trends, on which a Government population policy could be formulated with some chance of success.

Conference on Atmospheric Pollution

THIRTY-SIX representatives of local authorities and other organizations co-operating with the Department of Scientific and Industrial Research met on November 29 in the half-yearly conference. Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, presented the report on the progress of the investigations carried out under the Committee. He spoke in particular of the results which are being obtained in the special survey which is in progress in and around the City of Leicester. Two sources of atmospheric pollution which occur in

certain districts were also discussed. It was agreed that a letter be addressed to the Ministry of Health protesting against the continuation of nuisance arising from burning colliery spoilbanks and urging that action be taken to end it. It was also agreed by the representatives to ask the Department of Scientific and Industrial Research to consider and report on the possibility of research being undertaken to develop remedial measures to prevent nuisance caused by zinc oxide fumes in certain stages of the manufacture of brass.

Chronica Botanica

FROM February 1938, *Chronica Botanica* will be issued bi-monthly and no longer as a yearbook. The annual subscription will be reduced from 15 to 7 guilders. The new periodical will continue to give all the essential information which was given in the old yearbook and will include some important new sections. Results of research will be published only in the first two sections. The world list of plant science institutions and societies will appear as an annual supplement. The reorganized *Chronica* will contain short preliminary notes on the results of recent research or announcing new discoveries; discussions, announcements, letters to the Editor; detailed programmes, short reports, decisions, resolutions of international congresses; quotations from recent articles of general and timely interest; personal notes and queries; short reviews of new botany books, etc. The address is P.O. Box 8, Leyden.

Anti-Gas Training and Defence

THE Home Office has published a memorandum summarising in convenient form the more important information that has already been issued in various circulars of the Air Raid Precautions Department (Air Raid Precautions, Memorandum No. 5. London: H.M. Stationery Office. 4d. net). It outlines the suggested organization and arrangements for local anti-gas training. For districts where no gas chamber is available for the training, the Home Office has provided a fleet of 40 motor 'gas vans', by means of which instruction is given in the use of the respirator in an atmosphere of tear gas. In a report, just issued, describing experiments conducted by the Chemical Defence Committee with the object of testing the recommendations made by the Air Raid Precautions Department, it is concluded that sealing a room in the manner suggested, and the use of a gas-mask of the pattern which is being prepared, will give a high standard of protection against aerial gas attack.

Announcements

MR. C. FORSTER COOPER, F.R.S., director of the University Museum of Zoology, Cambridge, and reader in vertebrate zoology in the University, has been appointed director of the British Museum (Natural History) in succession to Dr. C. Tate Regan, F.R.S., who retires on February 2, 1938. Mr. Forster Cooper's zoological work has been concerned mainly with the vertebrates, both recent and fossil.

THE Medal of the Institution of Mining Engineers has been awarded to Dr. Carl Beyling, director of the Experimental Station at Dortmund-Derne, in recognition of his services in the application of scientific knowledge and research to safety and health problems in coal-mining, and to Dr. R. V. Wheeler, professor of fuel technology in the University of Sheffield and director of the Safety in Mines Research Board Experimental Stations at Sheffield and Buxton, in recognition of his services in the application of scientific knowledge and research to problems of safety and health in coal-mining, and of the utilization of coal.

MR. D. P. Costello, of Trinity College, Cambridge, has been awarded the Royal Asiatic Society's Universities Essay Prize for 1936-1937. The subject of his essay was "The Relations of the Greeks with the East". The other essays submitted were of such a high standard that the Council of the Society is also awarding a special second prize to Mr. John Bowman, of the University of Glasgow, for his essay on the alternative subject "Tamerlane".

PROF. A. S. EVE has undertaken the preparation of the authorized life of Lord Rutherford of Nelson, and it is to be published when completed by the Cambridge University Press. It is earnestly requested that any correspondents who have letters, written by Lord Rutherford, which throw light on his life and work, will forward them as soon as possible to Prof. Eve, 26 Willow Road, Hampstead, N.W.3. Original letters will be promptly returned if requested.

APPLICATIONS are invited for the David Anderson-Berry Gold Medal, together with a sum of money amounting to about £100, which will be awarded in July 1938 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases. A similar award will be made every three years. Further information can be obtained from the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh, 2.

THE following have been elected officers for 1937-38 of the University of Durham Philosophical Society: *President*: The Very Rev. O. A. Alington; *Hon. General Secretary*: Dr. W. A. Clark; *Hon. Treasurer*: Mr. J. W. Bullerwell; *Editor*: Prof. G. W. Todd; *Assistant Editor*: Mr. J. F. Wood; *Hon. Librarian*: Mr. E. Patterson.

THE annual meeting of the Science Masters Association will be held in the Chemistry Department of the Imperial College of Science and Technology on January 4-7. Sir Cyril Ashford will deliver his presidential address entitled "Past and Future Aims of School Science" on January 4. Further information can be obtained from Mr. R. E. Williams, 15 Norham Gardens, Oxford.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 975.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Relation between 'Fibrous' and 'Globular' Proteins

ON various occasions in NATURE and elsewhere it has been argued that the elastic fibrous proteins, keratin and myosin, by virtue of the system of intra-molecular folds which appears to be their characteristic stereochemical feature, are the linear prototype of the globular proteins, which presumably are constructed to similar principles but in two or three dimensions¹. Direct experimental support for this view comes from X-ray studies of the denaturation of the globular proteins, which show that the change always results in the appearance of polypeptide chains, which can often be drawn out into artificial fibres analogous to β -keratin or β -myosin². It has also been recognized for some time that feather keratin³ in particular is to X-rays really both fibrous and globular, and more recently the early observation of long spacings in the keratins has been supplemented by the discovery of even longer spacings in these and other protein fibres⁴. The tobacco mosaic virus⁵ is another protein which has properties both fibrous and globular⁶—and, to cut a long story short, it looks now as if the original apparent distinction between the two types is beginning to disappear. One possible way, based on density and other considerations, of deriving a general scheme directly from keratin⁷ amounts actually to building up molecules having essentially the structure deduced from X-ray data for the keratin *crystallites*, and this suggests at once the idea that *the protein fibre crystallites and the tobacco virus units fall into the same category*.

The recent work of Bergmann and Niemann⁸ also indicates that both fibrous and globular proteins are constructed to a common plan, or at least that some common factor is involved in their method of synthesis. Bergmann and Niemann conclude that both the total number of amino-acid residues in a protein molecule and also the numbers of each of the various residues are expressible in the form $2^a 3^b$. On this basis, the minimum molecular weights of chicken egg albumin, cattle haemoglobin, cattle fibrin, and silk fibroin are found to correspond to 288, 2×288 , 2×288 , and 9×288 residues respectively, which is equivalent to saying that *chemical analysis places not only two globular proteins—which would be expected—but also two fibrous proteins in one and the same scheme of multiple molecular weights*, the Svedberg scheme in fact, founded on ultracentrifugal studies of the globular proteins.

Now X-rays offer a way of supplementing the Bergmann argument, which requires a knowledge of the average residue weight, though there is no way of knowing this directly by chemical means owing

to incomplete analyses. For β -keratin, for example, the average residue weight can be calculated from the density (for an estimate of the density of β -keratin I am indebted to Mr. H. J. Woods) and the X-ray measurements of the average residue dimensions. The best available data make it equal to $(9.7 \times 4.65 \times 3.33 \times 1.3)/1.65$, or about 118, corresponding to approximately 0.85 gram-residues per 100 gm. of keratin. The number 0.85, when divided by values of $2^a 3^b$, should give the numbers of gram-residues of the various acids in 100 gm. of keratin. The accompanying table shows the results, to be discussed elsewhere, of the calculations for wool keratin:

Acid		Frequency	Gm.-res. in 100 gm. wool	
			Calc.	Obs.
A—	Glutamic	8 (2 ³)	0.106	0.103
	Arginine	16 (2 ⁴)	0.053	0.059
	Aspartic	16 (2 ⁴)	0.053	0.064
	Tyrosine	32 (2 ⁵)	0.027	0.027
	Lysine	48 (2 ⁴ .3)	0.018	0.019
	Tryptophane	96 (2 ⁵ .3)	0.008 ₄	0.009
	Histidine	192 (2 ⁶ .3)	0.004 ₄	0.004
B— Amide-N		9 (3 ²)	0.094	0.098
C—	Cystine†	8 (2 ³)	0.106	Mean value
	Methionine	192 (2 ⁶ .3)	0.004 ₄	Mean value
D—	Leucine	9 (3 ²)	0.094	0.088
	Alanine	16 (2 ⁴)	0.053	0.060
	Proline	24 (2 ³ .3)	0.035	0.038
	Serine	32 (2 ⁵)	0.027	0.028
	Valine	36 (2 ³ .3)	0.024	0.024
	Glycine	96 (2 ⁵ .3)	0.008 ₄	0.008

† Calculated as half-cystine residues.

It will be seen that the measure of agreement is quite good, and though it is difficult yet to prove that only powers of 2 and 3 are involved, there is sufficient evidence to warrant the belief that keratin also will be found to conform to the common stoichiometric plan. The following points may be noted with regard to the experimental data presented: (A) These are the most reliable, and require a molecule containing a minimum of 192 residues, including 17 basic residues. The equivalent weight comes to about 1,330, which agrees reasonably well with the estimate (about 1,250) given by acid absorption⁹. (B) If the number of amide groups is also a submultiple of the total number of residues, which is not unlikely, the latter would then be at least 2×288 (mol. wt. about 68,000), corresponding to haemoglobin and fibrin. (C) The variable sulphur content of the keratins is a difficulty at the moment, for the cystine values do not fall into a limited number of groups corresponding to 1/6, 1/8, 1/9, etc., as might be expected, though the mean estimates, both for cystine and methionine, agree roughly with the theory. It might be argued that there is a mixture of proteins each obeying the same law, but in that case there is going

* I am under the impression that I am responsible for the original use of the word 'globular' in discussing protein types¹; but of course it was never meant to imply the spherical shape only, but rather something bulky, as opposed to an extended molecular chain like cellulose.

to be trouble all round, and any number, whether belonging to the series $2 \cdot 3^n$ or not, could be claimed to fit the theory. It may be, though, that this really is the correct general solution, that the numbers of amino 'sites', as in alloys and mixed crystals, are expressible in the form $2 \cdot 3^n$, or whatever the law should turn out to be. The law would then be directly apparent in ideal or limiting cases only. (D) These data are probably unreliable.

In explanation of their results, Bergmann and Niemann¹ propose the hypothesis that "in every protein each amino acid residue is distributed throughout the entire peptide chain at constant intervals. The protein molecule therefore contains a great number of superimposed frequencies". But is not this impossible? The periods 8 and 9, for example, must 'clash' before we come to 72; and in general such a hypothesis involves more than one residue occupying the same place in the peptide chain. Again, Bergmann says¹⁰, "The presence of so complicated a periodicity explains why the problem of X-ray photography is so different for proteins than in the case of substances with simple periodicity". But is it?

However, quite apart from these questions, it seems clear that we are now on the fringe of something very fundamental indeed in protein theory, and the moral value alone of Bergmann and Niemann's discoveries will be immense. Exact analyses of the proteins, though always laborious, need no longer be the thankless tasks they have been. There is a goal in sight.

I should like to express my indebtedness to Dr. J. B. Speakman and Prof. A. C. Chibnall for advice on chemical points.

W. T. ASTBURY.

Textile Physics Laboratory,
University,
Leeds.
Nov. 8.

¹ Astbury, W. T., and Lomax, R., *NATURE*, **123**, 795 (1934). See also *NATURE*, **127**, 803 (1936); *Chem. Weekl.*, **33**, 778 (1936).

² Astbury, W. T., and Lomax, R., *J. Chem. Soc.*, 846 (1936); Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **20**, 2351 (1936).

³ Astbury, W. T., and Marwick, T. C., *NATURE*, **120**, 309 (1932); Astbury, W. T., *Trans. Farad. Soc.*, **29**, 193 (1933); *Kolloid-Z.*, **69**, 340 (1934); *Chem. Weekl.*, **33**, 778 (1936).

⁴ Clark, G. L., et al., *J. Amer. Chem. Soc.*, **57**, 1500 (1935); Corey, R. B., and Wyckoff, E. W. G., *J. Biol. Chem.*, **114**, 407 (1936).

⁵ Bawden, F. C., Pirie, K. W., Bernal, J. D., and Fankuchen, I., *NATURE*, **123**, 1051 (1936); Bernal, J. D., and Fankuchen, I., *NATURE*, **120**, 923 (1937); Best, R. J., *NATURE*, **120**, 528 (1937); **140**, 547 (1937).

⁶ Astbury, W. T., *NATURE*, **127**, 803 (1936).

⁷ Bergmann, M., and Niemann, O., *J. Biol. Chem.*, **115**, 77 (1936); **118**, 301 (1937); *Science*, **86**, 187 (1937).

⁸ Speakman, J. B., and Stott, K., *Trans. Farad. Soc.*, **30**, 539 (1934); *Id.*, **1425** (1936).

⁹ Bergmann, M., and Niemann, O., *J. Biol. Chem.*, **118**, 307 (1937).

¹⁰ Bergmann, M., *Harvey Lectures*, **81**, 56 (1935-36).

Diffraction of Light by Ultrasonics at Oblique Incidence

It is well known that the first simplified theory of the diffraction of light by ultrasonics, which Sir C. V. Raman and N. S. Nagendra Nath¹ put forward in 1935, explains many experimental facts in a very striking way. The main point of the theory is to neglect the bending of the light-rays in the sound field altogether and to attribute the observed effects wholly to the local variations of the optical length in the sound-wave. If a plane light-wave falls

normally on a sound-wave, the incident wave-front becomes a periodic corrugated wave-front. At oblique incidence it follows from this theory² that the corrugation vanishes for certain angles of incidence φ_n which satisfy the equation

$$\tan \varphi_n = n \frac{\lambda^*}{L}; \quad n = \pm 1, \pm 2, \dots \quad (1)$$

in which λ^* denotes the wave-length of the sound and L the breadth of the sound field; consequently there should be no diffraction spectra visible when the light is incident in any of these directions.

This consequence of the theory has never been verified experimentally. The vanishing of the diffraction effect at these angles of incidence can be seen at once by the use of divergent light and of a suitable optical arrangement (Fig. 1). An image of

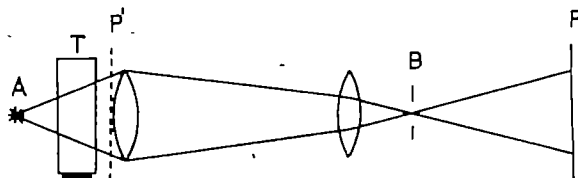


Fig. 1.

a point-shaped light-source A is formed in the plane B . The trough T with the liquid, in which the ultrasonics are generated, is placed in the divergent part of the light-ray. An image of a plane P' behind T is formed on the photographic plate P . On exiting the sound field, a number of diffraction spectra are produced in the plane B , one of which is transmitted by a suitable slit. The intensity distribution of the light falling on P is then an image of the intensity distribution of the light of this diffraction spectrum in P' . The dark bands visible in P correspond to the angles of incidence φ_n for which no diffraction takes place. A photograph, which was taken with sound-waves in water at a frequency of 15,000 kilocycles with a first-order spectrum is reproduced in



Fig. 2.

Fig. 2. In conformity with the theory, the angles φ_n are independent of the intensity of the sound-wave and the wave-length of the light used. The dependence of φ_n on λ^* is also in accord with equation (1). This has been verified in the range 4-15 thousand kilocycles, that is, for frequencies which are much higher than the domain of validity of this simplified theory with regard to other diffraction phenomena³. The dependence of φ_n on L is also in conformity with (1). The accuracy of these measurements is ± 5 per cent; for more exact measurements, an arrangement using parallel light would be preferable.

If the intensity of the sound is sufficiently high, the superposition of the intensities of all diffraction spectra gives rise to a phenomenon which has recently been described by L. Bergmann and H. J. Goehlich⁴.

It should be emphasized that the experiments can only be carried out with an exactly plane sound-wave. Consequently a piezoquartz from Messrs. Carl Zeiss of Jena was used, which was cut according to the prescription of H. Straubel⁵. With an ordinary quartz plate one gets very distorted figures.

A detailed account of these experiments will appear shortly in *Helvetica physica Acta*.

F. LEVI.

Physikalisches Institut der Universität,
Zürich.
Oct. 30.

¹ Raman, C. V., and Nagendra Nath, N. S., *Proc. Ind. Acad. Sci.*, **2**, 406, 413; **3**, 75.

² *Proc. Ind. Acad. Sci.*, **2**, 413.

³ Bär, R., *Helv. phys. Acta*, **9**, 265 (1936).

⁴ Bergmann, L., and Goehlich, H. J., *Phys. Z.*, **38**, 9 (1937).

⁵ Straubel, H., *Z. Hochfrequenz.*, **23**, 14 (1933).

The Paramagnetic Magnetron Numbers of the Ferromagnetic Metals

THE paramagnetic magnetron numbers of the ferromagnetic elements are derived from the linear portion of the $1/\chi, T$ curves above the Curie point. Of the three ferromagnetics cobalt, iron and nickel, only in the case of one, nickel, is the slope known with any degree of certainty. In the case of iron, Curie point 780°C ., the phase change at 920° so restricts the temperature range over which measurements can be made that the $1/\chi, T$ curve never becomes linear. The high Curie temperature of cobalt at about 1150°C . makes precise measurements difficult, largely owing to evaporation and solid diffusion.

We have developed a method using a magnetic balance devised by one of us¹, for measuring accurately susceptibilities up to 1500°C . Evaporation of the specimen is to a large extent eliminated by using an atmosphere of argon at low pressure. The method has been used successfully to measure the magneton numbers of iron and cobalt, and to extend the temperature range of measurements on nickel.

It is well known that the α and δ phases of iron are identical (body-centred cube), and the intervening γ phase, which persists from 920° to 1390°C ., can be removed by the addition of various metals which are soluble in the iron. The system iron-vanadium was chosen, in which about 5 per cent vanadium removes the γ phase completely. Our experiments show that the $1/\chi, T$ curve is linear above 900°C . The results for three different alloys are given in the accompanying table, from which the extrapolated value for pure iron is obtained. The second column gives the paramagnetic Curie temperature θ , whilst the third column gives the Curie constant per gram $C = \chi(T - \theta)$. In the fourth column are the values of the magneton number $p = \sqrt{8KC/N\mu^2}$, where K is Boltzmann's constant, N the number of atoms per gram, and μ the Bohr magneton $eh/4\pi mc$. It is worthy of note that the curve in the δ phase of iron (99.97 per cent pure) is linear, and when extrapolated to lower temperatures joins the α phase at the A_1 transformation. The value for the magneton number thus obtained is in close agreement with the value determined from the alloys.

Our measurements show that the curve for cobalt (99.8 per cent pure) is quite linear between 1230° and 1450°C ., the upper limit of our observations on this metal. It was observed that continued annealing of the (electrolytic) specimens produced parallel but displaced lines on the $1/\chi, T$ graph, usually tending to lower the paramagnetic Curie point. These changes do not affect the Curie constant, whilst the Curie temperature ranges from 1130° to 1155°C .

The results on nickel agree with those of earlier workers up to 850°C ., a linear relationship being followed from 500°C . Above 925°C . the slope decreases, giving a change in the Curie constant from 0.00548 to 0.00685.

A full account of the experiments, together with discussion of the results, will appear elsewhere.

	θ	$C = \chi(T - \theta)$	$\sqrt{8KC/N\mu^2}$
Nickel $500^\circ\text{--}850^\circ\text{C}$.	377°C .	0.00548	1.61
925°	265°C .	0.00685	1.78
Cobalt $1230^\circ\text{--}1450^\circ\text{C}$.	$1130^\circ\text{--}1155^\circ\text{C}$.	0.0206	3.16
Iron-Vanadium 5%	928°C .	0.0232	3.16
4.1%	838°C .	0.0224	3.17
2.5%	828°C .	0.0225	3.18
(extrapolated) 0%	—	0.0227	3.20
Iron from δ phase	630°C .	0.0220	3.15

W. SUCKSMITH.

R. R. FRABOE.

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University, Bristol.

¹ Sucksmith, *Phil. Mag.*, **3**, 158 (1929); **14**, 1115 (1933).

Joule-Thomson Effect and Quantum Statistics

IN view of the numerous physical and astrophysical applications of the new quantum statistics it may be worth while to investigate the Joule-Thomson effect for a gas obeying Fermi-Dirac or Bose-Einstein statistics. The calculation is simple and runs on the usual lines. The results obtained are quite interesting. It is found that for a degenerate gas, degenerate in the sense of Fermi-Dirac statistics, Joule-Thomson expansion produces a heating effect, the rise in temperature for a given fall in pressure being greater, the greater the degree of degeneracy of the gas. In fact

$$\left(\frac{\partial T}{\partial p}\right)_i \doteq - \frac{g}{\pi k n} \left(\frac{3A_0}{4\pi}\right)^{1/2} \\ = - \frac{3}{8\pi^2} \left(\frac{4\pi g h^3}{15 m}\right)^{1/2} \frac{h^2}{m k^2 T p^{1/2}} \dots (1)$$

where n denotes the number of particles (each of mass m) per unit volume, p the pressure, T the temperature, g the weight factor (for electrons $g = 2$), k the Boltzmann constant and h is Planck's constant. A_0 is called the "degeneracy discriminant" and its value gives a measure of the degree of degeneracy (or of non-degeneracy in the case of non-degenerate gas).

$$A_0 = \frac{\pi h^3}{g(2\pi m k T)^{3/2}}$$

For degeneracy $A_0 \gg 1$, and in non-degeneracy $A_0 \ll 1$.

It may be remarked for comparison that an adiabatic expansion produces cooling. In fact, as is easily seen, during an adiabatic process a degenerate

gas will remain degenerate and a non-degenerate gas will remain non-degenerate, the value of A , remaining constant during the process.

In the case of *non-degeneracy*, the Joule-Thomson effect is given by the relation

$$\left(\frac{\partial T}{\partial p}\right)_H = -\frac{\beta A_0}{2^{3/2}nk} \\ = -\frac{\beta h^3}{2^{3/2}g(2\pi m)^{3/2}k^{3/2}T^{3/2}} \quad (2)$$

where β is to be taken as $+1$ for a gas obeying Fermi-Dirac statistics and as -1 for a gas obeying Bose-Einstein statistics. It is of interest to note that the *Joule-Thomson effect is independent of the pressure, and further it vanishes only when $T \rightarrow \infty$.*

In order to illustrate the order of magnitude of this effect, let us take the case of helium at 5°K . Helium obeys Bose-Einstein statistics and hence, taking $\beta = -1$ and substituting numerical values for the quantities involved, we find

$$\left(\frac{\partial T}{\partial p}\right)_H = 0.076^\circ/\text{atmos.}$$

However, this will not represent the thermal effect actually observed, which will depend largely upon the Van der Waals' type of deviations from the classical perfect gas. It is difficult to estimate exactly the contribution due to Van der Waals' deviations, but if we use the ordinary formula¹ to obtain some idea of it, we find (taking Van der Waals' $a = 0.034 \times 10^6$ atmos., $b = 23.7$ cm.³) a value of $0.7^\circ/\text{atmos.}$ for helium at 5°K . The Van der Waals effect is much the larger, but the statistical effect is still 10 per cent of it. It therefore seems possible that the Joule-Thomson effect under suitable conditions may provide an experimental test of the statistics obeyed by gases, say, helium.

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B. N. SRIVANAVA.

Physics Department,
University, Delhi.
Oct. 14.

¹ Saha and Srivastava, "A Treatise on Heat", 476 (1935). We use the approximate equation in which the temperature is supposed small compared to unity.

Interpretations of Atomic Constitutions

PROF. ANDRADE has had the great courtesy to attempt to answer my two questions in NATURE of November 20, they are:

(1) Whether the theory of the electrical composition of matter now fails.

(2) The difficulty of the nucleus tightly packed with protons.

Prof. Andrade avoids my first question in the most accomplished parliamentary form, telling me that in future I must not look on electricity as a fluid, and ask for a pot, pint, or firkin thereof. Interesting and informative, but the position is that the physicists announced to the world the electrical composition of matter. I did not do it. Why should I be lectured? Now when the non-electrical neutron is established I ask a simple question: Have they been talking nonsense or not? The general impression I get from Prof. Andrade is that they have. If so, the sooner they announce it the better.

Now as to the nucleus.

Prof. Andrade, when I get him into a difficulty over the protons packed together, answers with the readiness of a cash register, "No charge". But I notice the charge, with its defensive field, is still there to account for the superior penetration of the neutron over the proton in hitting and disintegrating the nucleus in bombardment.

Apparently the physicist changes the conditions at any time he likes to suit his convenience, but you cannot have it both ways. The quotation from Rutherford seems to me extremely sane, to the point, and logical. Referring to the nucleus he says it is "held together by very powerful unknown forces". If everyone was as frank as that and confessed to difficulties instead of riding round them, the popular explanation of modern physics would be no less attractive and a good deal clearer.

I hope these somewhat harsh words in debunking the physicists will not be construed as an attack on Prof. Andrade. Alone, valiantly he has come forth to break a lance with me and I respect and admire him for it. In his concluding paragraph he asks me for information on one of my subjects, namely, foreign policy, over the last ten years. It being near Christmas time, mutual help seems only seasonable.

Macroscopic events, ethnical considerations, and crowd psychology are subjects that the simple physicists will not understand, therefore I will try to tell the story in their own language.

Europe may be looked upon as a nucleus composed of individual protons, not however all of the same size or power, mixed up with a few neutrons with no charge and little mass. This is kept together by a strong force which prevents them flying apart, known as geography. This nucleus is not symmetrical as, included on its western edge, is a particularly powerful proton that has "wave characteristics" of a definite type peculiar to itself. In the south there is what might be called a neutrino¹. This has, some think, also wave mechanic aspirations. It is peculiar in this respect that its core is eternal² but its surround, some think, is ephemeral.

Now the real trouble is that just as in the atom there are electrons in their orbits far away from the nucleus, so in this case there are colonies also revolving. These used to be attached, so to speak, to separate protons, but some years ago the nucleus was subjected to a terrific bombardment which shifted these electrons from belonging to one proton to another. One very powerful proton, in mathematical language generally designated thus $\frac{1}{2}$, suffered severely in this respect, with the result that the nucleus as such is no longer stable. It has been found, however, that if the western proton adds to its charge³, although a state of strain between the two protons is introduced, the nucleus qua nucleus becomes more stable.

I hope I have put this very difficult problem in simple terms for the physicists. I would have liked to have said a word on Newton's laws of gravity, as Prof. Andrade mentions them, but I feel that you, sir, must have your own laws on the same subject and that I am straining them.

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Nov. 22.

J. T. C. MOORE-BRABAZON.

¹ Britain.

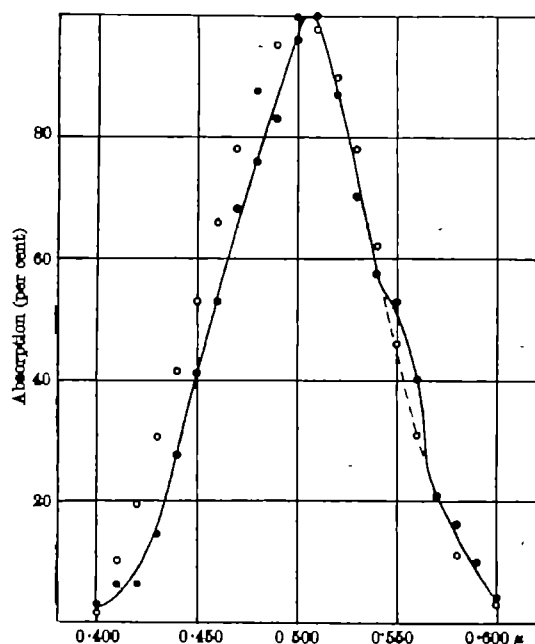
² Italy.

³ Rome.

⁴ By re-arming.

Absorption Curve for Visual Purple and the Electrical Response of the Frog's Eye

LETTERS in NATURE by Dartnall and Goodeve¹ and by Wald² have revived the question concerning the physiological significance of visual purple and visual yellow. Dartnall and Goodeve discuss the scotopic luminosity curve and compare it with the absorption curve for amphibian visual purple, determined by Lythgoe³. Attention may perhaps be directed to the fact that the retinal equivalent of the frog's luminosity curve has been measured by Granit and Munsterhjelm⁴ with the aid of the electrical response. In this work, 'luminosity' was obtained in terms of the amount of potential in millivolts of the initial positive *b*-deflection of the electroretinogram in response to stimulation with an equal energy spectrum.



We lacked then, and still lack, data showing the relation between amount of potential and energy absorbed (intensity), and therefore had to neglect the area of the curves showing size of *b*-wave against wave-length. However, recent interest in this problem may to some extent be satisfied by a calculation of the frog's 'luminosity' curve, that is, the physiological absorption curve, on the basis of the fact that at low intensities, such as were used by Granit and Munsterhjelm, the *b*-wave according to Chaffee, Bovis and Hampson⁵ is proportional to the square root of the intensity. This is a general equation that probably will not hold for all the twenty-seven somewhat differently distributed 'luminosity' curves measured by Granit and Munsterhjelm. But it should be acceptable if their 801 values are averaged together.

Applying the equation of Chaffee *et al.* to the average curve of Granit and Munsterhjelm (their Fig. 7) we obtain the effective intensity from the amount of potential at each wave-length. The effective intensity must be proportional to energy absorbed. Finally, following Dartnall and Goodeve, we correct the absorption curve computed from the electrical responses by multiplying by the value of the quantum at each wave-length. This gives us curve above.

The dots represent the 'physiological' absorption curve, the circles around it Lythgoe's curve for the absorption of visual purple in solution (his Table 1, column 2). Both curves refer to *Rana esculenta*. The hump in our curve between 0.550–0.560 μ is placed at the maximum of the cone curve of the same species, determined after light adaptation with the same apparatus by Granit and Wrede⁶. It probably signifies that in this region of maximal cone sensitivity some low threshold cones have succeeded in influencing the measurements. However, the main result is obviously that there is a reasonably good fit in the long wave-lengths, but that even the 'corrected' absorption curve for visual purple, used for comparison, is higher in the short wave-lengths.

Dartnall and Goodeve, coming to the same conclusion, prefer Lythgoe's uncorrected values and suggest that the greater absorption by visual purple in the short wave-lengths is due to 'yellow impurities'. Their comparison refers to the human scotopic luminosity curve. This may be the correct explanation of the discrepancy, so far as measurements of electrical responses at low intensities or human absolute thresholds are concerned. But it is an interesting and, perhaps, significant fact that we obtained a hump at about 0.480 μ when the scotopic eye was stimulated with a brighter spectrum (Granit and Munsterhjelm), and that the otherwise symmetrical cone curve had an 'appendix' of relatively too large responses in the same region (Granit and Wrede). It should be a relatively easy task to determine by means of the electrical responses whether all the yellow substances are internal filters or some perhaps physiologically active photochemical substances.

We hope to be able to publish such measurements in due course.

RAGNAR GRANIT.

Physiology Institute,
University, Helsingfors.
Oct. 10.

¹ Dartnall and Goodeve, NATURE, 139, 409 (1937).

² Wald, NATURE, 139, 587 (1937).

³ Lythgoe, J. Physiol., 89, 331 (1937).

⁴ Granit and Munsterhjelm, J. Physiol., 88, 485 (1937).

⁵ Chaffee, Bovis and Hampson, J. Amer. Opt. Soc., 7, 1 (1923).

⁶ Granit and Wrede, J. Physiol., 89, 229 (1937).

Effect upon Sex Behaviour of a Diet Deficient in Vitamin E

DIETS deficient in vitamin E produce sterility in the male rat and ultimately extinguish the sex drive^{1,2}. Preliminary observations suggested that the behavioural disturbances were not clearly related to, and dependent on, genital degeneration. Extended tests were therefore undertaken on 76 male rats reared on a diet lacking in vitamin E but adequate with respect to vitamins A and D and containing sufficient yeast.

Behaviour differed greatly. In some animals sex behaviour was normal during the first months of the experiment. In others it was disturbed during this period, the abnormalities resembling those described as a result of partial hypophysectomy³. In about 25 per cent of the animals no overt sex behaviour was observed at any time. As the experiment progressed, disorganization of sex behaviour took place in those animals which mated during the first stages of the experiment. Both structure and intensity of behaviour were affected; the males mounted but failed to complete the sex act.

Maturation of the glans penis and activation of the accessory genital glands took place in all animals. After disorganization of sex behaviour had become apparent, fairly large quantities of gonadotropic hormone prepared from pregnancy urine were administered and resulted in excessive development of the genital glands. Yet this hormone failed to evoke normal sex behaviour. Gonadotropic hormone prepared from the urine of an oophorectomized woman was similarly ineffective. But gonadotropic extract prepared from the blood of a pregnant mare invoked mating in 60 per cent of inactive males within three to five days. The same effect was obtained with some aqueous anterior lobe extracts.

The results of the present study resemble those obtained in experiments on total and partial hypophysectomy. Total ablation of the pituitary extinguishes sex behaviour, partial ablation is apt to produce disturbances of structure and/or intensity of the drive. The resemblance between animals reared on an E-deficient diet and hypophysectomized males respectively extends to the effect of suitable extracts: these restore sex behaviour in either group. It would appear, then, that the dietary deficiency affects sex behaviour by disturbing the erogenous function of the anterior pituitary. It is also interesting to note that since the completion of this work Miss M. M. O. Barrie⁴ has published evidence of hypopituitarism produced by vitamin E deficient diets in rats and their offspring.

The procedure used in these experiments makes it possible to eliminate the erogenous function of the pituitary without surgical ablation and the consequent cachexia, stasis of growth and other general adverse effects. But it should be added that the deficiency produced in these experiments may not be wholly referable to the absence of vitamin E; some other deficiency may have existed, since we were not successful in obtaining normal sexual behaviour by addition to the basal diet of vitamin E (wheat-germ oil or its concentrates). Since disorganized sex behaviour was observed even in males whose basal diet was supplemented with vitamin E from weaning onward, failure to repair the defect cannot be attributed solely to irreversible changes produced by vitamin E deficiency.

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A. L. BACHARACH.

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37 Great Cumberland Place,
London, W.1.

⁴ Evans, H. M., and Bishop, K. S., *Ann. Rec.*, 99, 447 (1932).

⁵ Mason, K. E., *Ann. J. Physiol.*, 56, 64 (1933).

⁶ Wisner, B. P., and Sheard, N. M., *NATURE*, 132, 641 (1933).

⁷ Barrie, M. M. O., *NATURE*, 139, 236 (1937); 140, 426 (1937), *Lancet*, ii, 251 (1937); *Chemistry and Industry*, Proc. Biochem. Soc. 55, 1055 (1937).

Protective Effect against Experimental Rickets of Rats of a Single Massive Dose of Vitamin D

It is a well-known fact that there is a very wide margin between the therapeutic and toxic doses of vitamin D. It may safely be stated that a thousand times the therapeutic dose is quite harmless, at least for rats. It seemed to be worth while to investigate whether such a large dose if given intramuscularly would render rats immune against rickets for a long period.

Two pairs of young rats were placed on the rachitogenic diet McCollum No. 3143. To each of

the first pair 750 international units of vitamin D were injected intramuscularly, while the other pair remained untreated. X-ray photographs were taken at weekly intervals. The rats were weighed weekly.

Of the pair given the vitamin D injection, one remained free from any signs of rickets for eight months (died accidentally), the other for 14 months (end of the investigation). Their weights increased from the initial 40 gm. to about 165 gm., which can be looked upon as normal, taking into consideration that the animals were kept continuously on the restricted diet McCollum No. 3143. The control rats showed the usual picture: after two weeks on the rachitogenic ration, severe rickets developed, after five to six weeks, decline of weight began and the animals died within three months.

The experiment shows that a single massive dose of vitamin D given as an intramuscular injection, was able to protect rats living on a rachitogenic diet from rickets.

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Trisomic Mutations in Jute

Corchorus capsularis Willd., the common jute plant, has usually 14 chromosomes in the diploid state. No other number has been reported in the species or varieties of jute.



Fig. 1.

LEFT: TRISOMIC MUTANT PLANT; RIGHT: NORMAL JUTE PLANT.

In the course of cytogenetical studies a variant plant was discovered in the jute cultures which is characterized by much smaller and deeply serrated leaves. The plant proved to be highly sterile, setting a few seeds. Cytological studies have revealed 15 chromosomes in the root-tip cells as well as in the pollen mother cells. Selfed seeds collected from this mutant were grown this year. In Fig. 1 a typical mutant in the flowering stage is shown beside a

normal from the same pedigree culture. The differences are such that the mutants are easily recognizable. The trisomic is distinguished from the normal plant, from which it arose, not merely by single visible differences but also by a complex of characters which seem to be inherited as a whole in the offspring.

The leaf is the part of the plant which is most conspicuously affected, and I can pick out readily the trisomic mutant from the seed pan before the opening of the second leaves. The leaves are narrower, pointed and much more serrated than the normal. The two hood-like appendages generally present at the base of the lamina in all the normal varieties of jute are totally absent in the trisomic mutant. The petiole is on an average 2.1 cm. in length while those of the normal measure 3.3 cm., the lamina is 4.2 cm. $\times$ 1.6 cm. in size, the normal being 6.2 cm. $\times$ 3 cm. on an average. Axillary branches extrude from the axil of the leaves, causing irregular branching and increasing the strangeness of appearance of the trisomics. Flower buds are much smaller, stamens fewer in number, ranging from 10-16, whereas in normal plants the stamens are 15-24. Some of the stamens in the mutant are deformed and transformed into petals. Anthers are generally empty with aborted pollen grains; ovary with trifold or 4-fold stigmas, the normal being single and undivided; capsule smaller, seeds very few, with a low fertility.

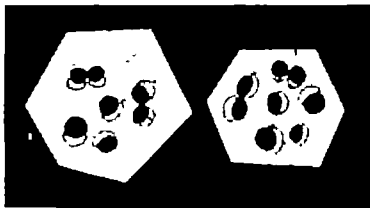


Fig. 2.

METAPHASE I FROM NORMAL (LEFT) AND TRISOMIC PLANTS (RIGHT), SHOWING PAIRS OF BIVALENTS SECONDARILY ATTACHED.

Study of the pollen mother cells at diakinesis revealed six pairs of bivalents and a trivalent frequently, as also seven pairs of bivalents and a univalent. At metaphase I, the trivalent divided as usual, two chromosomes passing to one pole and the third to the opposite pole. Sometimes a lagging univalent was noticed in the first and second division.

The trisomic mutant thus produces dimorphic gametes with 7 and 8 chromosomes. The breeding behaviour of the trisomic shows that when the mutant is selfed or crossed with normal pollen, it produces a large number of trisomic mutations in the offspring. But when the normal is used as female and trisomic as the male, the percentage of trisomic in F_1 is reduced to a considerable extent. This shows that egg cells with one extra chromosome are more effective in fertilization.

With regard to the origin of this trisomic mutation, it has been noticed that the normal sometimes throws trisomic plants under field conditions. Cytological studies of the normal plants with 14 chromosomes showed failure of pairing of one bivalent in some of the pollen mother cells. At metaphase I, eight chromosomes pass to one pole and six chromosomes to the other. It is possible that the same thing happens in the megaspore mother cell. The trisomic most probably arises from the mating of an egg cell

with 8 chromosomes to a normal 7-chromosome pollen grain.

It may also be mentioned here that the cultivated varieties of jute are usually regarded as diploids. But chromosome morphology and meiotic chromosome behaviour indicate that jute is a secondary polyploid. The metaphase I (Fig. 2) from normal and trisomic shows pairs of bivalents secondarily associated. The maximum association observed is two groups of two bivalents, the other three bivalents remaining separate. It is therefore suggested that the basic number of *C. capensis* is $n = 5$, and that the present number $n = 7$ is secondarily balanced.

An analysis of the genetic constitution of different trisomic types obtained is proceeding, and the use of trisomic ratios in locating the genes affecting different characters is being studied.

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Sept. 27.

Wild Birds and Butterflies

PROF. G. D. HALS CARPENTER has recently published "Further Evidence that Birds do attack and eat Butterflies"¹. I have read this paper with great interest, and while I am fully aware that the observations contained therein approach the subject from rather a new angle, they are, to me, quite unconvincing in so far as they claim more than that butterflies constitute but the merest fraction of a bird's food.

I am surprised that Prof. Carpenter is apparently unaware of the evidence I set forth in a letter in NATURE in 1929². The observations there were made by men with long experience, and specially trained observers of the stomach contents of wild birds. None of them was likely to overlook the scales of a butterfly's wing, the spicules of worms, the eggs of insects, or the limbs or cuticle of an isopod, and yet none of them found butterflies in an appreciable percentage in upwards of 100,000 stomach contents.

No one can deny that birds do snap at the wings of butterflies. Sir Guy Marshall has chronicled a long list of such cases³. On rare occasions they may possibly eat the bodies, but these cases, in my opinion, are few and far between.

Many years ago I had planted in my garden a new variety of lettuce, and I was puzzled at finding the leaves cut in this fashion A. Careful observation soon proved that house sparrows, chaffinches, tits, robins and thrushes were the depredators, but it would be unscientific to chronicle these species of wild birds as enemies of lettuce, or to say that such food constituted anything but an infinitesimal fraction of their food.

WALTER E. COLLINGS.

Yorkshire Museum,
York.
Nov. 8.

¹ Proc. Zool. Soc. (Ser. A), 222-247 (1937).

² NATURE, 324, 335 (Aug. 31, 1929).

³ Trans. Entom. Soc. Lond., 322-323 (1909).

DR. W. E. COLLINGS is apparently under a misapprehension as to the degree to which it is claimed that birds eat butterflies. I do not think that it is ever claimed that these insects form the principal food of any bird; only that they are eaten to an extent sufficient to have a selective effect, and I

believe that work by Prof. R. A. Fisher has demonstrated mathematically that this extent need be very much less than was previously supposed.

Dr. Collinge's point of view on this question seems to be expressed by his phrase "No one can deny that birds do snap at the wings of butterflies". It is because the imprints known as beak-marks imply something more than merely snapping at wings that for some years attention has been particularly directed to this subject, presumably that which Dr. Collinge mentions as an approach from a new angle. The clear A-imprint on the scales means that the wing has been definitely held in the beak but that the butterfly has escaped again. The high proportion of species with 'distasteful' qualities among beak-marked specimens is at present engaging particular attention; it is a very significant fact.

The observation by Mr. T. H. E. Jackson recorded in *NATURE*¹ deals with selective feeding upon butterflies by a bird to a considerable extent. The black-and-white African wagtail (*Motacilla*) habitually feeds upon butterflies, as shown by observations by Pitman², who mentions it daily "consuming dozens of butterflies", Major I. G. Owen in the Sudan³, and Mr. J. P. Chapin⁴, as well as by myself in Uganda⁵.

An observation recently received from Mr. C. W. Chorley, an experienced field-naturalist in Uganda, may be quoted here: it is apt because attention

has been directed to the lack of evidence of attacks upon migrating butterflies. Mr. Chorley wrote: "Once in Ankole I saw a migration of thousands upon thousands of butterflies [apparently a species of *Glycetha* = *Belenois*] travelling towards the west. The Yellow-fronted Bush Shrike (*Olorophoneus olivaceus* Lees.) was very numerous and at the foot of the perches there was quite a collection of butterflies' wings".

Finally, it is a little hard to be criticized for not mentioning a paper on *negative* evidence in a contribution entitled "Further evidence . . .". This was put together from notes hitherto unpublished to aid the provision of evidence which is said to be lacking. A discussion of the whole subject would have necessitated reference not only to the negative evidence but also to much recent positive evidence of which Dr. Collinge is apparently unaware, and would have been a larger undertaking than was attempted.

G. D. HALE CARPENTER.

University Museum,
Oxford.

Nov. 11.

¹ *NATURE*, 135, 194 (Feb. 2, 1935).

² Pitman, O. R. L., *J. Bomb. Nat. Hist. Soc.*, 22, 204 (1918).

³ Observation 22 of the paper under discussion.

⁴ Chapin, J. P., *Natural History*, 22, 66 (1922).

⁵ Carpenter, G. D. H., "Mimicry", p. 66. (Methuen and Co., Ltd., 1933).

Points from Foregoing Letters

Dr. W. T. Astbury summarizes accumulating X-ray evidence for the belief that ultimately there will be found no real distinction between 'fibrous' and 'globular' proteins, and points out that the stoichiometrical data of Bergmann and Niemann indicate the same thing. He shows how X-ray measurements can be used to supplement the Bergmann argument, and calculates a stoichiometrical distribution of amino acid residues and provisional molecular weight for keratin, which also appears to fit into the new scheme.

Dr. F. Levi describes some experiments which confirm certain consequences of C. V. Raman and N. S. Nagendra Nath's first simplified theory of the diffraction of light by ultrasonics at oblique incidence hitherto not experimentally verified.

From measurements of the magnetic susceptibility of nickel, of cobalt and of iron-vanadium alloys (from which the susceptibility of iron can be obtained by extrapolation), Prof. W. Suksmith and R. R. Pearce calculate the magneton number of these metals. The susceptibility for cobalt was found to be linear between 1,230° and 1,450°, and that of nickel between 500° and 925°. Above 925°, for nickel, the slope of the $1/\chi$, T curve decreases.

Dr. D. S. Kothari and B. N. Srivastava point out that the heat absorbed or given off when a gas such as helium expands in a vacuum (Joule-Thomson effect) can, under suitable conditions, provide an experimental test to show whether the statistics of Fermi-Dirac or Bose-Einstein are applicable under those conditions. The authors give formulae from which the magnitude of the effect may be calculated, both for 'degenerate' gases (which deviate from the

gas and Van der Waals' laws) and for non-degenerate gases.

A curve showing the absorption of visual purple pigment (of the frog *Rana esculenta*), in solution, is compared by Prof. R. Granit with the 'physiological' absorption. The latter is obtained by calculating the 'effective intensity' from the luminosity curve determined from the response to an electrical stimulus. There is a reasonably good fit of the two curves for the longer wave-length, but for the shorter wave-length the absorption of the visual purple is higher than the 'physiological' absorption.

A diet deficient in vitamin E is found by Dr. B. P. Wiener and A. L. Bacharach to have a complex disorganizing effect upon the sex organs and sex behaviour of the male rat. The addition of vitamin E to the basal diet does not bring about complete normality and some other factor may therefore be involved.

A single large dose of vitamin D injected in the muscle is found by Dr. H. Rotter to protect rats living on a rachitogenic diet for a long period.

The character and behaviour of a variant of the common jute plant, containing 15 chromosomes in the nucleus instead of the usual 14, are described by Dr. H. K. Nandi. It produces sex cells (gametes) containing seven and eight chromosomes, and breeding experiments indicate that the egg cells with one extra chromosome are more effective in fertilization. The behaviour of the chromosomes during nuclear division, the author states, leads to view that the basic number of chromosomes in the jute is five and that the present usual number, seven, is secondarily balanced.

Research Items

Fatigue and Air Movement in Rooms

WHILE the importance of maintaining the air in a public building or in the home at a reasonable standard of purity has been appreciated for many years, it is only recently that the importance of keeping the air in movement has been seriously considered. This question is discussed in a paper by J. R. Henderson in the *G.E.C. Journal* of August. It has been noticed that when no movement of the air at head-level is provided, a feeling of 'stiffness' is experienced, accompanied by fatigue and loss of efficiency. The necessity for air movement is emphasized in the Home Office Welfare Pamphlet No. 5 (London: H.M. Stationery Office). It states that no work-room, even if lofty and spacious, is satisfactory without adequate air movement, and that the importance of this to physical health cannot be too widely understood. It is difficult to lay down definite rules concerning the optimum air velocity. It seems to lie between 50 feet and 200 feet per minute according to the prevailing temperature and humidity, and also to a certain extent to individual requirements. Some individuals, acclimatized to hot and humid conditions, are very susceptible to draughts. There are three principal methods of producing the necessary air movement: by high-velocity streams of air flowing through a system of ducts and fed by an air-conditioning plant; by table electric fans of the propeller type; and by ceiling fans. The high-velocity jets are usually part of an air-conditioning plant. For the home and small offices, the table or bracket fan is successfully used. If necessary, oscillating mechanisms are fixed to them to increase the area over which they are effective. Ceiling fans are the best means of producing air movement in large rooms. Owing to the large sweep of the slow-speed propeller, it is more silent than table fans. Their power consumption is small, being less than that taken by a hundred-watt lamp. When a regulator is used, a wide range of speeds is obtainable.

Digestion in Polyplacophoran Molluscs

A MORE complete account of the morphology, histology, mode of action of the alimentary canal and of the process of digestion in polyplacophoran molluscs than has hitherto appeared is now furnished by Vera Fretter (*Trans. Roy. Soc. Edin.*, May 1937). The principal type studied is *Lepidochiton cinereus*, but the following are also fully compared with it: *Acanthochiton crinitus*, *Ischnochiton magdalenensis* and *Cryptochiton stelleri*. The account is illustrated by plentiful, clear figures. The stomach in some species is complex and divided into a dorsal channel, with two longitudinal ciliated bands and a non-ciliated sac. The bilobed digestive gland has two ducts opening into the dorsal channel. It is only in this digestive gland that the soluble food material is absorbed. In *I. magdalenensis* and *C. stelleri* the intestine is complexly coiled. Food is conveyed through the oesophagus to the stomach by ciliary currents. The posterior oesophageal pouches secrete an enzyme with an optimum pH of 5.6 and an optimum temperature of 34° C. The stomach produces a proteolytic enzyme with an optimum pH

between 4.29 and 4.86. The intestine is divided into an anterior and a posterior moiety separated by a valve which regulates the passage of food through the gut and also shapes faecal pellets. The alimentary canal of the group resembles that of the lower gastropods in structure but differs in function.

Chironomid Fauna of River Mosses

AN interesting research has been carried on by Carmel F. Humphries and Winifred E. Frost during a biological survey of the River Liffey, the primary object of which was to investigate the food and growth of the brown trout (*Salmo trutta*) from acid and alkaline waters ("The Chironomid Fauna of the Submerged Mosses" River Liffey Survey. *Proc. Roy. Irish Acad.*, 43, Section B, No. 11, 1937). The paper deals with the chironomid larvae and pupae found in these mosses, and the results are striking. One alkaline and one acid site were chosen, and although the species of mosses were different, it was found that the fundamental form was the same, so that the chironomids had similar habitats, and the total estimated number of larvae is almost the same in the two sites. The dry weight of moss formed the same proportion of the whole sample in both places. Percival and Whitehead (1929) stated that in the River Wharfe "By far the greater proportion of the Midge larvae of our area consists of *Orthocladiariae*". The present authors find that it is the same in the Liffey and that there is a close quantitative similarity between the chironomid fauna at the two stations, the dominant subfamily in both cases being the same, and forming an almost equal proportion of the organisms present. The *Orthocladiariae* constitute 95.9 per cent of the total chironomid fauna at Straffan, the alkaline site, and 98.6 per cent at Ballymutton, the acid site; the remainder is composed of *Tanytarsariae*, *Chironomariae* and *Tanytarsinae*. The seasonal distribution of all the chironomid larvae as expressed in the graph shows that the seasonal abundance of the larvae from the acid and from the alkaline waters is almost identical.

Citrus Manuring

AN outstanding example of the application of modern statistical methods to the elucidation of interacting factors in the nutrition of fruit trees on a commercial scale is presented by F. G. Andereson in a recent investigation on citrus manuring in South Africa (*J. Pom. and Hort. Sci.*, 15, 2, 117; 1937). The experiment was designed to determine the influence of the common artificial fertilizers on the composition and quality of oranges and on their keeping quality. 2,500 Washington Navel orange trees comprised the experimental material, and these were manured with twenty different combinations of potash sulphate, superphosphate and ammonium sulphate, with applications of lime and the sowing of cover crops on some of the plots. Record were taken of crop weights, tree growth, rind thickness and keeping quality of the fruit, and chemical analyses were carried out on the fruit juice, rind and pulp. The data when analysed statistically gave

definite evidence of the effects of the various treatments. Applications of ammonium sulphate to the soil induced very marked increases in weight of crop and number of fruits, but there were no significant differences between applications of 2, 4 and 8 lb. per tree. A leguminous cover crop did not increase the nitrogen content of the soil or the size of crop, nor was crop size affected by superphosphate, potassium sulphate or lime. Calculations of correlations and partial regression coefficients showed that a high phosphorus content and probably also a high calcium content in the fruit were associated with low acid content and thin rind. High potassium content, on the other hand, caused high acid and thick rind. High calcium content caused an increase in the amount of wastage in storage due to mould, whilst nitrogen had the reverse effect. Sugar content and total soluble solids were increased by high nitrogen content, which was also shown to be necessary for the synthesis of phosphatic organic substances. The juice content of the fruit was not directly affected by any of the factors determined. The importance of balanced nutrients is emphasized, particularly in respect to nitrate and phosphate, which should be present in high concentration and suitable proportions.

Bending Wood by Hand

At the Forest Products Research Laboratory of the Department of Scientific and Industrial Research an investigation has been made on the practice of bending solid wood by hand as distinct from machine bending, and the conclusions reached have now been published ("Methods of Bending Wood by Hand", *Forest Products Research Bull.*, No. 17. London: H.M. Stationery Office, 1937. 1s. net.) Of the bending machines available, there are few which are capable of producing a really large variety of designs, and, as a result, the most complicated bends are still almost invariably made by skilled hand-bending operators. The process is divisible into three distinct stages—the preparatory softening of the wood, the actual bending and the setting of the bend—and each of these is dealt with. In the first, steaming is regarded as the most efficient method, and the preparation and treatment of the blanks are discussed. Several different bending appliances are illustrated and described, including those for bending over pegs, and for bending between forms, the use of one form and a strap, and the need in certain cases for additional appliances such as clamps, end stops, wedges, etc., to prevent tension, shear or other failure of the wood. It is on the intelligent adoption of the right type of equipment that the combination of economy and success depends, and the text seeks to set out in general terms the principles by which one should be guided in these matters. Examples are given of difficult bends such as the Austrian chair-back type of bend, the S and sinuous types, and two-plane bends. The final setting stage has an important bearing on the finished bend; the conditions under which it must proceed are explained and particulars of the temperatures and precautions to be observed are set up. The Forest Products Research Laboratory invites inquiries from those who wish assistance in its subject, and places the results of its experience at the disposal of anyone interested. There is a wide field for quantitative investigation of this age-old process and the wood properties on which it is dependent.

Glaciers of the Wicklow Hills

IN an investigation of the glacial events in the Wicklow region during the later stages of the Glacial Period, Prof. J. K. Charlesworth has amplified the recent researches of Mr. A. Farrington on this subject. Prof. Charlesworth's recent paper (*Proc. Roy. Irish Acad.*, 44, B, No. 3) is entitled "A Map of the Glacier Lakes and Local Glaciers of the Wicklow Hills". A notable feature is the smallness of the glaciers on the western side compared with their development on the eastern side, but Prof. Charlesworth's most striking conclusion is that the whole upper surface of the mountain plateau, above about 2,000 ft., was covered by a firm field. In this conclusion, he differs from Mr. Farrington. Prof. Charlesworth shows how the Irish Sea ice-sheet, in pressing against the flanks of the Wicklow Hills, closed the valley mouths and ponded the water into lakes which were drained by overflow valleys excavated across the main watershed, or projecting spurs. The withdrawal of the ice towards the north resulted in the more southern overflow valleys being smaller than the more northern.

Earthquake Swarm of Itô in Japan

THE remarkable swarm of slight earthquakes felt at Itô during the first half of 1930 has already been referred to in these pages (126, 326, 971). Mr. F. Kishinouye has recently studied their variations in frequency (*Bull. Earthq. Res. Inst.*, 15, 785-828; 1937), and, if he had done nothing more than print, for the first time in English, a complete list of all the shocks recorded at Misako, his memoir would have possessed great value. From February 14 until June 26, the total number was 5735. A peculiarity of swarm earthquakes is that large numbers are crowded into a few hours of the day. On March 8, for example, the numbers in four successive hours were 54, 35, 19 and 29, while, during the rest of the day, there were only 24, and in each of 18 hours no shocks were felt. Such concentration, of course, limits the determination of seismic periods, and it is not surprising that the existence of a diurnal period is regarded by the author as doubtful. The diagrams representing the height of the tide and the hourly numbers of earthquakes recorded at Misako seem to show that earthquakes are most frequent at the times of low water, but Mr. Kishinouye does not admit any connexion between them owing to the small amplitude of the semi-lunar period. An interesting result follows from the comparison of the diagrams of the frequency and seismic energy of the Itô earthquakes, namely, that the strong earthquakes occurred as a rule during intervals of great frequency.

Vitamin C in the Potato

BEFORE the potato was introduced into the Netherlands, scurvy was a very common ailment; to-day the potato is the chief source of vitamin C in the dietary of the Dutch people. In the few determinations of the vitamin C content of potatoes that have been published, no regard has been paid to the possible differences between varieties or to the possible influence of the conditions under which they are grown. These points have recently been investigated by J. B. H. Ijdo, of the Hygiene Laboratory of the University of Utrecht, and his results are recorded in the *Landbouwkundige Tijdschrift* of August-September 1937. He has found that the vitamin C

content of thirteen varieties of potato grown in the same conditions varied from 25 to 63 per cent, whereas samples of the same variety showed an average difference of only 10 per cent. Locality of growth was also found to influence the content of vitamin C in potatoes of the same variety; the greatest difference observed was 40 per cent for the variety 'Iris'. Practically no difference was found between the contents of small and large tubers, or between samples taken from the centre and the periphery of the same potato. The absolute amount of vitamin C was found to vary from about 10 mgm. to 20 mgm. per 100 gm. of fresh material, a result which is in keeping with those previously published by other investigators.

Atomic Distances in Crystals

THE empirical function used by Pauling, Brockway and Beach to relate interatomic distances to bond types has been used to predict the carbon-oxygen and nitrogen-oxygen distances. A large discrepancy occurs for the carbonate ion between the predicted distance of 1.32 Å. and the distance reported for calcite. N. Elliott (*J. Amer. Chem. Soc.*, 59, 1380; 1937) has now redetermined the C-O distance in calcite and the N-O distance in sodium nitrate by X-ray methods by Laue photographs. The parameters found are 0.2635 for calcite and 0.2394 for sodium nitrate. These lead to the values for the interatomic distances of C-O = 1.313 Å. and N-O = 1.210 Å. A comparison with the distances predicted by Pauling, Brockway and Beach is made, and agreement is found for the carbonate ion. In the case of the nitrate ion, however, the predicted value is 1.26, leaving a discrepancy of 0.05 Å. It is suggested that this is due to a previously unrecognized factor, the effect of the resultant charge of an atom on its covalent radius. In the nitrate ion there is a double bond to a neutral oxygen atom and single bonds connecting nitrogen with a formal charge +1 with oxygens with formal charge -1. Resonance between the double bond and the single bonds would be expected to diminish the N-O distance by 0.05 Å., so explaining the discrepancy. The phenomenon should be observed in other substances such as the tetramethylammonium ion, and experiments to test this prediction are planned.

Petroleum Fuels in Canada

LAST year the Canadian Department of Mines issued a Bulletin (No. 772) giving statistics of petroleum fuels marketed in Canada during the years 1933 and 1934. A further Bulletin (No. 780) is now available, which deals with comparable statistics for the year 1935. As in earlier years, petroleum fuels are divided into four main classes, namely, fuel oil, kerosene, gasoline and petroleum coke. First, tables are given showing quantities of each type marketed in Canada during 1935 and their distribution throughout the various Provinces, and then each class is considered separately. In this year, more than 85 per cent of fuel oil was processed in Canadian refineries, the rest being imported. Of this, more than 24 per cent of the total was used for domestic heating, 26 per cent for industrial heating and power, 7 per cent for tractor fuel and 41 per cent for fuel for rail and water transportations. Deliveries of kerosene in 1935 represented less than one fourteenth of the volume of fuel oil, or about one thirty-third of the

total volume of petroleum fuels delivered. In fact, about 1 million gallons less kerosene were delivered in this year than in 1934. 65 per cent of the total sold was used for domestic heating, cooking and lighting, 23 per cent for tractor fuel and the rest for general miscellaneous uses. Gasoline statistics given in the report are not strictly comparable with those furnished for fuel oil and kerosene, as they merely represent the amounts recorded by the several provincial tax departments of the Bureau. Nevertheless, a general study of these tables shows that the provisional figure for total sales during 1935 exceeds that for 1934 by nearly 30 millions of imperial gallons.

Magnesium Alloys

THE low density—1.74—of magnesium has led in recent years to its introduction into industry for the production of light articles not subjected to excessive stresses in use, and a considerable amount of information is now available as to the strength of the material and of many of its alloys. The issue of the *Science Reports* of the University of Sendai, Japan, for September, contains a report by Messrs. H. Endô and S. Morioka to the Research Institute for Iron, Steel and other Metals on the corrosion of magnesium alloys containing manganese and silicon. The corrosion is measured by the decrease in weight of rods of the alloys 3 cm. long and 0.5 cm. diameter immersed in 0.1 normal solutions of common salt in water for periods of 5–30 days. The authors conclude that the following are the compositions of the alloys which show the greatest resistance to corrosion under the above conditions: For magnesium-manganese alloys cast, Mn exceeding 2 per cent; annealed at 470°C., Mn exceeding 0.6 per cent; for Mg-Zn-Mn alloys, Zn 2–6 per cent, Mn 0.6–2 per cent; for Mg-Sn-Mn alloys, Sn 2–8 per cent, Mn 0.5–2 per cent; for Mg-Zn-Si alloys, Zn 2–6 per cent, Si 0.05–0.8 per cent; for Mg-Zn-Al-Mn alloys, Zn 4, Al 6, Mn exceeding 1 per cent. They attribute the resistance to the formation of a film of $\text{Mn}(\text{OH})_2$ or $\text{MnO} \cdot 2\text{H}_2\text{O}$, mixed with $\text{Mg}(\text{OH})_2$, on the surface.

Oriented Crystallization

THE July issue of the *Memoirs of the College of Science* of the University of Kyoto contains descriptions of two methods of obtaining crystals with a particular axis oriented in a given direction. The first, due to N. Matsumoto, consists in forming the crystals between the fibres of a bundle of stretched rayon threads by dipping the bundle into a saturated solution of the substance and then allowing the solvent to evaporate in the air. On examining the bundle under X-rays, he finds that the patterns due to the crystals can be distinguished from those due to the bundle of threads and that they indicate that one crystalline axis is parallel to the fibres. In the case of ortho-rhombic potassium chromate, for example, it is the *a* axis of 5.88×10^{-8} cm., and in that of monoclinic sodium sulphate the *c* axis of 11.5×10^{-8} cm. The second method, by S. Shimadzu, consists in allowing a metal plate to stand for a couple of days in a weak solvent, for example, silver in chlorine water. On examining the surface of the plate by electron diffraction, it is found that the (331) axes of the cubic micro crystals of the silver chloride are all arranged perpendicular to the surface of the plate.

Anniversary Meeting of the Royal Society

THE presidential address to the Royal Society was delivered by Sir William Bragg on November 30, opening with the usual brief references to the work of fellows of the Society who died during the past year. Their number this year is unusually high, namely, twenty-four fellows and two foreign members. A portion of Sir William's address is printed elsewhere in this issue (p. 954).

The report of the Council refers to a number of matters of interest, including the various activities of the Society during the 275th year of the Society's existence. On the accession of King George VI the Society was informed that His Majesty was graciously pleased to follow the practice of his predecessors in becoming the Patron of the Society.

His Majesty has also graciously signified his intention to continue the gift of the two Royal Medals which have been awarded annually by the Sovereign since their institution in 1825 by King George IV.

The proposal of the Council that the number of candidates selected for election annually shall be twenty instead of seventeen has been finally approved and the first election of twenty fellows will take place in March 1938.

The total expenditure authorized by the Council for the promotion of scientific research during the year under review was £33,500 and in addition nearly £10,000 was spent in the production of the Society's scientific publications. In these figures are included the Government grants in aid of scientific investigations and publications. The nature and scope of the research work undertaken by the research professors, fellows and students appointed by the Society and by other recipients of grants are indicated in a series of reports printed in the report; and they demonstrate to what good purpose the grants are being put.

When the Bermuda Oceanographic Committee held its first meeting in 1936, Dr. H. B. Bigelow, director of the Woods Hole Oceanographical Institution, proposed that an intensive programme of research into Gulf Stream and Atlantic Drift problems should be carried out jointly by the Woods Hole Oceanographical Institution and the Bermuda Biological Station. The proposals were strongly supported by the trustees of the Bermuda Station, who were, however, unable to undertake their share of the scheme without further financial assistance. Since fluctuations in the strength of the Atlantic Drift are suspected to have a marked effect on the sea fisheries of the United Kingdom, it was hoped that support for the proposed work might be obtained in Great Britain. The Committee recommended that the Council of the Society should make application through the Development Commissioners for a grant to cover the cost of the work. The Council agreed to these proposals; and, subject to certain conditions, a grant of £5,100 for capital expenditure and £3,500 a year for a period of five years has now been allocated for an approved programme of research. The scheme which has been approved includes provision for the employment of two scientific officers, who will assist Dr. J. F. G. Wheeler, director of the Bermuda Biological Station, and for an annual subvention to the station, which will be used as the base for the oceanographical work. The Committee is also providing a small research vessel to make the necessary

observations at sea, and the selection and equipment of this vessel have been entrusted to a Ship Sub-Committee with Vice-Admiral Sir Percy Douglas as chairman. Unless unforeseen difficulties occur, it is expected that the research boat will be at work in the spring of 1938. The two additional members of the scientific staff have been appointed and will leave shortly for Bermuda. Dr. Ernest F. Thompson has been selected for the post of hydrologist and Dr. Hilary B. Moore for that of assistant to the director.

The Pilgrim Trust has offered to the Society 250 guineas annually for six years to allow an annual "Pilgrim Trust Lecture" to be arranged jointly by the Royal Society and the National Academy of Sciences and to be given alternately in London and Washington. The National Academy has agreed to co-operate. It is hoped that the first "Pilgrim Trust Lecture" will be given by an American scientist before the Royal Society in the summer of 1938.

PRESENTATION OF MEDALS

Copley Medal: Sir Henry Dale, C.B.E., F.R.S.

Sir Henry Dale's most important contributions to physiology and pharmacology lie in two different but closely related fields: (1) the isolation of certain chemical substances, notably histamine and acetylcholine, from animal tissues, and (2) the discovery of the part played by these in a large number of important physiological and pathological processes.

Dale's earlier work (1905-11) on the active principles of ergot led to progress in many allied subjects. The study of histamine, isolated from ergot extract and later found as a normal constituent of certain tissues, has modified profoundly our views of the capillary circulation and of the conditions known as 'wound shock' and 'anaphylactic shock'. In 1914, he became interested in the choline esters, and with extraordinary prescience singled out acetylcholine as the most interesting member of the series and pointed out the extreme likeness of its action to that of stimulating the parasympathetic.

In 1924, Loewi demonstrated that a substance indistinguishable from acetylcholine is liberated by the heart when the vagus nerve is stimulated. The researches of others, prominently among them Dale himself and his colleagues, have since shown that acetylcholine is liberated at many other junctions between conducting tissues, and the results with acetylcholine and adrenaline are embodied in the description of nerves as 'adrenergic' and 'cholinergic'. Recently convincing evidence has been given by Dale and his collaborators that acetylcholine plays an important, possibly an essential, part in the transmission of impulse from nerve to voluntary muscle: a discovery which has direct practical bearings on muscular fatigue and in various pathological conditions, and also is of the greatest interest in the theory of the mechanism of the nervous and neuromuscular systems.

As director of the National Institute for Medical Research, Dale has inspired and directed a wide variety of investigations outside his special field, and numerous investigators from many countries have worked under his guidance.

A Royal Medal: Prof. N. V. Sidgwick, O.B.E., F.R.S.

Prof. Nevil Vincent Sidgwick has always been primarily interested in the causes which determine molecular structure, and his earlier experimental work chiefly dealt with such subjects as tautomerism, and the vapour pressures, boiling-points and solubilities of isomerides. The development of the conception of the nuclear atom made possible for the first time a quantitative treatment of chemical valency other than purely formal, and the first steps in this direction were taken by Langmuir, G. N. Lewis and Kossel during, or just after, the Great War. Others followed with theoretical or physical extensions.

Sidgwick's post-War experimental work has all been concerned with particular problems of structure, utilizing to the full available physical methods of attack. To take a few examples, he has shown the existence of co-ordination compounds of the alkali metals, and has demonstrated the co-ordinating properties of the hydrogen atom. In particular, it was he who distinguished clearly the existence of a third and very important type of chemical binding, the so-called co-ordinated covalent link.

In 1927, Sidgwick published "The Electronic Theory of Valency", in which, for the first time, the most diverse structural phenomena covering the whole field of chemistry were rationally systematized. The book met with immediate and enthusiastic acceptance. In 1928, he played a leading part at a conference held at Munich to discuss chemical binding in its relation to atomic structure. In 1931, he lectured in the United States of America. He has continued his work of fruitful interpretation in a series of remarkable contributions made to the annual reports of the Chemical Society, and in his recent presidential addresses to the same Society on the subject of resonance phenomena in chemistry.

A Royal Medal: Prof. A. H. R. Buller, F.R.S.

Dr. Arthur Henry Reginald Buller was professor of botany in the University of Manitoba in 1904-36. His original contributions to science are mainly in the field of mycology and have been published in his "Researches on Fungi", six volumes of which have appeared.

These researches fall into two groups. The first comprises studies on the morphology, biophysics and physiology of the higher fungi, including the physiology of the mycelium and the organs produced on it, and especially of the production and liberation of spores. The second group deals with sex in the higher fungi, and Buller's studies on this subject rank among the most important that have been made. Particular mention should be made of his observations on the process of diploidization in the higher fungi, and of the discovery of heterothallism in the rusts in conjunction with his student Craigie, work which has revolutionized our conception of the life-cycle of these forms. Buller's studies have not been confined to one group of fungi, but include researches on Discomycetes and many groups of the Eu-Basidiomycetes, as well as on rusts and smuts. Reference should also be made to his "Essays on Wheat" and also to his efforts which made possible the publication of the translation by his friend W. B. Grove of the brothers Tulasne's monumental "Selecta Carpologia Fungorum".

Davy Medal: Prof. Hans Fischer

During the past twenty-five years Prof. Hans Fischer has been continuously engaged in the study of the chemistry of the porphyrins, the bile pigments and chlorophyll. Starting from the knowledge that the porphyrin molecule was built up of pyrrole nuclei, variously substituted in the different porphyrins, Fischer developed controlled methods of degradation which extended the possibility of the identification of the pyrroles in any given porphyrin. With the accurate information acquired in this manner as a basis, Fischer proceeded, by bold and original synthetic work, artificially to prepare a large number of porphyrins of known structure, many of which proved to be closely related to or identical with natural products; his crowning achievement in this field was the synthesis of protoporphyrin, which, with iron, yielded haematin identical with that derivable from blood haemoglobin.

From the porphyrins Fischer turned his attention to the bile pigments and was able to explain the fundamental chemical features of their relationship to haemoglobin, thus paving the way for the biochemical work which is now proceeding in other laboratories and which promises to explain the actual mechanism of bile pigment formation in the body.

In recent years Fischer has applied his brilliant synthetic technique with outstanding success to the elucidation of the detailed structure of chlorophyll.

Buchanan Medal: General F. F. Russell

Frederick Fuller Russell graduated from Columbia College of Physicians and Surgeons in 1893, and began his career as a member of the Medical Corps, U.S. Army, in 1898, advancing through the various grades to that of colonel in 1917. He resigned in 1920. He was curator of the Army Medical Museum, Washington, D.C., from 1907 until 1913, and also instructor in bacteriology and clinical microscopy at the Army Medical School, where he performed distinguished service in developing and producing the typhoid vaccine which the Army has used with great effectiveness since that time. From 1920 to 1923 he was director of the public health laboratory service of the International Health Board and from 1923 to September 1, 1935, he was general director of the Board. It was during the period while General Russell was director of the International Health Division of the Rockefeller Foundation that the Foundation gave such material aid towards the establishment of schools of hygiene in various European countries. It also contributed largely to the All India Institute of Hygiene in Calcutta and to the Singapore Medical School. General Russell was also responsible for establishing the yellow fever unit in West Africa. Large grants were given to the Health Section of the League of Nations, and the fellowship scheme under the International Health Division was considerably extended.

Sylvester Medal: Prof. A. E. H. Love, F.R.S.

Prof. Augustus Edward Hough Love is most generally known as the author of the "Treatise on the Mathematical Theory of Elasticity" which has attained a universal reputation and remains the standard work of reference on this subject all over the world.

Before the first edition of Love's treatise was published in 1893, this branch of mathematical physics

received little attention and its results were often regarded by engineers with suspicion. During the intervening years it has gradually established itself as one of the most reliable mathematical theories of continuous media and, unlike its sister science of non-viscous hydrodynamics, its results have been increasingly verified in practice. That this has come about is due in great part to the influence of Love's "Treatise", which, indeed, like Lamb's "Hydro-dynamics", is far more than a mere treatise and embodies a vast amount of original work.

Looking at Love's other work there is a great volume of research dealing not only with elasticity, but also with hydrodynamics and electromagnetism. His earlier work was mostly on hydrodynamics, particularly vortex motion and wave-motion. He returned also at various times to electrical problems, especially those relating to the propagation, scattering and transmission of electric waves. His elastical investigations range over an exceedingly wide field, from the equilibrium of beams and plates of various shapes to the study of vibrations in a variety of difficult cases and to the applications of the theory of elasticity to problems connected with the earth.

Hughes Medal: Prof. E. O. Lawrence

Prof. Ernest O. Lawrence, professor of physics in the University of California, is the inventor (1932) of the cyclotron, the most important instrument of physical research since the C. T. R. Wilson expansion chamber, whereby ions are accelerated in a magnetic field and move within two half-cylinders which change electrical polarity in rhythm with the circulating ions, so that deuterons have been spirally speeded in a vacuum to velocities due to three million volts, and these deuterons, impinging on beryllium, have produced neutrons and protons in great number, and some of the protons have been projected through the equivalent of forty centimetres of air. Many elements have been proved to be radioactive when thus bombarded by high-speed protons or deuterons.

Hydrogen molecular ions have been used also as bombarding elements with velocities due to five million volts. Such high-speed ions are available for developing the theory and practice of atomic disintegration, and Prof. Lawrence and his co-workers are playing a leading part in this development.

Racial Evolution and Archæology*

IN Huxley's day the Neanderthal calvaria was the only hominid not clearly included in the *Homo sapiens* group available for study; but since his time other skulls have been found, which make it evident that there were several hominids widely scattered over at least the northern hemisphere of the Old World, while the Broken Hill skull from Rhodesia may be taken as evidence of the penetration of one of these types into Africa south of the equator. There is thus conspicuous evidence already for an early stage of evolution of the unique capacity for migration that man has demonstrated.

W. D. Matthew suggested the plateau of Central Asia as the original home of man; but, on the whole, this is to be set aside, in part at any rate, for several reasons. It may well apply to the early beginning of hominid forms; but North Africa and south-west Asia, as Darwin suggested long ago, seem to have played the great part in the early evolution of the modern races. Here, broadly speaking, we have indications of important contributions to the full evolution of man as working themselves out to make our race increasingly different from the apes of the forests and their edges, taking to a life away from the vicinity of the trees and evolving towards the erect posture, with more effective stereoscopic vision, adding to this the use of tools held in the hand, increased attention to hunting, and consequent differentiation of the work of the two sexes. While this sketch is still partly unverified, circumstantial evidence, including physiological indications that man's constitution adapts him to a temperate environment, makes this the most probable hypothesis to use and test as new knowledge grows.

We need not assume that all the stocks of modern man descend ultimately from one pair of beings, or

even one small localized group. Nor should we assume that stocks of modern man in different parts of the earth have descended entirely from diverse ancestral hominids. We have to bear in mind the great migrations or drifts of humanity that have occurred from very early times onwards. It is the best hypothesis for the present to think of human stocks as of complex origin, with diverse constituents that may persist side by side to tell us of ancient drifts, as well as, perhaps, of diversities correlated with the different hominids concerned. Moreover, in every case we have to bear in mind the strong likelihood of adaptations to environment that may show themselves throughout a population, or may develop to different extents among its diverse constituents.

There is general agreement that the erect posture, improved stereoscopic vision and hunting developed among beings who lived a group life. All the indications we have for the past back to the Aurignacian-Capeian phases, even some relating to the Challeo-Acheulean, suggest group life. Students of society have been apt to think of man as the creator of society. Ethical ideas have, in rather a perverse way, been set over against the natural tendencies. Yet it is an idea that is in large part false, if society is, as the scientific study of man suggests, a basic feature probably older than man. Self-conscious individuality is really a development within the matrix of society. Both grew side by side, with mutual adjustment, often after conflict, but with many movements towards considerable freedom of conscience, which may be considered the fine flower of the human social garden.

One cannot leave this aspect of the subject without reference to the importance of the woman's part from the earliest stages in the processes of both individualization and social evolution. Apart from maternal care, the development of the 'mother-tongue'

* Substance of the Huxley Memorial Lecture, 1937, delivered by Prof. H. J. Fleure before the Royal Anthropological Institute on November 9.

and other activities, cultivation grew from the food-collecting, rather than the hunting, function, that is, from the woman's side rather than the man's.

Prof. Fleure then proceeded to trace the evolutionary sequence in the development of the races of 'modern man', as classified according to physical character, and followed the probable course of migration of each in geographical distribution, correlating them with the development of phases of cultural life—hunting, agriculture, pastoral, and so forth—from the later palaeolithic period onward. His conclusion on the question of the racial composition of the people of any one specific area is that "As something special in the way of immigration, conquest or other change has affected almost every region, each must be considered for its own sake and on the basis of its own story, if we are to understand the composition of its population". He went on to consider the complex racial composition of the European populations, pointing to the possibility, still not proved, of the association of a peculiar and characteristic mentality with racial type. It has not yet been possible satisfactorily to discriminate verifiable bundles including both physical and psychical characteristics that tend to be handed down together in the course of inheritance. Achievements of different peoples in literature, religion, government and so on may be brought into relation with what are thought to be prevalent types, but these are the achievements of exceptional people, while the opportunities and difficulties presented by different environmental or historical circumstances affect the result.

The warped interpretation of archaeological data in support of the 'autarkic' idea, with the object of glorifying the Nordic race, was shown not to be in accordance with the facts. Prejudice claims that the Nordic race developed many of the chief features of

European civilization of itself and spread them to more southern lands. So far is this from being true, that it can be shown that in the development of culture in the Baltic we are dealing, not with the advantages of racial purity and seclusion from contamination, but with repeated fertilizations of the north by ideas and techniques from the more advanced south.

In conclusion, Prof. Fleure stressed as an inference from the evidence of racial evolution and archaeology the importance of a diversity of racial and cultural elements in a given population, as having tended to promote adjustments as between social groups and the recognition of justice rather than privilege and group ritual. The extrusion or suppression of active thinkers means the loss of the means of keeping in contact with the ceaseless process of change. "Any group," he said, "that claims for itself complete truth or knowledge really forfeits its status and title as a contributor to civilization, which is, in a very deep sense, the process of growth of freedom of conscience . . . The principle of freedom of conscience is claimed to be a large element in the scientific ideal, and a necessary part of it. Without it there can be little trust, even in alleged statements of fact, much less in the good faith of arguments. . . . Formerly it was widely held that basic general truths were known, and must be accepted and applied as guides of conduct. The scientific movement, on the other hand, has pressed the view that man's codes and creeds and conclusions are all provisional, that the truth is an ideal towards which we try to approach, but which we may never completely grasp. Freedom alone can, in the long run, keep us flexible enough for continuous adjustment to the ceaseless change that is the inevitable accompaniment of life."

The New Inventions Exhibition

THE Institute of Patentees' policy of going on tour has provided some interesting exhibits at the New Inventions Exhibitions at Sheffield (October 20-30) and Leeds (November 10-20) this year.

The exhibits varied from obvious, though ingenious, gadgets to complex mechanisms of scientific and social significance which require demonstrating to be 'understood of the people'. The total number of exhibits was about 260, of which forty are by Leeds, and fifty by Sheffield inventors, and the remainder international. Doubtless these numbers would be greatly increased if, quite absurdly, inventors had not to be 'uncertainty-bearers'—a true function of Capital—as well as advance creators—an all-but-unbearable burden.

There are several new engines. One of these purports to drive a dynamo direct by a piston, itself steam-driven. The steam is produced suddenly by successive drops of water reaching a coil heated by the dynamo, 'cranked' over to provide starting heat. Another exhibit is a turbine engine claiming to yield around 40 b.h.p., and has its rotor driven by petrol-air explosion impulses, the gas mixture being induced by an automatic compression unit revolving together with a driving shaft at 2,000 r.p.m., whilst the rotor revolves at 30,000 r.p.m. on the same shaft, reduction

gearing of 15:1 being required. Third, a two-stroke 'six' engine, which lends itself to mass production, has correct balance due to each power piston being balanced by a full-charging pump piston moving oppositely, and achieves noiselessness because of this and the absence of valves, tappets and gearing. There are but twenty-seven moving parts, and each crankshaft revolution has six power impulses giving even torque similar to an ordinary 12-cylinder engine.

The electrotor dust and smoke meter, already referred to in NATURE (140, 331, Aug. 21; 582, Oct. 2) abstracts the particles, however small, from dust or smoke suspensions over a wide range of application. Since dispersions actually consist of separate particles invisible to the eye, these must be microscopically counted to determine the dispersion. By providing an extensive choice of record areas in this light and convenient instrument, and achieving electrification, rotation, suction and centrifuging by one simple motivation, the countability of particles is maintained over a unique range of over 1,500,000 per c.c.

Pit-coal arresters; a trolley device making only one overhead wire necessary; and a bell rung inside when it rains, are other intriguing exhibits.

S. C. BLACKTIN.

Committee on Social Contacts of Science

THE Committee on Science and its Social Relations (abbreviation: C.S.S.R.), instituted by the International Council of Scientific Unions (I.C.S.U.) at its meeting in April last, and appointed in July (see NATURE, 139, 870, May 22, 1937; and 140, 358, August 28, 1937, for the members nominated), has recently met in London. It has elected the following officers: *President*: Prof. F. J. M. Stratton (Cambridge); *Vice-President*: Prof. S. Chapman (London); *Secretary*: Prof. J. M. Burgers (Delft). As a development of the original terms of reference, the Committee has adopted the following more precise statement of the objects of its activity: "to consider the progress, interconnections and new directions of advance in the mechanical, physical, chemical and biological sciences, especially in order to survey, at suitable intervals, and to promote, thought upon the development of the scientific world picture, and upon the social significance of the applications of science" (the corresponding French version reads: "pour examiner les progrès, les rapports réciproques et les orientations nouvelles dans les sciences mécaniques, physiques, chimiques et biologiques, spécialement afin de résumer, à des intervalles convenables, et de contribuer à l'étude du développement de la représentation du monde par la science et de l'importance sociale des applications de la science").

The Committee will begin its work by collecting materials for the preparation of a report and of bibliographies concerning the points mentioned, in so far as they are reflected in publications and state-

ments of the years 1936-38, and in books which have appeared since the post-War period. As a general plan for the report a division has been suggested into the following headings: (1) outstanding developments and problems in scientific work; (2) new applications of science in human society; (3) interpretative work on the world picture as given by science; (4) thoughts on the social relations of science and the influences connected with its applications.

To obtain the necessary information, the Committee in the first place will address itself to the national and international bodies adhering to the International Council (national academies, research councils, etc., and international scientific unions), which are being asked each to appoint a correspondent interested in the activities of the Committee, who will act as a link between the organization by which he is nominated and the Committee. Further, an attempt will be made similarly to approach a number of organizations, both national and international, outside the I.C.S.U.; this in consultation with the Institut International de Coopération Intellectuelle of the League of Nations.

The Committee will appreciate it if persons or institutions who are interested in the work undertaken, and are in a position to make suggestions or to give indications concerning phenomena or points of importance, would write to the Committee. Communications can be sent to any of the members, and in particular to the secretary (address: van Houtenstraat 1, Delft, Holland).

Progress in Road Research*

IN the Second Annual Report of the Road Research Board it is shown that many road failures have been caused by the imposition on existing roads of loads much greater than they were originally constructed to carry, with the result that the foundations have given way. This is not surprising when it is recalled that many such roads started as cart tracks, and in the course of their evolution were next converted to water-bound macadam and later given superficial dressings of tar or bitumen or coverings of tar macadam or concrete, the foundations receiving no reinforcement to render them more fit to bear the heavier loads which these improved surfaces were attracting to the roads. The foundation of the road is therefore a vital factor in its durability, and is itself dependent on the supporting qualities of the subsoil, so that both for the building of a new road and for the adequate treatment of an existing road an examination of the subsoil is an obvious prerequisite. The report describes a field procedure whereby cylindrical cores of undisturbed material

can be obtained from any site for the purpose of ascertaining its value.

The foundation usually consists of stones laid on the subsoil or, alternatively, concrete slabs may be used. The Road Research Station at Harmondsworth, West Drayton, Middlesex, has devised practical methods for the study and measurement of road aggregates and, while not yet in a position to place limits upon the maximum percentage of flaky or long material permissible in the bulk—a matter which at present is left to the judgment of the engineer—has adopted methods by which supplies of road aggregates can be compared with approved samples. No quantitative basis of the exact measurement of the roundness or otherwise of stone has as yet emerged and the terms employed are restricted to such descriptive words as round, sub-round, sub-angular and angular.

In connexion with the use of concrete in road work, the large quantities of material on the site, the time required to complete the work, and the variability of the British climate, combine to make conditions which defy uniformity in the product unless the means of rigid control can be provided. In the vibrator, a machine has been devised which

* Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the year ended 31st March 1936. Pp. viii + 135 + 9 plates. (London: H.M. Stationery Office, 1937. 2s. 6d. net.)

meets this difficulty and ensures that the sand and stone are brought to a constant water content before mixing. Bituminous road materials have also been under continuous review. These deform permanently under load to an extent depending on the time of application of the load, and the tendency to deformation under given conditions of loading can be adjusted by varying the viscosity of the binder and the grading of the aggregate. In some cases, cracks formed at low temperatures heal themselves in warm weather, and the application of heat to the binder may alter its characteristics. The effect of moisture reaching an aggregate before it is completely coated with binder is to promote disintegration. Thus load, time, temperature, rain and other weather conditions and their influences on bituminous constructions are being closely studied.

The length of life of bituminous roadways has been under investigation in full-scale experimental sections of roads, but the information available from these only comes in slowly and with difficulty, and the laboratory research which is in progress to overcome this delay ultimately must of necessity be slow until the results can be co-related with the full-scale tests. Three machines are in use at Harmondsworth to obtain the nearest approximation to continuous road conditions on limited areas. One of these presents the novel feature that the 5 ft. 6 in. diameter track under test is revolved under a wheel with stationary axis, which is fitted with a full-size pneumatic tyre. Its purpose is, in conjunction with laboratory tests, to eliminate undesirable factors in road construction and in surface dressings. Those which give favourable results under this wheel are tested again under the second machine, which operates with full-sized tyres under their rated loads and makes use of a track 38 ft. in diameter laid under ordinary conditions. Those materials which pass this second test are laid down to form a track of 110 ft. mean diameter and tested by a third machine by means of which a full-size lorry is run at maximum speed.

For the study of skidding, the standard machine consisting of a motor cycle and sidecar fitted with dynamometers as previously described is still used. The report points out that the limitations of this apparatus are its one size of tyre and load, both smaller than those of cars and commercial vehicles, the necessity for using smooth treads in order to obtain comparative results, and the fact that the machine records only side-way skidding. To meet these defects, another apparatus has been designed which will be towed by a two-ton lorry and will allow tests to be made with tyres of 27 in. diameter loaded up to 600 lb. A further apparatus has been designed and constructed at the Laboratory to make accurate measurements of surface irregularities, by giving a profile of the road surface.

It will thus be apparent that road research has now reached the stage of the active production of apparatus to measure the factors which are of importance in road construction. Although in recent years, as Dr. R. E. Stradling, the director of research, states in his survey, there has been a rapid advance in the methods of highway engineering, the absence of sufficient scientific knowledge has led to a certain amount of design and construction on the wasteful expedient of hit and miss procedure. The work of the Road Research Board very largely aims at the formulation of a science of road engineering, which will enable engineers to work on definite lines rather than by trial and error.

Science News a Century Ago

The Management of Bees

At a meeting of the Ashmolean Society, Oxford, held on December 4, 1837, Mr. W. C. Cotton, of Christ Church, read a paper on the management of bees, showing the defective system pursued by cottagers and suggesting improvements. All that was required for bee-keeping, he said, is a small garden or even a few yards of ground before the door of a cottage.

The great secret of success, Mr. Cotton observed, is never to kill a bee. The smoke of the large fungus or puff ball, when quite dry, had an intoxicating effect upon bees, and by its aid, weak swarms might be united to strong swarms, and the combs might be taken out of a full hive without injury to the bees themselves. The method of uniting swarms at the conclusion of the honey season was first practised by Mr. Thorley a century previous, and side boxes had been introduced about the same time by Mr. White. Bees were of the greatest use in distributing the farina of fruits and flowers. Bees seldom lived beyond the year so that no apprehension need be entertained that they would grow old and lazy. Mr. Cotton had just published a pamphlet on bee keeping for cottagers (*Athenaeum*).

Mails from India

In the "Annual Register" for 1837 under the date December 8, it was said, "The project of steam communication with India through the Red Sea has been successfully accomplished, and is now in operation. The last communication was effected in forty-three days, including the stoppage at Alexandria. The following are the particulars: The *Atlanta* left Bombay on the 2nd of October and arrived at Suez on the 16th of October, with the mail of September; and at Alexandria on the 20th of October, from whence the mail was despatched by her Majesty's ship *Volcano* on the 7th of November, and arrived at Malta on the 11th, and was despatched from Malta to Gibraltar by her Majesty's ship *Fire-fly* on the 16th of November, and was due here on Monday the 4th of December".

Alexander's Electric Telegraph

In the *Athenaeum* of December 9, 1837, it was said, "We have been admitted this week to a private view of an ingenious model for an Instantaneous Telegraphic Communication, by means of electric or voltaic currents transmitted through metallic conductors under ground, the invention of Mr. Alexander, of Edinburgh. The principle Mr. Alexander uses is to have as many wires as will correspond with the letters of the alphabet and thus, of course, the person in London can by applying the electric influence to any wire apprise a person in Edinburgh that a particular letter of the alphabet is indicated. The expense of such a telegraph from London to Edinburgh is estimated at £100,000. To test the plan, various experiments have been tried in the University of Edinburgh, and we are informed with perfect success. We may further mention that we have this week been invited to inspect a Hydraulic Telegraph and we hope to be able to report on it shortly."

Societies and Academies

Paris

Academy of Sciences, October 18 (C.R., 205, 633-696).

MARCEL DELAUNAY: Obituary notice of Jean Baptiste Senderens.

KENTARO YANO: The change of the coefficients of a projective connexion.

GEORGES TRÉPICA: Certain quadratic curves and the displacement of a parameter.

DAVID WOLKOWITZ: The conoid of Plucker.

RENÉ HARMIGNIES: The torsion of curves traced on a surface.

ERNEST VESSIOT: Partial differential equations of the second order $F(x, y, z, p, q, r, s, t) = 0$, integrable by the method of Darboux.

JEAN DELSARTE: A functional transformation relating to the theory of harmonic functions.

JOHN ELLSWORTH: Rapid changes in the tail of the Finsler comet, 1937f. A description of the changes shown by photographs taken between August 2 and 11. There was a second tail, and a marked change in position was shown in two consecutive photographs with an interval of 75 minutes.

LOUIS BERGERON and JOSEPH BETHENOD: The hydraulic tourniquet.

LEOPOLD ESCANDÉ: The theory of flow through a depth valve.

MARCEL ATANABU: Study of natural convection in liquids. Convection in castor oil. An electrical heater is placed in the centre of the castor oil and the temperature differences measured at different points in the oil after the whole has reached a steady state. The convection flow is deduced from these figures. The results are in agreement with the views of Vernotte and experiments of Bory on convection in air.

AUREL NICOLAU: The thermomagnetic properties and constant paramagnetism of the ion UO_2^{++} in some uranyl salts in aqueous solution. Neither uranyl sulphate or nitrate follows the law of Curie or that of Weiss: the paramagnetism is independent of the temperature.

JEAN DEBIÈRE: Absorption spectra of microbial broths. The growth of micro-organisms in broth produces clear and characteristic modifications in the absorption spectrum. It is suggested that similar observations in the infra-red region and with Raman spectra would be of interest.

ALEXANDRE DUFOUR and FERNAND PRUNIER: The Sagnac effect.

MARCUS BRUTZOUS: The thermochemistry of oxygenated hydrocarbons.

FRANÇOIS BOURION and EMILE ROUYER: The determination of the total hydration of the ions of strontium nitrate.

RENÉ DELAPLACE: The pressure of some permanent gases at low temperatures in the presence of silica gel. The gases studied were nitrogen, oxygen, carbon monoxide and methane. A table is given showing the pressures measured for a range of temperature between -182°C . and -134°C . The figures show that it should be easy to separate the oxygen-nitrogen group from the carbon monoxide-methane group.

CLÉMENT DUVAL: The cobalt hydroxides. By the precipitation of aqueous solutions of cobalt salts with potash, six different precipitates can be obtained, varying in colour. The necessary conditions for the preparation of each variety are given, together with analytical figures.

GEORGES WEITBOFF: The oxide of phosphonitril, (OPN)₂.

LOUIS CHASSEVENT: The hydraulicity of slags.

ALFRED MAILLARD and R. FRIEDRICH: The products formed by the incomplete combustion of light liquid hydrocarbons. The combustion products were cooled to 15°C . and the condensate examined. Results are given for seven different petrols.

MILLE. MARIE LOUISE QUINET: The classification into two groups of the complex compounds of magnesium chloride with oxygenated organic compounds according to the nature of the oxygen linkage. The (OH) group, water and alcohols, gives complex molecules with six molecules attached to one molecule of magnesium chloride; the $=\text{O}$ group, aldehydes and ketones, attach three molecules; the ether oxide, $-\text{O}-$, gives no complex compound, at least for temperatures above -20°C .

PAUL CHOVIN: Researches on Pechmann's colouring matters. The supposed isomerism of Pechmann and Kugel colouring matters.

JEAN DUCOMBE: Syntheses by means of β -chlor-ethylated or β -vinyl ketones. The preparation of some homologues of 1-cyclohexene-3-one.

GEORGES DARZEN: The preparation of some glycerides of phenylacetic acid and their reduction to the corresponding alcohols. Application to the preparation of phenylethyl alcohol.

JEAN BNAUVIEUX: The granular structure of chloroplasts: the *grana*.

WERNER MÜLLER and WILLIAM HENRI SCHOPFER: The action of aneurin and of its constituents on *Mucor Ramannianus*.

P. BONET-MAURY: The optical properties of bacterial suspensions. Four species of bacteria were studied and in each case the optical density was proportional to the bacterial concentration.

F. ARTIGAS: The emission of an ionizing radiation by the total ash of plants. The radiation was found to be proportional to the amount of potassium in the ash.

ALEXANDRE BESSEDEKA and LUDWIG GROSS: The role of the skin properly so-called and of the subcutaneous tissue in the evolution of malignant tumours.

Delhi

National Institute of Sciences of India, November 6.

M. ISHAQ: The O-O-Band of OD.

T. S. WHEELER: The theory of liquids.

H. S. PRUTHI and E. S. NARAYANAN: A study of the behaviour of some common varieties of sugarcane in reference to the attack of borers.

D. S. KOTHARI: Joule-Thomson effect and adiabatic changes in degenerate gas.

B. RAMAMURTY: The chemical fixation of nitrogen at low temperature and its significance in agriculture.

M. N. SAHARA and K. B. MATHUR: The propagation of electro-magnetic waves through the atmosphere.

B. N. SRIVASTAVA: Joule-Thomson expansion of a non-degenerate gas.

Moscow

Academy of Sciences (C.R., 16, No. 1, 1937).

KH. SMALIKOV: The functions of Le Roi, H. Poincaré and V. Stekloff.

M. KELDÝŠ and L. SHODOV: The effective solution of some problems limited by harmonic functions.

STEFAN BERGMANN: Some values in pseudo-conformal images.

J. A. MUNDLE: The boundary dynamic problem of the theory of elasticity for a circle with given displacements.

V. SOKOLOVSKIJ: The design of a spherical shell.

V. S. KOSLOV: Determination of the elements of percolation flow under dams with three cut-off walls resting upon a permeable foundation of finite depth.

V. D. KUPRADIN: Solution of the general problem of the diffraction of electromagnetic waves.

V. K. ARKADIEV: The dispersion band and the skin-effect in the sinusoidal field and in the transitional one.

A. PROKOFJEV: Torch ion counter.

P. LAZAREFF: Theoretical study of the influence of mountain ascents and that of winds on peripheral visual adaptation.

N. MIHAL: The determination of the figure of the geoid from the anomalies in the horizontal gradients of gravity.

I. A. SMORODINOV and A. M. FELD: Determination of the dissociation constant of thyroglobulin.

M. A. KLOČKO: The 'lake age' of the Caspian Sea and its volume at the time it became a closed basin.

K. S. ANDRIANOV and A. I. SMIRNOV: The problem of the genesis of vivianite.

P. O. SITKO: Frequency of lethals in the X-chromosome due to the irradiation of spermatozoa in the males and in the spermathecae of the females of *Drosophila melanogaster*.

I. N. KONOVALOV and I. E. ROGALJEV: The behaviour of nitrogenous substances during the vernalization of plants.

V. L. RYJKOV and A. M. VOVK: A new disease of the onion (*Allium Cepa*).

(O.R., 16, No. 2, 1937.)

V. STEPANOV: Arithmetical demonstration of a theorem of B. Segal.

A. V. JOFFE and A. F. JOFFE: (1) Electronic semiconductors in strong electric fields. (2) Properties of the blocking layer of solid rectifiers.

H. MANDL and P. KUTENIKOV: The full electro-dynamics of material media.

N. S. KURNAKOV, A. V. NIKOLAEV and A. G. ČILINČOVA: (1) Heating curves of borates. (2) Specific gravity and hardness of natural borates and of the products of heating them. (3) Hydration heat and exothermic transformation of borate into inyoite. Some considerations on the transformation of borate.

V. V. ČILINČEV: Explanation of the disposition and inclination of rows of molecules in layers of organic acids according to roentgenograms.

B. P. NIKOLSKI and V. M. VDOVENKO: The potential difference between solid silver halogenides and aqueous solutions.

A. G. KOGAN and V. I. NIKOLAEV: Studies on the polythermes of the binary system $\text{HNO}_3\text{--HCl}$, and of the ternary system $\text{HNO}_3\text{--HCl--H}_2\text{O}$.

N. A. ORLOV and I. S. MUSTAFIN: Oxidation as a way to the formation of carbohydrates.

V. A. ŠPAK: A new method for differentiating rocks from borings by a counter recording gamma radiation impulses.

N. P. LUPPOV: The age of the "Upper Siderite clays" of the basin of the River Kuban (North Caucasus).

O. S. VIAOV: The mesozooids of Asia.

J. A. EFREMOV: Stratigraphic subdivision of the continental Permian and Jurassic of the U.S.S.R. on the basis of the fauna of early Tetrapoda.

V. I. CALKIN: The distribution of the common dolphin (*D. delphis* L.) in the Black Sea.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, December 6

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Prof. F. W. Twort, F.R.S.: "A Comparative Study of Filter-passing Bacteria and Viruses" (succeeding lectures on December 8, 10, 13 and 16).*

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Charles Sherrington, F.R.S.: "Jean Fernel" (Thomas Vicary Lecture, (1)).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Rev. W. L. S. Fleming, A. Stephenson and G. G. L. Bertram: "Scientific Work of the British Graham Land Expedition".

Tuesday, December 7

CHADWICK PUBLIC LECTURE (at the London School of Hygiene, Gower Street, W.C.1), at 5.15.—Dr. William Butler: "The Thames Estuary and the Problem of Sewage Disposal of Greater London".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Colonel W. Garforth: "Air Raids as they Affect the Work of the Civil Engineer".

QUINCE MICROSCOPICAL CLUB (at 11 Chandos Street, Cavendish Square, W.1), at 7.30.—Prof. L. O. Martin: "The Present Limits of Microscopy".

Wednesday, December 8

INSTITUTION OF CIVIL ENGINEERS, at 6.15.—Dr. Brynson Cunningham: "Estuary Channels and Embankments" (Vernon-Harcourt Lecture).

Thursday, December 9

THE ROYAL SOCIETY, at 4.30 p.m.—Dr. R. W. Gurney and Prof. N. F. Mott, F.R.S.: "The Theory of Photolysis of Silver Bromide and the Photographic Patent Image".

Dr. A. L. Reimann: "The Temperature Variation of the Work Function of Clean and of Thoriated Tungsten".

ROYAL ASIATIC SOCIETY, at 4.30.—Prof. Doi: "Japanese Myth and Tradition".

Friday, December 10

ROYAL INSTITUTION, at 9.—Sir George Simpson, F.R.S.: "Ice Ages".

BRITISH INSTITUTE OF RADIOLOGY, December 8–10.—Annual Congress to be held in the Central Hall, London, S.W.1.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MATHEMATICS in the City of Leeds Training College.—The Director of Education, Education Office, Leeds 1 (December 8).

PRINCIPAL of the Openshaw Municipal Technical School.—The Director of Education, Education Office, Deangate, Manchester (December 11).

LECTURER IN ANATOMY in the University of Birmingham.—The Secretary (December 11).

PATHOLOGIST AND BACTERIOLOGIST in the Memorial Ophthalmic Laboratory, Cairo.—Mr. H. H. Rew, The Examination Hall, Queen's Square, W.C.1 (December 18).

ASSISTANT in the Observatory at the Cape of Good Hope.—The Secretary of the Admiralty (O.H. Branch), Whitehall, S.W.1 (Ref. O.H. 7104/37) (December 21).

GLASS TECHNOLOGIST to the Government of the United Provinces.—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (December 31).

METEOROLOGIST (Grade III) in the Meteorological Office.—The Secretary (S.S.A.), Air Ministry, Admiralty House, Kingsway, W.C.2 (December 31).

INSPECTOR OF METALLIFEROUS MINES AND QUARRIES in North Wales.—The Establishment Branch, Mines Department, Dean Stanley Street, Millbank, S.W.1 (January 1).

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SATURDAY, DECEMBER 11, 1937

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The University in Modern Life

MORE than one discussion at the recent meeting of the British Association at Nottingham raised questions about the fundamental purpose and functions of the university in modern life which went far beyond the immediate practical problems under discussion. Some of these problems—for example, the part of the university in education for citizenship—had been raised at the conference arranged by the Association for Education in Citizenship at Ashridge in July, while since the Nottingham meeting a lively attack on the inadequacy of the universities in regard to adult education has been delivered by Prof. L. Hogben in a paper "Education for an Age of Plenty" at the conference of the British Institute of Adult Education at Cambridge.

Prof. Hogben criticized the universities for not supplying directly the instruction which is immediately helpful in the task of salvaging democracy, and argued for more courses on public health, nutrition, the social services and the economics of everyday life. The university, of course, teaches the way to sources of such information, but for adult education a special technique is required and its curriculum is not necessarily that which should be followed by the university itself. As Mr. W. Spens pointed out at Ashridge, the university should be an introduction to later life and assist the initial understanding of problems rather than the formulation of conclusions or actual participation in political or economic contests.

The tribute paid to the Modern Greats course at Oxford in itself shows that even in education for democracy the universities have scarcely been so deficient as Prof. Hogben would appear to suggest. None the less, the many and diverse concrete suggestions which have been made as to

the courses which a university should provide and the functions it should fill in a modern democratic society indicate that some fundamental reconsideration of their position is called for if their work is to be reorientated or planned to the better advantage of the community.

Most of the recent criticism of the universities has been concerned with their teaching functions, and a remarkable consensus of opinion has argued that this should be aimed more specifically at imparting the ideal of service and in training for citizenship and for leadership. In the discussion at Nottingham on the training of university graduates for the engineering industry, the importance of a broad training and one which stimulated participation in everyday affairs was repeatedly emphasized by different speakers. It was equally remarkable that not only was premature specialization in technical subjects recognized as undesirable, but also a definite suggestion was made, by Dr. A. P. M. Fleming, that the post-graduate instruction in the highly specialized and technical branches of engineering is a responsibility which the more progressive and larger industrial firms might well be expected to assume.

The significance of this suggestion lies, at least in part, in the fact that it was made by a representative of one of the most progressive firms in Great Britain, who himself has made an important contribution to technical training in that field. Obviously a proposal of this kind would involve very careful examination by all concerned before it could be adopted, but that it should be made at all indicates at least the existence of an atmosphere and a spirit of co-operation, in which the reorganization or reorientation of university courses to avoid overloading or excessive specialization and

to encourage all-round training, creative and independent thinking and the development of personality becomes practicable. The plea for the provision of travelling scholarships for the further training of immediate graduates, to be maintained by industrialists, which Mr. R. H. Clayton has since made in his presidential address to the Manchester Literary and Philosophical Society, is another indication of the increasing readiness of the industrialist to co-operate.

We are here, of course, once more faced with the old question as to whether a university training should be primarily to give the knowledge required to qualify men and women for some special mode of gaining their livelihood, or to equip them as members of society and as human beings. It seems to be clear from almost all recent criticism of the training of scientific workers such as engineers and chemists, however, that under modern conditions even the first objective cannot be realized if the second is neglected. Alike in industrial, commercial and civic life a sense of values and of perspective is demanded of those who hold responsible positions in management or even in the direction of research itself.

The very complexity of the problems with which leadership is confronted in society to-day emphasizes the importance of the cultural elements in a university training, not only because of the large number of those who become leaders in the national life who must have been under its discipline, but also because of the importance of critical intelligence in the rank and file of democracy. Premature or excessive specialization in any branch of science, or indeed elsewhere, is now almost universally condemned, and the dictum that the only specialization at a university should be specialization in the fundamental principles of the science as subject studied commands general support. Dr. Fleming's suggestion, if taken up, might well assist both the universities and the technical colleges to avoid some of the dangers of the past and to concentrate on the fundamental task of turning out trained minds, able to absorb knowledge later in life when left to their own resources, and to take their proper part in the life of the nation.

However important the teaching function of the university may be, the training of men is only one of these functions. Equally important is the conservation of knowledge and ideas. Under present conditions, indeed, as the report of the University Grants Committee pointed out, an exceptional

responsibility rests on British universities owing to the suppression in the universities of several European countries of all independent thought and critical discussion of the principles of government or of the meaning of life. Moreover, as Prof. M. Ginsberg pointed out in a thoughtful address in Section L (Educational Science) of the British Association on the functions of the universities in regard to the social sciences, there are important contributions which university study can offer to the clarification of the issues involved in many social and economic problems to-day, alike in regard to methods and assumptions made by the social sciences and in regard to the problem of values and moral issues. It was never more imperative that universities should be places where thought and disinterested inquiry are pursued on the highest level, and where the best minds of each generation are trained for intellectual achievement. The undoubted need for a re-orientation of our research effort so as to secure a more equable distribution between the social and biological and the physical sciences should not lead us to limit in any narrow spirit the fundamental researches which the university may initiate in any branch of knowledge, or to seek to influence its strictly theoretical approach to such problems. Never, indeed, was it more important that the fundamental research pursued in the universities should be pursued in a spirit entirely free from bias, prejudice or preconceived ideas.

Significantly enough, in the very address in which he suggested that large-scale industry should assume some responsibility for specialized technical training in engineering, Dr. Fleming stressed the opportunities for co-operative research which exist in the engineering departments of the universities but which at present, largely for financial reasons, are far from being fully utilized. Especially is this true of research in borderline subjects which are often outside the scope of an industrial research laboratory. In research no less than in teaching, the possibilities of co-operation between the universities and industry have yet to be fully explored and developed, and co-operation in the way indicated by Dr. Fleming is likely to strengthen rather than impair the independence and resources of the university in regard to long-range and fundamental research on problems the practical bearing of which cannot yet be foreseen.

Under modern conditions, however, it has been suggested that these important functions, of

teaching and training men, and research for the advancement of knowledge, are by no means the only functions which are required of a university. In our swiftly changing world, instructional studies ceases at about twenty-three years of age, and a man is very liable to lose intellectual energy by the time he is forty, and so fail to keep up with advancing knowledge. Sir Richard Livingstone, speaking in Section L at Nottingham, made a powerful plea that the universities should give attention to this problem of arranging systematic refresher or vacation courses at which those especially who occupy responsible positions in industrial, commercial or professional life, whether as managers or directors, should be able to refresh, re-equip and reorientate their minds and guard against the ever-present danger which the numbing effect of routine involves.

Here again, as Sir Richard Livingstone pointed out, is another field for co-operation between industry and the universities. If the special type of adult education required, enabling the student to place his special subject against the background of modern civilization, can only be supplied by the universities, the arrangement of such courses largely depends on the extent to which industry, commerce and the professions are willing to second promising officials for such systematic study. Moreover, it is probable that such a system offers the best means of giving the training in administration and management which is now generally recognized to be so important for those destined to fill the highest positions of management and control in industry. Apart from that, the contact thus established between the university and those with considerable practical experience of industry and the world of affairs can scarcely fail to have a very stimulating and helpful effect on the study of the social sciences at the university itself.

If, therefore, the universities are being called to reconsider their exact functions in our rapidly changing modern society, there is no less insistent call to industry and to society to consider their own relations with the university. The university cannot exercise the new functions unless the society in which it lives recognizes their value and is anxious that they should be performed. Not even in the training of men, whether for citizenship or for industry and the professions, can the university realize its highest ideals unless other sections of the community are prepared to co-operate with it, both by seeing that those entering a university have received an adequate general training, including some for citizenship upon which the university can base its own contribution, and by assisting in the provision of the detailed technical training required to equip those leaving the university for some particular vocation or branch of industry. The redistribution of research effort in relation to the fundamental needs of society and the planning of the reconditioning courses visualized by Sir Richard Livingstone demand as much thought from society as a whole as from the universities. In considering, therefore, the criticism which has been levelled at the universities in recent months, it should not be forgotten, that the highest traditions of the university can only be realized in a community which is willing to co-operate generously with the university. Not even the material endowments of a university are of more vital importance than a true harmony of spirit in which the highest ideals of a university are cherished without as within its walls, and where the community no less than the university is concerned that the tradition of candid and intrepid thinking about the fundamental issues of life shall be handed on unimpaired from one generation to another.

A Life of Lord Haldane

*Haldane, 1856-1915:

the Life of Viscount Haldane of Cloan, K.T., O.M.

•By Major-General Sir Frederick Maurice. Pp. xv + 394 + 8 plates. (London: Faber and Faber, Ltd., 1937.) 18s. net.

VOLTAIRE'S saying, "We owe consideration to the living; to the dead we owe truth only", would have been accepted by Lord Haldane. His autobiography was published soon after his death; and a leading article in NATURE of April

20, 1929, discussed especially his services to science and education as set out therein. But Haldane, always an exceptional man, showed a diffidence in his last testament contrasting strangely with the somewhat arrogant conceit of his years of power. The personalities of the small group of politicians who held the destiny of the Empire in their hands during the pre-War years will always be of interest. Haldane's life should be a compulsory subject of study for politicians.

Ironically, Sir Frederick Maurice's life of Haldane, who was a believer in 'wholeness', has been divided into two parts, and the biography is to be published at an interval of a year or so in two volumes. The year 1915, when Haldane's army reforms were being submitted to war's arbitrament and he himself was dismissed from office as Lord Chancellor, forms a natural line of division. To the scurrilous abuse heaped upon Haldane during this hectic year, the answer is now provided. His work in creating the Expeditionary Force is fully justified; and documentary evidence is produced that he urged its dispatch without delay to the seat of war. Some of his highly sculptured reforms proved to be 'snowmen'. His "General Staff", the brains of the Army, melted away at the outbreak of war; his Territorial Army, dubbed by Kitchener as the "Town Clerk's Army", was not used, as Haldane urged on Kitchener that it should be used, as the basis of military expansion. There were faults in his military policy—especially his failure to deal effectively with the grave question of the officering of the Army. The writing must surely have been legible on the wall of the War Office. "If there is one thing," Sir Coleridge Grove told the Military Education Committee on May 16, 1901, after the South African War, "which was shown by the war more absolutely than anything else, it is how enormously short we are of officers at the outbreak of any war. . . . In this last war, I had to get by any means that I could, over 2,000 officers additional to our usual supply in 15 months."

Two thousand officers! A bagatelle compared to the number of officers required during the Great War. Haldane's creation of the Officers Training Corps was a contribution of great value to this problem; but the role of the Corps after mobilization received no attention. The *liber aureus* concerned itself with the outbreak of war. Afterwards we followed our traditional policy of 'muddling through'. That gifted woman, Gertrude Bell, in one of her letters, remarked that "when people talk to me of our muddling through it throws me into a passion. Muddle through! Why, yes, so we do—wading through blood and tears that need never have been shed." Since the War, there has not been much disposition to brand the culprits for our sins of omission and commission. Silent and abashed we stand before the Cenotaph. In any impartial audit, Haldane's record will show a substantial balance on the credit side.

It is, however, Haldane's services to science and education with which we are chiefly concerned. He was an early convert to the idea of the civic university. Disbelieving in the federal conception as exemplified in the Victoria University of Manchester, he gave evidence before the Privy Council

and assisted in its disintegration. He worked also for the Bill of 1898 which purported to create a civic university in London. His speech in Parliament on that subject is reprinted. "This speech completely changed the atmosphere in the House, and when Balfour, who had come in to help his friend, rose and appealed to the opponents to withdraw their opposition the motion against the second reading was withdrawn." In this speech, Haldane invoked the late Prof. Huxley, "who was a distinguished advocate of this Bill, and who gave evidence before the Royal Commission, in which he laid down a scheme for a university which is now practically embodied in the Bill".

If space permitted, it would be of interest to contrast Huxley's noble conception of a re-organized University of London with the reality. Haldane followed his success with a scheme for establishing a London Charlottenburg at South Kensington. This in the result took an entirely different form from the original plan. "Haldane persuaded Sir Francis Mowatt, then Head of the Treasury, to agree that they [the Royal College of Science and the Royal School of Mines] should be incorporated in his plan." These institutions, by the way, had not "grown out of" the 1851 Exhibition and were administered by the Science and Art Department, not by the Treasury. Mowatt had no more right to de-nationalize them than to give away the King's battleships. Associates and students, traditions and trusts, should not be treated as chattels, even by Parliament. The Government was defeated in 1873 on a question relating to colleges in Ireland; and Gladstone tendered his resignation to the Queen.

We should hesitate to admit that the Imperial College of Science and Technology was "one of the great monuments of Haldane's vision and skill as a negotiator". The question of the proper relation of the technical college to the university was left open. Haldane tells us in his autobiography that he had been unfavourably impressed by the divorce of technical education and university education in Germany and resolved to work for a different plan. The close association of the London Charlottenburg, as originally proposed, with the University of London was fundamental, and the first public announcement was addressed to Lord Rosebery as chancellor of the University.

If Haldane had carried through the original scheme, for which he collected large funds, no trouble would have arisen. Controversy arose under the modified scheme, leading to the appointment of the Royal Commission of 1907. The immediate object of this was to define the relationship which should exist between the Imperial College of Science and Technology and the University, but "at Haldane's suggestion the terms

of reference were widened into an inquiry into the working of the university and the development of advanced education in London".

This suggestion fostered animosities between people who should have been working together *ad majorem gloriam Universitatis*, and deflected an enormous amount of energy in order to create another 'snowman' to add to Haldane's comprehensive collection. To vary the metaphor, Haldane overlaid his own child. The new statutes had been in operation for only a few years. It was unfair to subject the nascent university to an examination only appropriate to an adult organization. The recommendations of the Royal Commission over which Haldane presided "led eventually to the preparation of new statutes". This proposition may be arguable; but the historian should have recorded that the reconstitution of the University under the Act of 1926 bore little if any resemblance to that recommended by the Haldane Commission.

Sir Frederick Maurice, not being a compost of politician, jurist, philosopher (Hegelian and Epicurean) and educationist, will not claim to be the ideal biographer of this multifarious personality.

He has performed a useful task, for which readers in the present and historians in the future will be grateful. Ink is thicker than water, and it was impossible to disguise the fact that Haldane was by nature an intriguer. He must have created a new precedent in writing in 1905 to the King's private secretary to recommend his own appointment as Lord Chancellor—"The Woollack for me"; and his disloyalty to his own leader, Campbell-Bannerman, stands revealed. "He never sought popularity, and he was not the type of man to whom it came naturally." This is a frank admission. We have to remember, on the other side, the loyalty of some of his friends, particularly Grey and Asquith and Haig. The tributes exchanged in 1915 between Grey and Asquith, reprinted in Trevelyan's "Grey of Falloden" but not published at the time, should have been included. "I cannot express to you," Grey wrote to Asquith on January 25, 1915, "how indignant I feel about the attacks on Haldane"; and Asquith in his reply, after regretting that Haldane was "very much disliked by my own political party", added, "Personally I like Haldane".

T. L. H.

The Physical Interest of Eclipses

Eclipses of the Sun and Moon

By Sir Frank Dyson and Dr. R.v.d.R. Woolley. (International Series of Monographs on Physics.) Pp. viii + 160 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15s. net.

THE chief importance of this book for most readers will lie in the full discussion that it offers on the knowledge as to the physical state of matter in the outer layers of the sun that has been derived from eclipse observations. Naturally there are interesting chapters on the causes and the prediction of eclipses, on the Saros, on lunar eclipses and on the secular accelerations of sun and moon. These chapters cannot contain much new material, but they do give useful references, especially for the last-named subject. We note here one gap in the chapter on the prediction of eclipses that might well be filled in future editions: a reference, at least, might have been given to Dr. Comrie's corrections for a small difference in position in the site of an eclipse camp from the one for which complete data may have been calculated in advance. This would add to the usefulness of the book for an observer on an eclipse expedition.

As was to be expected with Sir Frank Dyson as one of the authors of the book, a full discussion is given of the deflexion of light by the sun's gravitational field. The conclusion reached that Einstein's prediction has been verified, though there may be a small additional displacement to be attributed to some other cause, will be one with which few will quarrel. That future eclipse observations of the Einstein effect should only be attempted when the sun is surrounded by a good field of stars is a sound piece of advice.

An interesting account of the older eclipse observations is given, but some of the space occupied by the account of the early controversies might have been better used, for example, in expanding for the benefit of future observers the chapter on eclipse expeditions and instruments. The most valuable part of the book lies in the account of recent published work, both observational and theoretical, on the chromosphere and corona. Very little has been missed, the most noticeable perhaps being the theory of the corona by von den Pahlen and Kohlschütter (*Veröff. d. Sternw. zu Bonn*, 24). Full attention has properly been paid to the successful results obtained at recent eclipses by Grotrian and von Klüber, and also to the beautiful work on the corona carried

out without eclipse at the Pic du Midi by Lyot. It looks as though we are within sight of the day when the occasional observation of the corona will be replaced by regular daily observations, either by direct photography or by some method such as that now being tried out by the Bell Telephone Company with the aid of television apparatus. Save for the extreme ultra-violet spectrum and for faint extensions, the corona may soon follow the prominences and drop out of eclipse programmes, leaving the field clear for the eclipse observer to concentrate on the important spectro-photometric problems connected with density gradients in the chromosphere and the transition stages at the limb between absorption and emission levels.

It is to be hoped that a future edition will contain a subject index as well as the index of names. There are one or two slips to be corrected. The date of the eclipse observed by Dufay and

Grouiller (p. 133) is 1932 and not 1936; the observations are the same as those mentioned two pages earlier and not a confirmation of them. The duration of totality for the observers in 1926 in Sumatra (p. 57) was 3.2 min. not 4.2 min., which was the maximum possible time of totality for the eclipse. Further, there seems no reason why the principal coronal line at 5303Å. should be omitted from the list of coronal lines (p. 149) observed in RS Ophiuchi at its outburst in 1933.

The mention of these minor slips must not obscure the high value and interest of the work to those interested in eclipse observations. The physicist will find the first connected account both reasoned and critical of all recent work on the chromosphere and corona. The observer will have his attention directed to the observations needing confirmation and to the more important problems requiring elucidation.

F. J. M. S.

Pond Life

Ferskvandsfaunaen, biologisk belyst:

Invertebrata. Af Prof. Dr. C. Weesenberg-Lund. Bind 1. Pp. vi + 414 + 12 plates. Bind 2. Pp. iv + 415-837 + plates 13-24. (København: Gyl-dendalske Boghandel, 1937.)

IN 1915 Prof. Weesenberg-Lund published a volume entitled "Insektlivet i ferske Vande" in which he gave a semi-popular account of the life-histories and habits of freshwater insects, based largely on the researches of himself and his pupils. As he explained in the preface, one of his objects was to make available to his countrymen, in their own language, the results of researches that had, for the most part, been published in foreign scientific periodicals and in foreign languages. With the same object in view, he has now produced in these two handsome volumes a survey of the remaining groups of invertebrates inhabiting fresh water, omitting the Protozoa, which stand apart and would require a volume to themselves. The theme of the work is the 'biology' (in the German sense) of the animals, their habits and mode of life. Systematics, anatomy and development are considered only in so far as they bear on this subject. At the same time, the abundant and excellent illustrations should enable the student to identify, at least approximately, most of the common species found in Denmark. Since 1930, the author has been director of the freshwater biological station established by the Carlsberg Foundation at Hillerød, and while the researches

carried on there have supplied much of the material for the book (including some hitherto unpublished matter) the survey has been extended to include brief accounts of the freshwater fauna of other parts of the world.

The first volume opens with a memorial notice of Otto Frederik Müller, the great Danish naturalist of the eighteenth century, who was a pioneer in the study of freshwater invertebrates. It is of interest to learn that thirty years ago Weesenberg-Lund drew much of his material from the very fish-ponds in which Müller had worked a century and a half before. Nowadays, it is sad to learn, they are all filled up or so polluted as to be of no further use to the naturalist. The author of the present work has, indeed, much in common with the naturalists of the eighteenth and early nineteenth centuries, whose powers of observation he commends and whose exquisite copper-plate engravings he reproduces in many of his illustrations. Like them, he is primarily interested in the living animals, and although he takes account of the physical and chemical data supplied by modern limnology, the study of the environment is subsidiary to the study of the organism. For him, the microscope is still a more important tool than the thermometer or the photo-electric cell.

In a work of such wide scope it was perhaps inevitable that the treatment of the various groups should be somewhat unequal. The most detailed and interesting chapters are those devoted to the

subjects of the author's own special researches. Thus we have very full accounts of the life-cycles and of seasonal and local variations in planktonic Cladocera and Rotifera, of the wonderful sporocysts of *Leucochloridium*, of the post-embryonic development of Hydracarina, and of the Polyzoa. A particularly attractive chapter is that dealing with the habits of the water spider *Argyroneta*.

Naturally there are omissions and occasional errors in dealing with groups with which the author is not personally so familiar. That favourite of the amateur microscopist, the rotifer *Meliceria ringens* (which we ought now, deplorably enough, to call *Floscularia*) does not build its wonderful tube with faecal pellets, although some of its congeners do. The author frequently quotes the work

of British zoologists, but there are lamentable gaps, showing that he is less in touch with their work than with that of their Continental colleagues. If he had been a more assiduous student of NATURE he would not have overlooked Lowndes' remarkable discovery of *Bathynella* in England, nor would he have failed to notice Gurney's fine monograph of the British freshwater Copepoda published by the Ray Society.

Prof. Wesenberg-Lund expresses the hope that the work may be found of use by the teaching profession. It would certainly be of much use both in schools and in universities in Great Britain to any teachers who would take the slight amount of trouble necessary to acquire a reading knowledge of the Danish language. W. T. C.

Medical and Psychological Aspects of Sociology

A Social Problem Group?

Edited by Dr. C. P. Blacker. Pp. vii + 228. (London: Oxford University Press, 1937.) 15s. net.

IN addition to a foreword by Mr. D. Caradog Jones, who explains the interrogation mark of the title by the intention to raise questions in the reader's mind, and a masterly introduction by the editor, this volume contains nine essays dealing with various aspects of the subject.

The first article, by Dr. A. A. E. Newth, senior school medical officer of the City of Nottingham, on the mentally retarded child, is based on a study of 1,872 children attending elementary schools in the area, of whom 1,388 were feeble-minded and 484 idiots and imbeciles. In his contribution on mental disorder and the social problem group, Dr. Eliot Slater, assistant medical officer to the Maudsley Hospital, has analysed 155 cases of adults receiving public assistance, and comes to the conclusion that apart from mental disorder the social problem group includes considerable numbers of psychopathic persons.

Dr. Tylor Fox, medical superintendent of the Lingfield Epileptic Colony, in a paper based on the study of 250 epileptic children of both sexes, maintains that no answer can be given to the question whether epileptics should rank in the social problem group.

The relation between inebriety and the social problem group forms the subject of a paper by Dr. C. W. J. Brasher, illustrated by cases under his observation at Woodlands Park, where he was formerly medical superintendent. He comes to the conclusion that psychiatrists are generally agreed

that parental and especially maternal inebriety has a profoundly injurious effect on the physical and mental development of the offspring, and that by some means the hereditary disposition to alcoholism is transmitted. Mrs. Sybil Neville-Rolfe, secretary-general to the British Social Hygiene Council, who writes on the biological aspects of prostitution, maintains that the prostitute is a social problem, and should be studied as such, mentally subnormal, psychopathic and over-sexed women forming a considerable proportion of those in the lower ranks of prostitution.

In his article on recidivism and the social problem group, Dr. W. H. de R. Hubert, psychotherapist to Wormwood Scrubs prison, claims that there is a definite relation between recidivism and the social problem group, although there are many gaps in our knowledge of the subject. Mr. E. J. Lidbetter's essay on the social problem group as a public charge contains a number of pedigrees showing the relation between psychological abnormality and destitution. Miss Janet Galloway, psychiatric social worker at the Maudsley Hospital, who writes on neurasthenia and unemployment, has made an elaborate analysis of 52 cases, including family histories, educational attainments, past occupations, military service, age at marriage, number of children, duration of unemployment and neurasthenia, income, housing conditions, food and treatment. The final contribution, by Mr. Caradog Jones, entitled "A Note on the Definition of the Social Problem Group", contains a survey of the previous articles.

The book may be warmly recommended to those interested in eugenics, anthropology, sociology and criminology.

Weeds, Weeds, Weeds

By Sir Charles Vernon Boys. Pp. 72. (London: Wightman and Co., Ltd., 1937.) 1s. net.

THIS charming little book relates the practical experiences of a very keen observer in eradicating by various methods the common weeds of his farms and gardens.

The earlier pages deal with lawns; the standard lawn sands have proved highly successful, but Sir Charles may have been a little more fortunate than other gardeners on chalk soils, where eradication of weeds from lawns is frequently difficult. A recipe for lawn sand would perhaps help readers who desire to make their own mixtures.

The author has thoroughly tested sodium chlorate as a weed killer against nettles and many other plants, and he recommends its use on drives and paths. He carefully points out the fire danger, and how it may be avoided. The reviewer has seen sodium chlorate effect a thorough clearance of some thousands of the lesser bindweed, pushing up through the surface of a newly made hard tennis-court. Care must be used to avoid any undesirable firework displays during subsequent play! By the liberal use of the hose the chlorate can be washed down below the granite chips, which dry rather slowly when the chlorate is used. Recent letters in *The Times* show the potency of this chemical in eradicating the troublesome *Aegopodium podagraria* L., well known as goutweed, or bishopsweed as it is inappropriately called, for bell, book and candle fail to exorcise it. The author well deserves to be free from such a diabolical weed; there is but brief mention of it.

There are many other practical hints of great value to the gardener concerning humus, monkey jacks and tools. Only a few generic names, for example, *Plantago*, escape a capital letter. This book is truly wonderful value at the price. M. A. H. T.

Borderlands of Language in Europe:

and their Relation to the Historic Frontier of Christendom. By Vaughan Cornish. Pp. x+105. (London: Sifton Praed and Co., Ltd., 1936.) 6s. net.

As an exponent of human geography, Dr. Vaughan Cornish is always stimulating. In the present study, he deals with the debatable borderlands of Europe. As the result of an examination of linguistic frontiers, in which he has traced their history backward, he has in almost every instance been able to arrive at a definite date of origin for such borderlands. This he finds falls within the period when the district under investigation was situated on the frontiers of Christendom. In the west, these linguistic boundaries perpetuate conditions in the political geography of Europe at the time of the collapse of the Western Empire. Thus, for example, the line of demarcation between French and German near Belfort follows the line of the political frontier between Christian Burgundians and heathen Alamannians in the fifth and sixth centuries; while an even more striking instance of the politico-religious frontier is to be seen

in the German-speaking population of the Italian province of Alto Adige, who are the survivors of heathen Bavarians who crossed Rhaetia and retained their pagan customs in the mountains until 730. The like argument is applied to the linguistic frontiers of eastern Europe. For these studies the author stresses the importance of the ecclesiastical map of medieval Europe, which is brought out most clearly in his examination of conditions in Bosnia, as a borderland of nationality and race, where peoples of the same language joined different churches.

Biology for Medical Students

By C. O. Hentschel and Dr. W. R. Ivimey Cook. Pp. xii + 664. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 18s. net.

THE second edition of this well-known text-book has been modified to cover the joint syllabus of biology for medical students adopted by the Universities of Oxford and Cambridge, as well as to satisfy the students in the University of London. This has involved descriptions of *Plasmodium* and several green algae, *Peronospora* among the fungi and the cockroach as an example of an insect.

Apart from these additions, the whole text has been revised and brought up to date.

In spite of the syllabuses, however, the text seems to contain too much for a medical student to grasp in his first year, for he is not studying the subject as a biologist but rather as an aspirant to different ends, using biology as a basic science to his more specialized and more relevant studies. This applies especially to the chapter on evolution and heredity.

The book, however, is well written and as such would form a very desirable introduction for students of biology itself. But while medical students are forced to read such (to them) detailed material in their first year, it is no wonder that the majority of them dislike the subject and ask why they should suffer it.

Systèmes de référence et mouvements (physique classique)

Par Prof. Augustin Sesmat. 5: L'Optique des corps au repos. Pp. 385-484. 18 francs. 6: L'Optique des corps en mouvement. Pp. 485-614. 20 francs. 7: L'Esprit de la science classique. Pp. 615-688. 12 francs. (Actualités scientifiques et industrielles, 483-485.) (Paris: Hermann et Cie., 1937.)

THE issue of parts 5, 6 and 7 completes the above volume in this series on classical physics; it is to be followed by one dealing with relativity physics. The present parts cover pre-Fresnel optics, the general theory of wave motion, the electromagnetic theory of Maxwell and the electronic theory of Lorentz, the influence of movement of the source or of the medium on the propagation of light, the drag of the medium, the experiments to test the theories, including those of Michelson, the origin of the idea of action at a distance, material points and their relations, physical time and simultaneity, relativity in physics. The volume concludes with a bibliography of ten pages.

The Pleistocene History of the West Midlands*

By Prof. Leonard J. Wills

THE DIFFERENT TYPES OF DRIFT AND THEIR DISTRIBUTION

THE region I propose to deal with is bounded on the west by the north-south line of hills from the Clees in Shropshire to Malvern; on the south by the Cotteswold escarpment; and on the east by the watershed surrounding the headwaters of the Avon. Its northern limit may be defined by a line from Iron Bridge to Wolverhampton, Lichfield, Tamworth, Nuneaton, Rugby. Within these boundaries there are the two great *vales* of *Severn and Avon*, embracing on the west, south and east a triangular plateau drained by the Cole, Blythe and Tame, which carry its waters away northwards to the Trent. In this 'Midland Plateau' is the high ground of the South Staffordshire coalfield reaching, via the Lickey Hills, into East Worcestershire and West Warwickshire, and into the high ground of the East Warwickshire coalfield: the lower ground of the Cole and Blythe valleys between these heights is itself elevated—an upland rather than a vale.

The greatest anomaly in the topography is the valley of the Severn, which is cut, first as a gorge, through what should be a major watershed at Iron Bridge, and later as a sort of groove along the west side of the great vale-like depression the centre line of which lies a few miles to the east. It is probable that in pre-Glacial times the upper Severn went to the Irish Sea, that the watershed of England separated it at Iron Bridge from the middle and lower Severn, which then had its source where now the Worfe rises. From here it may have followed the line of the great depression now occupied by the valleys of the Worfe and Claverley Brook, the Lower Stour, the Elmley Brook and Salwarpe, and the Bow and Piddle Brooks.

A thorough appreciation of the vast extent to which erosion has gone on, and of the enormous length of time involved, at once helps us to understand the apparently anomalous distribution of Glacial drifts in this region, in which, as a rule, the vales and lower ground are free from Glacial deposits, whereas the higher country and the watershed areas are extensively and often heavily drift-covered—a disposition that is the exact converse of the usual arrangement in a glaciated region. I shall attempt to show in the sequel that

the drifts formerly extended beyond the regions where they now form large outcrops, and that their absence from an area need not be taken as an indication that it was never under ice.

The drift-covered areas may be grouped in relation to the major watersheds, as follows:

(1) Watershed between the *Tern* and *Pent* on the north and the *Severn*, *Worfe* and *Smestow* on the south, and between the *Pent* and the *Shenstone Brook*. Towards the north-west it is continuous with the heavily drift-covered plain of North Shropshire.

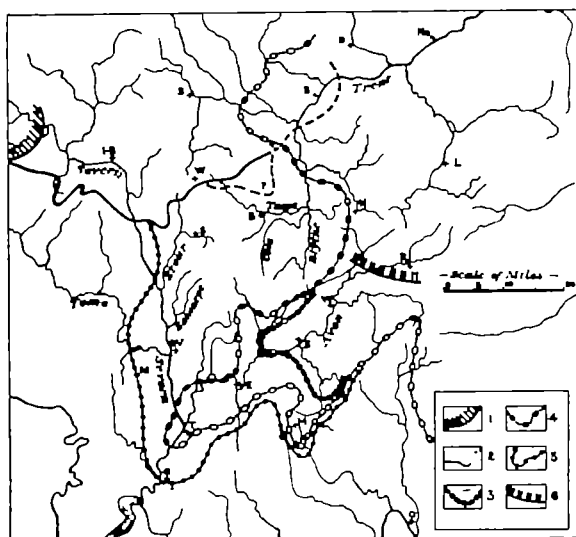


Fig. 1.

THE SPHERES OF INFLUENCE OF THE GLACIERS THAT INVADDED THE MIDLANDS 1, LITTLE WELSH GLACIER OR 'WELSH RE-ADVANCE'; 2, MAIN IRISH SEA GLACIER; 3, STRATFORD STAGE OF, and 4, SUPPOSED MAXIMUM OF GREAT EASTERN GLACIER; 5, MAXIMUM OF FIRST WELSH GLACIER; 6, POSSIBLE SOUTHERN LIMITS OF A VERY EARLY EASTERN GLACIER.

(2) Watershed between the *Tame* on the north and the *Pent*, *Severn* and *Avon*. This contains most of the Midland Plateau, as defined above.

(3) The watersheds between the *Avon*, *Anker* and *Soar*.

Each of these three areas is characterized by a particular type of drift (Fig. 1). Yet each type is by no means confined to one district, but as a rule has had a wider distribution, evidence for which may in some cases be found in the intervening vales.

In the first or *north-westerly district* the drifts belong, perhaps exclusively, to the Main Irish Sea

* From the presidential address to Section C (Geology) of the British Association, delivered at Nottingham on September 8.

glaciation. They are full of Scottish and Lake District erratics, and contain fragments of shells picked up from the floor of the Irish Sea. In addition, there is material from Wales; but this, for the most part, has probably been incorporated from the deposits of earlier glaciations. There seems very little evidence of such older deposits still in their original positions.

The Irish Sea glacier advanced inland counter to the drainage, and in our district surmounted the watershed. It is significant that its deposits occur on the watersheds and at the same time reach into the valleys. The southern limit of the Main Irish Sea drifts is shown on Fig. 1. It is generally marked by a great concentration of boulders.

It is now generally accepted that we can divide our British Glacial deposits into 'Older' and 'Newer Drifts'. The *Newer* can be recognized by reason of the freshness and unaltered state of their surface features, which exhibit clearly original forms like kames, *dsar*, kettle-moraine, moraine-lakes, and so on. Their obvious influence on, and relation to, the present drainage is another characteristic feature. On both these counts, the Irish Sea Drifts of this north-western area must be regarded as part of the Newer Drifts. Outside the line marking their limits the rest of the Midlands belongs to the realm of the *Older* series, and has remained extra-glacial since the time of the deposition of the latter.

It is fortunate that the Irish Sea Glacier brought with it a great influx of Scottish and Lake District erratics, for such vast numbers of them found their way into the Severn via the Worfe and Smeaton as to give a characteristic lithology to the Main and Worcester Terraces, by which they can be recognized with certainty as later than the terraces which belong to the time of the 'Older Drifts'.

The other two districts belong to the domain of the 'Older Drifts'.

We may consider next the *eastern area*. Here the most characteristic drift is the Chalky Boulder Clay and its associated flinty gravels and sands. Though there are other drifts present, these deposits are proved by superposition to be the most recent. As is well known, the Chalky Boulder Clay was the product of a mighty ice sheet to which Harmer gave the title of the Great Eastern Glacier, the limits of which are indicated on Fig. 1. In the main area, which is that lying east of the Tame and lower Anker, and round Nuneaton, Coventry and Rugby, the drifts are the westward continuation of the great spreads of Rutland and Northamptonshire so clearly delineated on Harmer's famous map of English erratics. From the Soar and Anker valleys there is an extension into the Trent valley. Southwards, the 'Main Eastern'

drifts (of Miss Tomlinson) near Stratford-on-Avon appear also to belong to the Chalky Boulder Clay Series. The same is true of the 'Moreton Drift' of the same author, though this can only be linked with those of Stratford by a series of hill-top occurrences in the otherwise drift-free vale of Avon.

In the last of our three drift-covered areas, the *Midland Plateau*, it is not easy to generalize about the distribution, composition and origin of the drifts. Often they consist of 10-20 feet of pebbly clay, sands and coarse gravel, but there are several districts where far thicker deposits occur. Most of the Warwickshire Plateau has a covering of clayey gravel, sand and sometimes coarse gravel. The high-level drifts of the Ridgeway and of the hill-tops of Worcestershire are chiefly sands and gravels, 'fringe' deposits as Jerome Harrison termed them, implying that they were mainly periglacial in origin. On the Ridgeway there are also areas of clayey ground-moraine.

The composition of the drifts varies somewhat, but they always include a great deal of Bunter material, both pebbles from the Middle Bunter and quartz grains from the sandstones. Next perhaps in number are erratics from the coalfields and from the Wrekin area. North Welsh rocks are often common, many coming from the Berwyns and the Denbighshire Silurian country. Large boulders of Arenig (and ? Aran) origin are common in the district stretching from Walsall through Birmingham and Harborne, and over the Lickeys and Frankley to Bromsgrove. North Welsh material is therefore the most striking of the common far-travelled erratics, and for this reason it is appropriate to term these deposits the *Welsh Drifts*. To them, however, an Irish Sea Glacier contributed Scottish and Lake District erratics on an exiguous scale. We may perhaps infer from the distribution of the latter that they belong to a later stage in the glaciation than that which was responsible for the more southerly Welsh Drifts, these being devoid of the northern elements. It is important to realize that various lines of evidence point to the fact that it was not the Main Irish Sea Glacier, but an earlier one that introduced these few boulders.

Owing to its position between the spheres of influence of the Irish Sea and the Great Eastern glaciers, this central area with predominantly Welsh drifts offers borderline cases where it is difficult to decide to which glaciation a particular deposit belongs. The Kingswinford Eaker described by Boulton, and the gravels with many northern boulders at Maney near Sutton Coldfield, provide two examples where it is a question of distinguishing between a Main Irish Sea and a Welsh origin; whereas the drifts of the Ridgeway in East

Worcestershire seem to be compounded of Welsh and Eastern elements.

Over much of that part of the Warwickshire-Staffordshire Plateau which is drained by the upper waters of the Tame, Cole and Blythe, the mantle of drift is comparatively intact, and frequently forms the valley floors; but on the Severn-Avon side of the watershed of England it becomes very ragged, projecting outwards as promontories or forming outliers on the highest hills. This is so far a rule that one is forced to view the capping as remnants of a more or less continuous sheet which once stretched far into the vales of Severn and Avon. Here it has in most places been completely destroyed. Evidence of its presence must be sought for on the hill-tops and not in the valleys, all of which in their present state are younger than the glaciation.

It is, I think, fair to conclude that the ice sheets at their maxima occupied the vales, and that these were far shallower than now. This hypothesis sounds very speculative, but there are some remarkable pieces of evidence in its favour*.

THE RIVER TERRACES AS EVIDENCE OF THE STAGES IN THE EROSION

If we are right in claiming a former far wider distribution of the drifts than the areas where they now occur in force, the river valleys should provide a great deal of evidence concerning the way in which their destruction has been brought about. In the present case this is certainly so; for we have in the Severn and its tributaries a wonderfully developed system of river terraces and of deposits that originated under the rigorous conditions of glacial climates, the so-called taele gravels and melt-water flood gravels.

The farther we go from the plateau and from the drift-covered ground on its north-west and eastern sides the greater the number of high-level terraces. In some cases the geographical distribution and the lithological composition enable us to relate a terrace to a particular set of glacial

* The evidence is discussed in the printed address.

deposits. These points are brought out by the accompanying table.

Severn	Avon*	Height at Mouth of Severn†	Upstream Limit		Composition
			Severn	Avon	
Woolridge	—	? about 200 O.D.	Tewkesbury	—	B, ?W, M**
Bushley Green	No. 5	110/75 O.D.	Tewkesbury	Stratford	a few P do.
Kidderminster	No. 4	66/35 O.D.	Bewdley (goes up Stour)	Stoneleigh near Kemilworth Church	do.
Main	Nos. 2 & 3	357/15? O.D.	Coalport (goes up Worfe)	Lawford near Rugby	do. and S
Worcester	No. 1	?—25 O.D.	Strewsbury	?	do. do

* Miss Tomlinson's nomenclature. † Height of top/height of base.
 ** B, Bunter Pebbles; W, Welsh; P, Flints; M, Malvernian; S, Scottish and Lake District.

I have elsewhere discussed the extremely ambiguous evidence bearing on the question whether there was an interglacial episode between the time of the Main and Worcester Terraces, without being able to obtain an assured answer. On the other hand, the fauna of Avon No. 4 is a warm climate one, which makes it probable that both it and its correlative, the Kidderminster Terrace, are interglacial. The position of Avon No. 4 Terrace below Avon No. 5 which connects with the Great Eastern glaciation, and above the terraces, Avon No. 2 and ? No. 3, which correlate with the Main Terrace of the Severn and so with the Irish Sea glaciation, forces us to conclude that these two glaciations were not contemporaneous.

Various lines of evidence converge, therefore, towards the following conclusion: that the Bushley Green-Avon No. 5 Terrace and the still higher Woolridge Terrace are to be correlated with the 'Older Drifts'; that the Main, the Worcester, and Avon No. 2, and possibly Avon No. 3, Terraces, belong to the 'Newer Drifts'; and that the Kidderminster-Avon No. 4 Terrace records the intervening 'Great Interglacial.' The question whether the older drifts of the Midlands bridge more than one glacial epoch is dealt with in the sequel.

[To be continued.]

Mechanism of the Photographic Process

A GENERAL discussion on "The Mode of Action of the Photographic Plate" in Section A of the British Association meeting at Nottingham, was opened by three speakers, who treated the problem of photography from three different points of view. Mr. E. R. Davies drew a picture of the action of light on photographic materials mainly from physical evidence. Dr. S. O. Rawling gave an account of the action

and theory of development. Prof. N. F. Mott described a theory of light action and latent image formation which was developed on a wave-mechanical basis and which provides an explanation for many hitherto puzzling facts and a useful working hypothesis.

The sensitive layer of any piece of photographic material consists of a thin film of gelatin in which is embedded an enormous number of minute

crystals of a silver halide. Silver bromide is most commonly used and is precipitated in the course of manufacture in a gelatin sol. After various operations which greatly affect the sensitivity to light, the so-called emulsion is spread out on a support and dried down to form a layer about $1/1000$ in. in thickness.

The light-sensitive unit in the photographic layer is the individual silver halide crystal. Its sensitivity manifests itself in two ways. Sufficient exposure to light causes the crystal to darken visibly—print-out effect. Exposures smaller by a factor of $1/10^4$ produce the 'latent image', which makes the crystals developable.

The print-out effect consists of the direct production of silver by the action of light, with liberation of the halogen. If this can be taken up by the surrounding medium the process will proceed to completion. Two points were emphasized. The quantum efficiency is of the order of one silver atom formed per absorbed quantum of light. Light is absorbed all over the crystal, but the silver coagulates and forms specks.

The latent image provides the ever-new problem in photography which cannot yet be regarded as solved. No satisfactory proof of its nature has so far been offered, although the print-out effect strongly suggests that it consists of specks of metallic silver. A few to a few hundred light quanta must be absorbed to make a grain developable. It is difficult to say what effect so few silver atoms could have unless they coagulate to form a speck. Since there is so far no sufficiently sensitive physical method by which the latent image can be detected, we have to use the results of development for its interpretation. A thorough understanding of the process of development is therefore essential.

The latent image acts as a trigger or a catalyst, which enables the developer to reduce the silver halide crystal. Practically all the energy required is supplied chemically, and the latent image itself is lost in the process of development. Developers are often regarded as solutions possessing certain redox potentials. (In the physicist's language, the term redox potential may be explained by saying that the potential measures the ease with which electrons are given off by the solution, a low potential meaning a stronger reducer, giving off electrons more easily.) If the potential is too low, silver halide crystals will be reduced indiscriminately, whether they carry a latent image or not: if the potential is too high, they will not be developed at all. By preparing a series of solutions of decreasing potential it can be shown that at a certain critical potential no development takes place; below that a solution will act as a developer; above it as an oxidizer,

destroying the latent image. Similar results are obtained on a partly developed piece of photographic material, which, of course, contains bigger particles of silver. At another critical potential no change occurs; above it the density is diminished, below it further development occurs. This critical potential is higher than that of the latent image. The conclusion from these experiments is that the latent image silver speck must be above a certain critical size—which cannot, however, be worked out from these data—but below the size at which it would act as solid silver.

These thermodynamical considerations do not tell us anything about the actual mechanism of development. Two essentially different processes have been suggested. One is that the silver halide is dissolved, is reduced to silver in the solution, which soon becomes supersaturated with reduced silver, and the supersaturation is relieved by deposition of silver upon the latent image. From the behaviour of artificially produced silver particles it has been estimated that an aggregate of four or five atoms of silver may be necessary for this, action to occur. The other suggestion is that the developer, while not being adsorbed by the surface of silver bromide, which is negatively charged, is strongly adsorbed by a speck of latent image, and from this foothold is able to reduce the rest of the crystal, either through the body or at the interface between crystal and developer. Experiments have shown that some of the commonly used developing agents, which yield negatively charged reducing ions, are indeed only feebly adsorbed to negatively charged silver bromide but are strongly adsorbed to colloidal silver, and that by this very adsorption their reducing activity is enhanced. These facts lend strong support to the second hypothesis.

It is, however, probable that both mechanisms can operate, sometimes together. With some developers, yielding positively charged ions, the deposition mechanism probably operates almost exclusively, and we then have the slow, so-called physical development. With other developing solutions the adsorption mechanism, with direct reduction at the interface between silver and silver bromide, may predominate. This seems to be the more likely action with ordinary commercial development.

Another mechanism is based on the fact that the negative charge on colloidal silver particles is discharged by light, when the particles become developable. A similar process may occur in the bigger silver halide crystals.

Development always takes place in two seemingly definite steps: an induction period, in which no visible changes occur, and the development

proper, which proceeds very rapidly. Unless special precautions are taken, a crystal is either found to be completely developed or not at all. The process of development seems to be an autocatalytic reaction, but the significance of this for the mechanism of development is not clear.

We are thus led to the assumption that the latent image consists of a silver speck of critical size.

The formation of this silver speck was then considered. Light is absorbed all over the crystal and forms isolated silver atoms, which then coagulate into a speck. The distinction was drawn between a primary process, the formation of silver atoms, and a secondary process, the coagulation.

The primary process in latent image formation is strongly influenced by changing the absorption of the individual silver halide crystal. This can be done by dyeing the emulsion with 'sensitizing dyes'. The natural absorption of silver bromide in the ultra-violet and the blue, and with it its spectral sensitivity, can be extended right into the red and infra-red. Silver bromide containing a few per cent of silver iodide is much more sensitive than pure silver bromide; this probably also influences the primary process. The absorption spectrum has mostly been found to coincide with the spectral sensitivity of an emulsion. Sensitizing dyes are always strongly adsorbed to silver halide: an intimate contact between dye and crystal seems essential.

The secondary processes strongly influence the sensitivity, that is, the number of quanta required to be absorbed to make the crystal developable. The sensitivity of crystals increases with their size: coarse grain materials are more sensitive. The explanation is not solely that a bigger crystal will absorb more light and thus form a bigger speck more easily, because it has been found that crystals of the same size differ widely in their sensitivity, which is also influenced by the gelatin and foreign substances generally. The active medium is found to be mainly silver sulphide. There has been much speculation as to the way it acts. Silver sulphide probably forms specks on the surface of the silver halide crystals and acts as a condensation nucleus. Much evidence, mainly of chemical nature, confirms this hypothesis.

Here the present writer would point out that, while the latent image in photographic materials cannot be detected by physical methods, there exists a seemingly strict analogy in big single crystals of silver halide. On illumination with blue light they become coloured and develop an absorption band in the red. On illumination with red light this absorption band is bleached out. This corresponds to the Herschel effect on

photographic materials, where the latent image is bleached out by consequent exposure to red light. Furthermore, the spectral sensitivity of the Herschel effect coincides well with the absorption band observed in single crystals, suggesting strongly that the particles responsible in both cases must be the same. The particles in single crystals are usually regarded as colloidal silver particles, the absorption band being due to colloidal scattering. This, however, leads to impossible dimensions for the silver particles, which cannot, from photographic evidence, be bigger than a few hundred silver atoms. The absorption band observed in single crystals cannot, therefore, be due to colloidal scattering, but must be caused by a more specific absorption process arising from the intimate contact between the silver speck and the silver halide crystal.

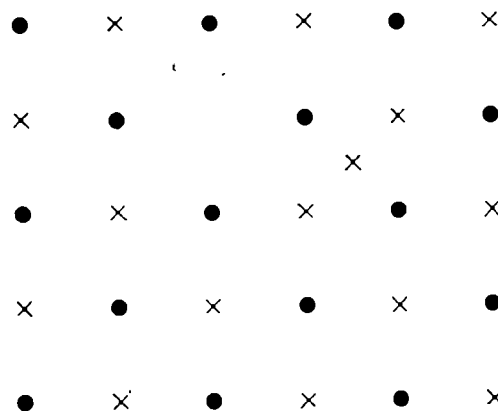


Fig. 1.

IONIC CONDUCTIVITY IN THE SILVER HALIDE LATTICE.

The mechanism of latent image formation was then considered. The crystals are made up from silver and halide ions. In order to produce a silver atom we have to remove an electron from a bromine to a positively charged silver ion. This act is thought to constitute the primary process in photography. In dye sensitization the electron may come from the dye molecule instead. The fact that silver halides are photo-conductors shows that the electron is not very strongly attached to the silver ion, and may move about in the lattice. Calculations show that the mobility of such an electron is almost as high as in a metal.

A speck of silver in contact with a silver halide crystal was considered. There is a certain probability for some electrons to escape from the silver into the crystal, and an electron vapour pressure is set up which depends on the temperature. The speck thus becomes positively charged. The sensitivity specks of silver sulphide may behave in a similar way. Illumination with light increases

the electron concentration in the crystal. If this concentration is higher than the equilibrium concentration of the speck, electrons condense on it. The speck becomes negatively charged and tends to attract the positive silver ions. Silver halides are also ionic conductors; the conductivity is entirely due to the silver ions. A mechanism has been suggested for this ionic conductivity which is illustrated by Fig. 1. At any temperature there are some silver ions in the wrong position in the centre of the cube of four others, leaving an empty space in the lattice behind them. These silver ions have a certain mobility, and so have the holes whence they came. The ions will be attracted by the charged silver or silver sulphide speck and will increase its size, pushing it out of the grain. We

certain density after development, against the intensity, that is, the rate at which the quanta are received. Two facts are most striking; that there is an optimum intensity where a minimum of exposure is necessary, and that with lowering of the temperature the material becomes more sensitive at low intensities—a fact which should be most valuable for spectrography. Since a critical electron vapour pressure has to be reached before the latent image can be formed, at sufficiently low intensities no latent image may be formed at all; since there is a certain chance for recombination of the electrons with the bromine atoms the critical vapour pressure may never be reached. On raising the intensity the critical pressure will be reached for the more sensitive grains in the material, but not

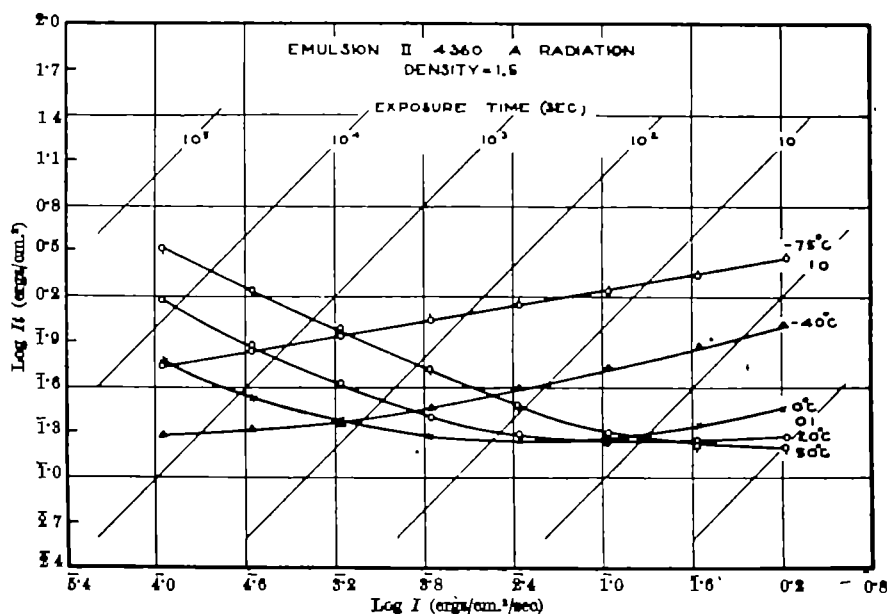


Fig. 2.

VARIAION OF THE RECIPROCIITY CHARACTERISTIC WITH TEMPERATURE.

are now left with a neutral bromine atom and a spare hole whence the silver ion came. There is reason to assume that the primary process mostly takes place on the surface of the crystal, so that the bromine atom escapes into the gelatin. Only a slight reshuffle of the lattice is necessary to get rid of the hole, when the crystal will be smaller by one ion pair.

The ionic movements take some time and are dependent on temperature, and it is therefore not surprising to find that the formation of the latent image depends not only on the number of quanta absorbed but also on the rate at which they are fed in, and on the temperature. Much attention has recently been paid to the 'reciprocity breakdown' of photographic materials. In Fig. 2 is plotted for various temperatures the exposure, that is, the number of quanta necessary to produce a

for others; on raising it still further the optimum will be reached. At high intensities there is no difficulty in reaching a sufficiently high vapour pressure, but since the ionic processes take time, it is not unreasonable to assume that the vapour pressure has to be kept up as long as possible for the optimum effect. For too short exposures the ions have no time to move up to the speck, and recombination will take place more readily. At low temperatures the critical vapour pressure is more easily reached, and the biggest effect is obtained at low intensity when the pressure is kept up for a long time.

It seems that we have arrived at a fairly simple picture of the mode of action of photographic materials, but it should be pointed out that the picture is by no means complete and will not be regarded as correct by all workers in this field. There is space for mention only of a few more facts which seem important and which cannot or can only partly be explained by our picture. There is solarization, the fact that on prolonged exposure development leads to a partly reversed image; desensitizing by dyes, whereby the material is made insensitive to further exposure while still remaining developable; reversal by dyes, where the latent image is destroyed by subsequent exposure in the absorption band of the dye; and many more. But our picture may be useful as a working hypothesis for future experiments.

W. F. BERG.

Obituary Notices

Prof. H. B. Fantham

THE death of Prof. Harold Benjamin Fantham, Strathcona professor of zoology and head of the Department of Zoology at McGill University, Montreal, on October 28, in his sixtieth year, has removed one who was widely known for his many contributions to the subject of parasitology.

Prof. Fantham was educated at University College, London, where he was gold medallist in zoology and Derby research scholar, at the Royal College of Science, London, and at Christ's College, Cambridge, where he was twice Darwin research prizeman. He was a fellow of University College, London, and also a member of many scientific societies. In addition to some 150 research papers published in various scientific journals, he was joint author of "The Animal Parasites of Man", in which he wrote the section on Protozoa, and also published a popular book, "On Some Minute Animal Parasites", in collaboration with Dr. A. Porter.

From 1904 onwards, Prof. Fantham was mainly engaged in university teaching, first in London, where he made various contributions to protozoology, especially in connexion with Haplosporidia and the molluscan spirochaetes, and afterwards in Cambridge, where he was assistant to the Quirk professor of biology, and conducted work in connexion with the grouse disease inquiry. From there he joined the Liverpool School of Tropical Medicine, where he worked on trypanosomes and spirochaetes, and in conjunction with Prof. J. W. W. Stephens gave the first account of *Trypanosoma rhodesiense*.

During the early part of the Great War, Prof. Fantham acted as parasitologist, and went to Egypt and Salonika where he contracted amoebic dysentery and was invalided home. In 1917 he was appointed as the first professor of zoology and comparative anatomy in the new University of the Witwatersrand, Johannesburg, where he not only organized and developed the Department, but also took a very active part in many university activities, being dean of the faculty of science and also for one year a member of the Council of the University. Whilst in South Africa he was closely associated with the South African Association for the Advancement of Science, and in 1927 was president of the Association, when his address on "Some Thoughts on Biology and the Race" was the subject of an editorial article in NATURE of September 10, 1927. In addition, he continued to publish papers, mainly on South African parasitic Protozoa and soil Protozoa.

In January 1933, Prof. Fantham took charge of the Zoological Department at McGill University, Montreal, and at once threw himself with enthusiasm into the task of reorganizing the Department. In addition, he continued research work on Protozoa and eugenics as well as on freshwater biology, and

made special efforts to develop this side of zoological ecology in the province of Quebec.

From the time of his arrival at McGill University, Fantham stimulated the interest of his students, not only those doing advanced work, but also the juniors, with the result that his Department grew continuously in numbers, particularly in research workers. He knew every student personally in his large Department, and would always help in personal as well as academic matters. As a tribute of him they wrote: "The University has lost a Department head, a professor and a colleague—but the students of the University mourn the passing of a friend".

Prof. Fantham is survived by his devoted wife and former student, Dr. Annie Porter, herself a well-known biologist, who co-operated with him in many of his undertakings.

Dr. J. A. Voelcker, C.L.E.

DR. JOHN AUGUSTUS VOELCKER, who died on November 6 at eighty-three years of age, was almost the last representative of the group of men whose work in the application of chemistry to the development of agriculture was of very great importance in the second half of the nineteenth century. The son of Dr. Augustus Voelcker, himself one of the most eminent of the group of agricultural chemists referred to, he was trained to succeed his father, first at University College, London, then at Giessen, and finally at Cambridge. After this he joined the laboratory which his father had established in London. This laboratory was unique at the time, and the methods used there, to which Dr. Voelcker adhered during almost all his life, have become very largely the standards used in similar laboratories all over the world.

On the death of his father in 1884, Dr. Voelcker had, at the age of thirty, the very difficult job of succeeding to the latter's consulting practice and to a number of the public positions which were held by his father. He rose to the occasion, and was for many years the principal and almost undisputed authority on questions of the application of chemistry to agriculture. Perhaps the climax of his career came when he was invited by the Government of India to visit that country and report on the scientific improvement of Indian agriculture. His visit there, in the years 1889-90, was a great success, and his report was the basis for the foundation of scientific work in connexion with agriculture in India. It remains to this day a classic.

When Dr. Voelcker succeeded his father in 1884, he also took over the position of consulting chemist to the Royal Agricultural Society of England, which he retained until his death. His annual reports in this connexion, of which the series is almost unbroken,

will be found a unique record of the changes which have taken place in the character of the feeding stuffs and fertilizers which are used by the farmers of the country. His services towards the purification of such materials have been very great, and his investigations were of importance in leading to the passage of the Fertilisers and Feeding Stuffs Acts in later years.

Dr. Voelcker became director of the Woburn Experimental Station also in 1884, and this remained one of the chief interests of his life from that time onward. The Woburn experiments owe almost everything to his zeal and energy, and rarely has there been much more than a month since he took over charge when he has not visited the experimental station. He only relinquished his position as honorary director in 1936, just after an account of fifty years' experiment there had been published by himself and Sir John Russell. It is a source of great satisfaction that he was able to co-operate in bringing out this monument of what he regarded as, to a large extent, his life-work.

Dr. Voelcker had a special bent for applying scientific results to actual problems, especially agricultural problems. He had, in fact, an almost uncanny knack of extracting, from comparatively simple experiments, conclusions which would stand the test of practice, and, hence, he was in great demand as an adviser in agricultural difficulties. His interest in agriculture was profound, and nothing pleased him more than to spend time on a farm or to associate with those who were responsible for managing agricultural land in any capacity.

On the chemical side, Dr. Voelcker was a prominent member of many of the professional and other societies. He was an early member of the Institute of Chemistry and for long a member of its council. He was also a past president of the Society of Public Analysts, and an old member of the council of the Chemical Society. Apart from his scientific activities, he was a man of very wide interests. An athlete in his youth, when he was a well-known cross-country runner, and a sportsman later in life, he never lost his zest for the one or the other, and he could often be found on a Saturday afternoon attending the events of the London Athletic Club (of which he was twice president).

Mr. C. W. S. Crawley

We regret to record the death of Mr. Charles William Scott Crawley, which occurred on November 9 at the Corner House, Charlbury, Oxon. Mr. Crawley was seventy-nine years of age and was a partner in the business of the well-known electrical instrument makers—now Nalder Bros. and Thompeon, Ltd. He went into partnership with the well-known electrical instrument manufacturers, the late Mr. Francis H. Nalder and his brother, Mr. H. Nalder, two years after the business had started. Mr. Soames was also a partner, and the letters N.C.S. on ammeters and voltmeters are familiar to all electricians.

Mr. Crawley designed many instruments, and was an expert in their actual construction. After he retired from Nalder Bros., he became a consulting

engineer and spent much of his time in the Board of Trade Electrical Standards Laboratory, voluntarily assisting Mr. Rennie. He worked chiefly in the resistance room making accurate comparisons of the standards, some of which had been made by Nalder Bros. in 1892 for the electrical standards committee of the British Association. The work was very difficult as it was known that some of the B.A. coils had changed owing to acidity in the paraffin wax used for insulation. Major Cardew and Mr. Rennie had used them for measuring resistances sent to them for calibration. Mr. Crawley recognized that the weak point in most measurements of resistance was the determination of temperature. At his suggestion, Dr. Guillaume was asked to procure a thermometer of the highest precision.

The provision of a scale of corrections to the thermometer for changes due to the barometric pressure showed Crawley's scrupulous care. He invented 'build-up' boxes for passing from 0 ohms to 10 ohms and so on to 10,000 ohms, using only two mercury cups at a time.

At the International Conference on Electrical Units and Standards in 1908 he was one of the secretaries, the others being W. Duddell, F. E. (now Sir Frank) Smith and M. J. Collins of the Board of Trade. Mr. Crawley, who could converse fluently in French and German, was of great help in explaining matters to the delegates and in showing them around the laboratory of the Board of Trade.

When he went to live at Charlbury, near Oxford, Mr. Crawley equipped a workshop laboratory. He made an instrument for tracing and recording variations of earth currents between buried earth plates. He designed and constructed several barographs for recording variations of atmospheric pressure on a scale twenty times as large as that of a mercury barometer. One of these was sent for comparison of observations to the neighbouring radio station at Leafeld. For many years Mr. Crawley was a member of the Institution of Electrical Engineers and a fellow of the Physical Society. He often attended their meetings and took part in the discussions. He was the pioneer of many new methods of making high-precision measurements which have greatly helped physical and electrical research.

We regret to announce the following deaths:

Sir Charles Bright, an authority on submarine and general telegraphy, on November 20, aged seventy-three years.

Mr. Henry Crowther, formerly curator of the Leeds Museum, on November 29, aged eighty-nine years.

Prof. A. Lodge, formerly professor of pure mathematics in the Royal Indian Engineering College, Coopers Hill, president of the Mathematical Association in 1897-98, aged eighty-three years.

Dr. D. S. Macnair, known for his work in analytical chemistry, an inspector in charge of the scientific and technical instruction under the former Science and Art Department, on November 27, aged seventy-six years.

News and Views

Queen Mary College Jubilee Celebration

THE tangled tale of the foundation of the colleges of London and of their welding into one of the greatest universities that the Western world has seen is, in its revelation of a complete absence of planning, fascinatingly and characteristically British. None of these colleges has a history more stimulating to the student of social developments than that of Queen Mary College. The College, known until December 12, 1934, as East London College, when Her Majesty Queen Mary presented to the College, through the master of the Draper's Company, a Royal Charter incorporating the College under its new name, finds its origin in a bequest made by Mr. Barber Beaumont, who died in 1841. The eighties of the last century saw the beginning of the generous interest of the Drapers' Company in the movement which resulted in the People's Palace, and on May 14, 1877, Queen Victoria opened the Queen's Hall, and laid the foundation of the Technical School, a School which formed an integral part of the People's Palace. In 1892, Mr. J. L. S. Hatton, to whose almost prophetic insight the metamorphosis of the Technical School is due, was appointed director of that School, and under his wise guidance the work of the School increased so greatly in volume and in importance that in 1907 East London College was recognized as a School of the University of London. The College has indeed been singularly fortunate in its principals. Sir Frederick Maurice, who accepted the office on the death of Principal Hatton in 1933, is steering the College through a difficult period of material expansion marked by a new building scheme, the opening of a high-voltage laboratory and the acquirement of an estate to be developed as a new sports ground.

THE year 1887, which saw the laying of the foundation stone of the Technical School, may be taken as marking the birth of the College, and the College, in holding its Charter week during the week beginning December 12, is also celebrating its jubilee. The outstanding event of the week will be a Congregation on the evening of December 14. The College has now two honorary fellows—Her Majesty Queen Mary and Sir Lynden Macasey—and on the occasion of this Congregation the master of the Drapers' Company, Mr. D'Oyly Monro, and the clerk to the Company, Sir Ernest Pooley, are to be admitted as honorary fellows. The jubilee celebrations mark fifty years of almost unexampled growth, and the College will embark on its journey towards a century of achievement with the good wishes of all who are concerned for the future of university education.

Population Statistics

THE debate in the House of Commons on November 29, on the second reading of the Population (Statistics)

Bill, was interesting on account of the criticism which the Bill received from both sides of the House. The adverse criticisms were chiefly directed against the requirement of information of a not obviously necessary character, and also against the ambiguous nature of the terms of the schedule. The feeling was expressed by Mr. F. K. Griffith that the public should not be worried by "intimate, irritating, and irrelevant questions". There was no general opposition to the asking of information of a definitely useful character. The report of the debate should be read in conjunction with subsequent correspondence in *The Times*. Thus, Mr. A. P. Herbert, in the issue of December 4, mentions the contention of Prof. A. M. Carr-Saunders and Dr. C. P. Blacker that "three pieces of information were essential for the proper elucidation of the trend of the population—the age of the mother and the duration of the marriage at the birth of each child, and the order of birth of each child"; and he remarks that "if this were all the Bill required the trouble would not have arisen".

PROF. MAJOR GREENWOOD, in the same issue, states that "in Germany the age of the mother, the date of marriage, and the order of birth of the child are recorded on the birth-card. Dr. Burgdörfer was therefore able to determine for 1933 the annual frequency of births to married women of different ages and durations of marriages." With this information, he was able to test the question whether fertility had remained constant in subsequent years. That is the kind of information required by statisticians in Great Britain, not now available, but intended by the Bill to be made available for the future. Unfortunately, the schedule to the Bill gave it a much wider and more indeterminate scope, and it is not surprising that objections were raised. The Minister would be wise if he were to confine the schedule to defining the few simple questions, such as those indicated above, which are really indispensable, at the same time eliminating Clause 3 of the schedule, which lays down that particulars may be required with respect to "any other matter" on which statistical information may be wanted for social investigation.

Sir Harold A. MacMichael, K.C.M.G.

THE appointment of Sir Harold A. MacMichael, Governor and Commander-in-Chief of Tanganyika Province, to be High Commissioner and Commander-in-Chief for Palestine and Commissioner for Transjordan in succession to General Sir Arthur Waughope, who resigns on the ground of health, will be received as singularly well judged. Sir Harold is by personal qualities—which count for much in the East—by knowledge of Eastern mentality, and by long previous experience, peculiarly well qualified to cope with the difficulties of mediating between the

conflicting interests now warring in Palestine. After a distinguished career as a classical scholar at Magdalene College, Cambridge, he joined the Sudan Political Service in 1905, and served in the provinces of Kordofan, Blue Nile and Khartum. During the Great War he served as political and intelligence officer with the expeditionary force which reoccupied Darfur in 1916. A successful official career culminated in the appointment of civil secretary, which he held from 1926 until 1934, on several occasions acting as governor. In the course of his service in the Sudan he became our foremost authority on the ethnology and history of the Sudanese tribes, his published works including "The Tribes of Northern and Central Kordofan" (1912), "A History of the Arabs in the Sudan" (1922) and "The Arabs of the Egyptian Sudan" (1924). For these studies he was awarded the Burton Memorial Medal of the Royal Asiatic Society in 1928. Sir Harold's onerous duties as Governor of Tanganyika have not precluded his continued interest in scientific studies, which has been directed mainly to local archaeology and the foundation of a museum at Dar-es-Salaam.

Memorial to Dr. Samuel Smiles (1812-1904)

ON Saturday, December 4, a bronze tablet to the memory of Samuel Smiles was unveiled at Zion School, Leeds, by Sir James Baillie, vice-chancellor of the University of Leeds. In the course of his speech Sir James said: "Smiles had a singularly sane outlook on human life and a remarkable grasp of the simple elementary principles on which human society ultimately rests. He made himself eminent in his spare time—what we should now call his leisure moments, at the end of busy days. Part of his spare time in Leeds he gave to those who attended Zion School." Smiles's first book, entitled "Physical Education", was published in 1837 at his own expense and reprinted in 1905. Messrs. John Murray published in 1905 his "Autobiography", which contains a copy of his portrait, by Sir George Reid, in the National Portrait Gallery, and in 1857 "Life of George Stephenson", which is an engineering classic. The latter arose from his meeting Stephenson at the opening of the Leeds and Derby railway, later absorbed by the Midland. He collected material during week-ends by interviewing people on Tyneside who knew of the early work, and also he received information from Robert Stephenson and the Peases of Darlington, etc. "Self-Help" arose from lectures he gave in Leeds, particularly one on education of the working classes in 1845. It was published in 1859, after being refused by a well-known publisher. Nearly half a million copies have been printed and it has appeared in the record number of twenty-six languages. In it and in "Character and Duty" Dr. Smiles showed the British people to the world as very virile and inventive. Although trained as a physician he spent most of his working life as editor and writer of books, and from 1845 until 1866 was secretary of two railway companies. He was largely responsible for the Charing Cross railway and terminuses.

In addition to the memorial tablet in Zion School, Alderman P. T. Leigh, chairman of the Library Committee, accepted copies of Dr. Smiles's books in bookcase presented by Sir John Murray for the branch library, which has occupied part of Zion School since 1870—the first municipal free library. Sir Walter Smiles, M.P., presented a picture of his grandfather copied from the oil painting in the National Portrait Gallery, to be hung in the civic hall along with other portraits of Leeds worthies. There was an exhibition of relics concerned with Dr. Smiles: copies of first editions of his early books, autographed letters, family bible and portraits, and the *Leeds Times* of 1838 containing his first speech in Leeds on repeal of the Corn Laws.

Centenary of William Harkness, 1837-1903

ON December 17, 1837, William Harkness, the American astronomer, was born at Ecclefechan, Scotland, his father being a Presbyterian minister. In 1839, the family removed to New York, and after attending private schools Harkness entered the University of Rochester and in 1858 took his degree. A short spell of journalism was followed by the study of medicine, and during the Civil War, at intervals, he served as a volunteer surgeon. In 1862, however, he was appointed an assistant to James Melville Gillies (1865) at the United States Naval Observatory, and it was at Washington that he passed practically the remainder of his life. He observed the solar eclipses of 1869 and 1870, and in 1871 was appointed one of the original members of the Transit of Venus Commission, being concerned with the preparations for the observation of the transits of 1874 and 1882, and also with the discussion of the results. The transit of 1874 he observed at Hobart, Tasmania. In September, 1894, when new buildings had been erected for the Observatory, regulations were promulgated by the Secretary of the Navy providing for the first time for an "Astronomical Director", who was to "have charge of and to be responsible for the direction, scope, character and preparation for publication of all work purely astronomical, which is performed at the Naval Observatory". To this post Harkness was appointed, the office providing, it was afterwards said, "a maximum of responsibility and a minimum of power". To his duties were added three years later the directorship of the "American Ephemeris and Nautical Almanac". The work, however, proved too much; he broke down and in 1899 retired, being granted the rank of Rear Admiral. He died at Jersey City, N.J., on February 28, 1903. Harkness was one of the founders of the Philosophical Society of Washington and in 1893 served as president of the American Association for the Advancement of Science.

Aborigines of Australia

THE petition of eighteen hundred Australian aborigines addressed to the King, and asking for representation of their interests in the Federal Parliament (see *NATURE*, Nov. 6, p. 798), whether it attain its end or not, has at least served to direct attention

once again to the question of their present condition and their future. Difficulties of the situation, which contribute to the failure to find a solution of a problem—for long a reproach to the Australian people—are set out with due appreciation of their weight by an Australian correspondent of *The Times* in an article in the issue of November 25. After pointing out the gravity of conditions which tolerate "tribe after tribe dying on their feet", and contrasting conditions among the natives of New Guinea, the writer refers to the mentality and character of the aborigines as in no small measure responsible for much for the failure of the Governments to check the degeneration which is taking place. Even such a beneficial, and indeed essential, provision in the organization of aboriginal protection as medical attention is rendered in a degree ineffective through the disinclination of the aboriginal to take advantage of it, owing to magical belief or misunderstanding. At the same time the nomadic habit, as well as the tendency to drift to centres of white civilisation, neutralize the advantages of reserves of aboriginal lands. On the other hand, the inadequacy of the financial provision made by the Australian Governments is stressed, its most serious consequence being the lack of a trained body of special officers, such as the service organized by Sir Hubert Murray in Papua. A graver indictment of the Australian people appears in the same issue of *The Times* in the form of a report of a valedictory address by Prof. F. Wood-Jones to the Victorian Anthropological Society, which, notwithstanding a certain lack of restraint in language and certain inaccuracies, cannot be passed over by Australia as ill-founded, even though Prof. Wood-Jones, as well as the writer in *The Times*, as has been pointed out in subsequent correspondence, gives little or no credit to Federal and State Governments for what has been attempted to ameliorate aboriginal conditions.

Marconi School of Wireless Communication

QUITE early in its history, the Marconi Company experienced a need for providing its recruits to the engineering and operating staffs with some centralized instruction in the technique of wireless communication. This technique was naturally ahead of any training provided by the universities or elsewhere, and, accordingly, a residential school for the training of probationary engineers of the Marconi Company was opened in 1901. This event established a notable precedent in industrial training institutions. From this date, the School has been in nearly continuous operation, with modifications and expansion of its activities from time to time to meet the demands presented by the progress in communication. Some two years ago it was decided to make very substantial increases in the facilities provided, and on November 29 last, representatives of the technical press were invited to inspect the new buildings and equipment of the Marconi School of Wireless Communication at Chelmsford. Its premises have been rebuilt and equipped on modern lines, its curriculum has been reorganised and additional appointments have been made to the staff.

As a training institution, the School is a leading example of the higher industrial education, and provides the link between the universities and the Research, Development and Engineering Departments of the Marconi Company. All engineering and physics graduates on their appointment as probationer engineers are given a course in experimental and applied wireless communication engineering at this School, which includes in its syllabus the application of circuit theory, the practice of valve, receiver and transmitter technique and experience in the design, construction and testing of representative aerial and feeder arrangements. A series of lectures is also given during the five months' session covering the whole field of wireless communication and a further series on engineering mathematics. The new School possesses a central college building containing the main experimental laboratory, two smaller research laboratories, a standards room, lecture theatre, library, common room, and general offices; and in the grounds are a number of detached buildings housing telephone terminal gear, direction finding plant, transmitters and television equipment. About sixty students are being trained at the present time; the lecture theatre has a seating capacity for seventy-five students and many more than this number can be accepted for work in the various experimental sections of the School. A hostel, with a limited accommodation, is available for those students who desire to live near by. A more detailed description of the School and of the facilities which it provides is given by the principal, Mr. H. M. Dowsett, in the *Marconi Review*, No. 66, May–August 1937.

Iodine in Inorganic and Organic Chemistry

FOR his Friday evening discourse at the Royal Institution on December 3, Prof. Irvine Masson discussed "Iodine". After a reference to the important part played by Sir Humphry Davy in the discovery of iodine (1812–1814) during his honorary professorship at the Royal Institution, the first half of the discourse reviewed the functions of this element in Nature. As a component of rocks, minerals, soils, and dissolved salts, iodine is widespread but is exceedingly scanty. Even in its chief commercial source, the nitrate deposits of Chile, its compounds are present only as minor impurities. It began to be significant, however, when organic life began. Certain marine creatures are rich in it, notably kelp, and in horny sponges (bath sponges) and those corals the skeletons of which are horny, not calcareous. In them, the iodine is in the skeleton, as a well-defined organic compound, di-iodotyrosine, closely related to the fairly simple compound tyrosine, which is a frequent constituent of proteins. Whether the organic iodine is useful to the vital processes of the cell-colony has not been ascertained. The same substance is one of the two iodine compounds in the thyroid gland; and although it there seems to have little or no direct physiological activity, it appears to serve as the chemical forerunner of the other and more complex iodine compound, which the gland evidently synthesizes from it, namely, the hormone

thyroxine. The second part of the discourse exhibited recent discoveries which show that the carbon compounds of multivalent iodine present a much more extensive field than had been realized, wherein this element is seen to be classed less with bromine and chlorine than with elements such as antimony, arsenic, phosphorus, and nitrogen, yet has specific characters of its own.

Chemistry in the Ancient World

THE fortieth Bedson Lecture was delivered on November 26, at King's College, Newcastle-upon-Tyne, by Prof. J. R. Partington, on "Chemistry in the Ancient World". The lecture dealt mainly with the period 4000-1000 B.C., and showed how the outstanding achievements in applied chemistry during this period were made in three principal regions, namely Egypt, Mesopotamia and Crete. The working of metals appears before 3500 B.C. in Egypt and Mesopotamia and somewhat later in Crete and Cyprus. The earliest metal known was probably gold, although copper was known very early in Egypt. The metals silver, lead and iron were also known in the earliest period but were scarce. Refining of gold appears about 525 B.C. An important copper industry was established in Egypt, the malachite ore being mined in Sinai. The use of iron and steel is found among the Hittites and related peoples at the time of the eighteenth dynasty in Egypt, and iron was freely used by the later Assyrians. Brass was known in Palestine about 1400-1000 B.C., and, since the brass industry was later established in Cyprus, some relation between the two regions by way of RAs Shamra seems to be indicated. The techniques of metal workers differed in different regions. The production of bronze was an important event, and the source of the early tin is still doubtful. Zinc occurs in small quantities only in the Roman period. The production of black-topped pottery in Egypt was described and also the preparation of glazes. In some cases the results have been imitated with difficulty and only recently. Glass itself was known in Egypt and Mesopotamia in 3000 B.C., the Egyptians being very skilled in its manufacture and colouring, although blown glass does not seem to have been made until the beginning of the Christian era. The dyes indigo and safflower were used in ancient Egypt, and in Mesopotamia there were the beginnings of the petroleum industry, with extensive use of bitumen for cement and asphalt.

Meteorites of the Gran Chaco

THE announcement in *The Times* of November 9 by a Buenos Ayres correspondent of the discovery of a large mass of meteoric iron in the Campo del Cielo region of the Gran Chaco in the northern Argentine is puzzling. He refers to a "legendary meteorite" long ago spoken of as the "Mesón de Fierro" (iron inn), and assumed to be the source of the iron tips of Indian spears seen by the Spanish conquerors. The discovery of a large mass of native iron in this region was made by Hernán María de Miraval in 1576. This, or perhaps another large mass, was seen

by Miguel Rubín de Celis in 1783, and was described by him in the *Philosophical Transactions* in 1788. The weight of this mass has been variously estimated at from 13½ to 45 tons. Another mass of about one ton, found in 1803, was transported to Buenos Ayres during the war of independence with the idea of manufacturing it into armaments; and a portion, weighing 1,400 lb., of this was presented to the British Museum in 1826 by Sir Woodbine Parish, who described it in the *Philosophical Transactions* in 1834. This is still on view in the Natural History Museum at South Kensington. More recently, a mass of 4,210 kgm. (more than 4 tons) was found in 1923, another of 732 kgm. in 1925, and several other smaller masses. These have been transported to the National Museum in Buenos Ayres. The new report may perhaps refer to the rediscovery of the larger mass seen by Rubín de Celis in 1783; or, not unlikely, still another large mass may have been found. It is suggested that the boundary between the provinces of Santiago del Estero and El Chaco is defined by the position of the "Mesón de Fierro". But as shown on a map of the region (*Geog. J.*, 81, 238; 1933) masses of iron have been found on both sides of this boundary line. Evidently at this place there was an unusually large shower of meteoric irons. The history of the several masses has been given by Dr. Antenor Alvarez "El meteorito del Chaco" (Buenos Ayres, 1926, pp. 222). But the associated meteorite craters, a group of round and shallow depressions (*hoyos* or *pozos*), still require investigation.

Iron Age Site in the Vale of White Horse, Berks

EXCAVATION of an archaeological site at Frilford in the Vale of White Horse, Berks, has afforded interesting evidence of a succession of cultures during a period, which if not prolonged in archaeological perspective, was at least of considerable duration, extending from the early Iron Age to Saxon times. The site lies close to the Oxford-Wantage road, where it crosses the River Ock, and is situated not more than a hundred yards from a well-known cemetery of the Roman and Saxon periods. The excavation, which was undertaken by the Oxford University Archaeological Society at the suggestion of Sir Arthur Evans, was carried out during last term by undergraduate members of the Society with the co-operation of Mr. D. R. Harden of the Ashmolean Museum. The evidence of early Iron Age occupation, according to a report in *The Times* of December 8, is in the form of a series of pits, circular and irregular, dug in the limestone subsoil. These contain Iron Age A2 pottery. In the largest found to date was a large hearth on a clay floor with, among other objects, a polished hammer-stone. In this period the district was remote and backward; but during the Roman occupation a small but well-built villa was erected on the site. This had a tiled roof and tessellated floor. Unfortunately, seekers after stone in later ages have left little of the walls but the foundation trenches, and the floors have suffered similarly. Sarnian pottery and coins point to an occupation from the first to the end of the fourth century. If this villa

is evidence of the advance of civilization in the area, there are also signs of disturbance, presumably tribal. In the largest pit of the Iron Age a small hoard of late Roman coins, dating from A.D. 370-380, had been buried. In the same pit was a Saxon burial of the sixth or seventh century. The skeleton was well preserved, and with it were a knife and "scramasax". Excavations will be resumed during the Easter term, when it is hoped to determine the date of the villa with greater precision, as well as its relation to the cemetery.

University Functions and Responsibilities

THREE addresses to Victorian political organizations by Dr. R. E. Priestley, when he was vice-chancellor of the University of Melbourne, have been published under the title "The University and the National Life". In the first of these addresses, dealing with the finance and objectives of the University of Melbourne, Dr. Priestley attempts to summarize the functions of a university in a democratic country. First, he considers a university should admit and, if necessary, finance by scholarships, grants and loans, the pick of every generation of the youth of the State, irrespective of the class of homes or society they came from. The university's first duty should be to provide inspiring teaching and the means of full development of body, character and mind for its undergraduate students. For this purpose, research and investigation are essential and the staff must be large enough to ensure adequate contact with students as well as leisure for investigation. The university should aim at sending out graduates whose natural and recognized place would be the front ranks of the occupations they follow and who would be the natural leaders of their generation.

Dr. Priestley also urged that a university should admit interest in, and a certain responsibility for, its men and women throughout their lives, and he stressed the importance of the university extension department as a means of stimulating and satisfying the desire for knowledge which, if democracy is to survive, must become the outstanding characteristic of the average citizen of the democratic state. A university, too, should be a reservoir of liberal and progressive thought, the defender and upholder of all that is best in the thought, customs and traditions in the lives of the people and the State. In his second lecture, on the university and rural interests, Dr. Priestley outlined the ways in which a university agricultural department could assist the farmer. Besides the training of men in the sciences of special importance to agriculture and the carrying out of research on fundamental problems which assists the building up of the fundamental knowledge needed to indicate to the technical worker the most profitable line of attack on his problems, Dr. Priestley stressed the value of the agricultural department as a source of unbiased opinion on agricultural matters. In his third address, on "A Free University", he referred to the value and importance of an adequate scholar-

ship system and to the danger in Australia that efficient representation of sectional views may cause selfish and sectional interests to prevail over national interests. An even graver danger might be the failure to secure the best possible recruits for Australian public services, and only when university graduates are freely recruited for such services is the university making its best contribution to the community.

Staff and Student Stipends in Soviet Universities

ACCORDING to the Soviet Union Year Book Press Service, on November 12 the Soviet Government published a decree changing the regulations governing the payment of the academic staff at the higher educational institutions (universities) of the U.S.S.R. and increasing the stipends granted to students at these institutions. Under the new regulations, the academic staff will be paid on a staff salary basis, instead of on the old system of payment according to the number of hours worked. They will be able to hold a staff position at one higher educational institution only, though at liberty to engage in work at other higher educational or research institutions if they so desire. The salary rates for the upper staff are: directors of chairs at universities, 1,100-1,500 roubles per month (about £42-56), in accordance with length of service; professors, 1,000-1,300 roubles per month; senior lecturers, 700-900 roubles per month. Apart from their salaries, the members of staffs have the advantages of many social services, such as free medical treatment and free school and university education for their children. The new rates of State stipends granted to students at the universities are as follows: students taking a five-year course receive 130 roubles per month for the first year, 150 roubles per month for the second year, 175 roubles per month for the third and fourth years, and 200 roubles per month for the fifth year. Students taking a four-year course receive the same amounts for the first, second and third years, and 200 roubles per month for the fourth year. Students at the teachers' training colleges receive 130 roubles per month for the first year and 150 roubles per month for the second year. Stipends for postgraduate research students will be increased to 400 roubles per month. The number of higher educational institutions in the U.S.S.R. in 1936 was 700, and the number of students in them in the educational year 1936-37 was 542,000.

Mitogenetic Rays?

AN article entitled "An Experimental Study of the Problem of Mitogenetic Radiation", which forms *Bulletin* No. 100 of the National Research Council, Washington, D.C., will be welcomed by many who have waited for an authoritative statement on the reality or otherwise of this type of radiation. The authors, Alexander Hollaender and Walter D. Claus, have spent two years in order to prove or to disprove the existence of the so-called mitogenetic rays. These rays have been defined as radiation comprised between the wave-lengths 1900 Å. and 2500 Å., having an intensity of 10-1000 quanta/cm.²/sec., the claim

being made that they are emitted by biological substances in certain stages of development. It is difficult to see how the authors could have gone further than they have in their efforts to prove or disprove the existence of these rays. Every precaution in the avoidance of errors and a wide range of material and methods of detection have been employed. In spite of this, all the attempts have yielded negative results. Neither biological nor physical detectors gave any indication that a measurable ultra-violet radiation is given out by typical 'mitogenetic senders'. It is a sobering reflection that no fewer than six hundred papers have been published on this subject.

Potato Synonyms

THE report of the work of the Potato Synonym Committee during 1936, recently published, forms a striking contrast to those issued in the early years of the Committee's activities. Whereas in former years a considerable proportion of varieties examined proved to be no more than established varieties under new names, in 1936 all but two were found to be distinct. A great reduction is also recorded in the number of synonyms which continue to be offered in seedsmen's catalogues. The improvement in this respect has been continuous, and as a result of direct correspondence, with few exceptions seedsmen throughout Great Britain now intend to list varieties only under their established names. It should be pointed out, however, that Cherub, Early Favourite and Cleodan Park are identical with Duke of York, Sharpe's Express and King Edward VII (red type) respectively, and that although Midlothian Early and Sir John Llewellyn still appear in some catalogues, they are identical with Duke of York and Eolipée. Dr. Salaman and his Committee are to be congratulated on the outcome of their work. At one time it was not generally appreciated, but we can say to-day that seed growers and buyers alike recognize the value of the efforts made to protect their interests by reducing the many names under which potatoes have in the past been sold. Copies of the report for 1936 may be obtained on application to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

The Royal Society of Arts

THE annual report of the Council of the Royal Society of Arts refers to the establishment of the distinction of Designer for Industry (D.I.) of the Royal Society of Arts as indicating the Society's continued efforts to raise the status of the British artist in industry. Other examples of its interest in this direction are the travelling bursary of £100 offered to art teachers, and the decision to revive on new lines the annual competition of industrial designs which was held from 1924 until 1933. It is hoped that the first of the new competitions will be held in 1938 for the textile industry, and that they will in due course be extended to other branches of industry. The Albert Medal of the Society for 1937 was awarded to Lord Nuffield "for services to

industry, transport and medical science". Fifteen silver medals were awarded for papers read before the Society during the current session. Entries for the ordinary examinations of the Society in 1937 numbered 75,372, and the total number of papers applied for in all the examinations was 93,497. An important innovation under the Thomas Gray Memorial Trust was the decision to award a number of prizes to stimulate and assist the education of apprentices and deck boys. Prizes to the value of £100 were awarded during the year under the Trust for essays and inventions connected with the science and practice of navigation.

A New Garden Periodical

THE first number of *Gardening* made its appearance on October 15. It ministers well to the increasing popularity of the small garden, and scientific processes are portrayed in simple language. Mention may be made of "Secrets of Dutch Bulb Raising" by Kurt Lubinski, and "Wild Trees in the Garden" by Richard St. Barbe Baker. There are, in addition, more general articles on garden design, plant pests and beneficial insects, the storage of vegetables and fruit, manuring, and many other practical problems. *Gardening* is a fortnightly journal, price 4d., and is published by Messrs. Condé Nast Publications, Ltd., 1 New Bond Street, London, W.1.

Aerial Protection in Belgium

THE Ministry of the Interior in Belgium has organized a graduate school of aerial protection in Brussels for physicians, pharmacists, chemists and engineers. A library has been formed to collect international documentation on the subject, and it is anticipated that practical research laboratories will be established. The programme comprises the following features: international legislation, general and special chemistry, general and special pathology, therapeutics, procedures of identification and dosage, principles of individual and collective protection and general organization for protection.

Ramsay Memorial Fellowship

THE following awards of new memorial fellowships for the year 1937-38 have recently been made: A. E. Alexander, a British fellowship of £300, tenable for two years, at the University of Cambridge; T. P. Hughes, a British fellowship of £300, tenable for one year, at the University of Cambridge; Dr. E. de Salas, a fellowship of £300, tenable for one year, at University College, London; Dr. E. C. Stathis, a Greek fellowship, tenable at University College, London; Hazime Oosaka, a Japanese fellowship, tenable for two years, at University College, London; Dr. M. C. F. Beukers, a Netherland fellowship of £300, tenable for one year, at the Imperial College of Science and Technology, London; Dr. J. J. Hermans, a Netherland fellowship, tenable at University College, London. The Glasgow fellowship held by Dr. R. R. Gordon at University College, London, has been renewed.

Finney-Howell Research Foundation

At the death of the late Dr. George Walker of Baltimore his will provided for the formation of a corporation to be known as the Finney-Howell Research Foundation, the purpose of which was to be the support of "research work into the cause or causes and the treatment of cancer". The will directed that the surplus income from the assets of the Foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories or other institutions, wherever situated, as may be approved by the Board of Directors". Fellowships will be awarded each year on the second Wednesday of March, beginning March 1938. These fellowships will be awarded for a period of one year with the possibility of renewal up to three years. Further information can be obtained from the secretary of the Foundation, Dr. William A. Fisher, Medical and Surgical Faculty Building, 1211 Cathedral Street, Baltimore, Maryland.

Meteors

ON November 9, about 21^h 25^m G.M.T., Mr. J. E. Daly, in North London, saw a meteor of magnitude equal to that of Jupiter, moving from the direction of the planet Saturn towards the west. Its motion was nearly parallel to the ecliptic, and its path was over 30°. No other observations of this meteor were reported, so it is impossible to give any details of its real path. On November 20, at 8^h 23^m, a bright fireball was seen by two observers in Rathmines and Mullingar, travelling from south-east to north-west. The body of the fireball gave out an intense bluish-white light, and it had a trail two to three times the apparent diameter of the moon. As it was quite light at the time, it was impossible to describe its path with sufficient precision to enable its height, etc., to be computed. If it had been dark at the time, it is certain that the fireball would have been a very imposing sight.

World Power Conference: Vienna Sectional Meeting

A **SECTIONAL** meeting of the World Power Conference will be held in Vienna next year on August 25-September 2, by invitation of the Austrian National Committee. The meeting will be followed by one or more 'study tours' of approximately a week's duration. We understand that the British Government has received an invitation to be represented by official delegates at Vienna. The British National Committee, 36 Kingsway, London, W.C.2, has copies in English of the technical programme of the Vienna Sectional Meeting. It is divided into five sections, dealing with the supply of energy for agriculture, small-scale industries, household purposes, public lighting and electric railways. The term 'small-scale industries' is used to cover both handicrafts and industries employing a relatively small number of workmen, about twenty or thirty; in addition,

hotels, cafés, restaurants and shops. The kinds of motive power used should be mentioned: solid and liquid fuel, gas, water power, wind power, steam or electricity, and stress should be laid on those of special importance. Information should be included on the use of human and animal as compared with mechanical power, and the influence of the latter on civilization and health. Technical and economic comparisons between the supply of energy from public electric or gas mains and from private plant would be welcome. Data about lighting power and heat in small-scale industries with special reference to the tools and the drive of the appliances employed, and in particular, room heating, air conditioning, cooking (on a large scale) in restaurants, bakers' ovens and welding. Under the section for the supply of energy for public lighting is included the energy used in traffic lighting, as on railways, for shipping, in air transport, and in traffic control signals.

Announcements

MR. E. HARRISON, director of agriculture for Tanganyika, has been appointed professor of agriculture at the Imperial College of Tropical Agriculture, Trinidad.

DR. JULIAN HUXLEY will deliver the Christmas Lectures (a course of six lectures adapted to a juvenile auditory) of the Royal Institution on December 28, 30, January 1, 4, 6 and 8. The subject of the lectures will be "Rare Animals and the Disappearance of Wild Life". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

ON the occasion of the eightieth birthday of Bernhard Nocht, founder of the Institute of Tropical Medicine at Hamburg, the Bernhard Nocht Medal has been awarded to the following, in recognition of their services to tropical medicine: Prof. J. Rodhain (Belgium), Prof. E. Brumpt and Dr. W. Fournneau (France), Profs. E. Martini and E. Reichenow (Germany), Dr. P. Manson-Bahr and Prof. G. H. F. Nuttall (Great Britain), Profs. E. P. Snijders and N. H. Swellengrebel (Holland), Prof. G. Bastianelli and Sir Aldo Castellani (Italy).

Messrs. E. P. GOLDSCHMIDT AND Co., LTD., of 45 Old Bond Street, W.1, in their latest catalogue, No. 45, offer a selection of important books in the history of science, and also a few early microscopes. Noteworthy items are the astronomical classics, Copernicus' "De Revolutionibus Orbium" (1543), and Kepler's "Astronomia Nova" (1609). They also catalogue that bibliographical rarity, the original edition (1669) of Nicholas Steno's "De Solido intra Solidum", described by Sir Archibald Geikie as "one of the landmarks in the history of geological investigation". The interest of the catalogue is enhanced by many informative notes, and also by reproductions of title-pages and illustrations.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1017.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

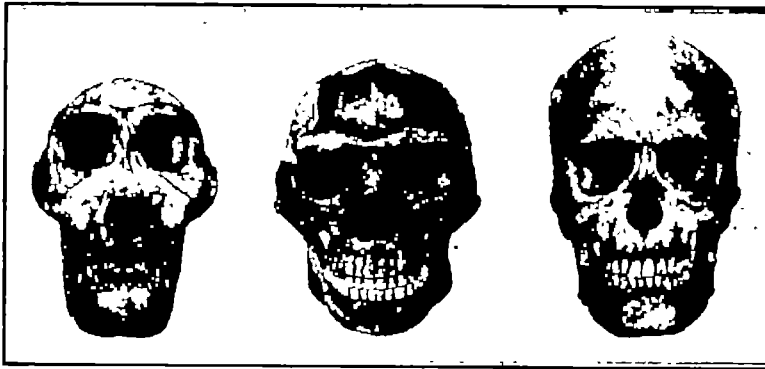


Fig. 1.

RECONSTRUCTION OF THE ENTIRE SKULL OF AN ADULT FEMALE *Sinanthropus pekinensis*. NORMA FRONTALIS. $\frac{1}{2}$ NAT. SIZE. FROM LEFT TO RIGHT: ADULT FEMALE GORILLA—*Sinanthropus*—ADULT MALE NORTH CHINESE.

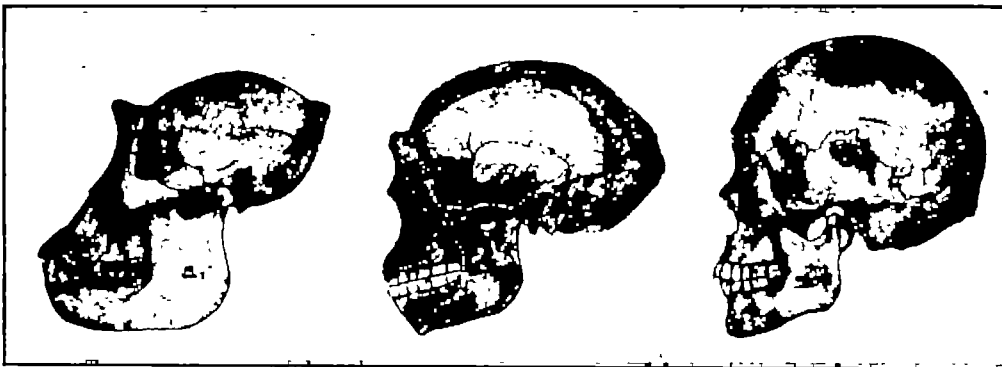


Fig. 2.

THE SAME AS IN FIG. 1. NORMA LATERALIS SINISTRA. $\frac{1}{2}$ NAT. SIZE.

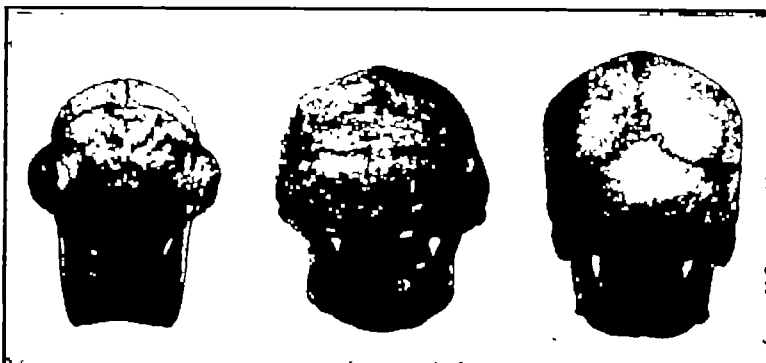


Fig. 3.

THE SAME AS IN FIG. 1. NORMA OCCIPITALIS. $\frac{1}{2}$ NAT. SIZE.

Reconstruction of the Entire Skull of an Adult Female Individual of *Sinanthropus pekinensis*

DURING the last days of our spring excavations in Choukoutien this year, the left side of an upper jaw of *Sinanthropus pekinensis* with six teeth *in situ* was recovered. A preliminary description of this fragment is contained in my publication on the *Sinanthropus* dentition which will be available for distribution towards the end of this year. This specimen, together with other fragments of the facial skeleton of Skulls I, II and III of Locus L, which have already been described in NATURE¹, have made it possible to restore the entire face in connexion with the brain case.

Since the last discovered maxilla fragment, according to its teeth, apparently belongs to a female individual, the brain case of the female Skull II of Locus L was used as a basis, but the nasal bones, the lateral border of the orbit, the frontal process of the maxilla with

the upper lateral part of the nasal aperture and the zygomatic bone which were unearthed together with Skulls I and III, respectively, belong to male individuals. The reconstruction, therefore, was only a matter of adapting the various parts and of reducing them to the size and proportions given by the brain case—with the preserved supraorbital ridges and the deeper interorbital parts—and the above-mentioned maxilla.

Since the fragments found all happened to be of the left side of the face only, the entire right side was restored on the basis of the left one. The reconstruction of the mandible required very little effort

since the *Sinanthropus* mandible H 1 was available for use¹. The only alteration consisted of adapting it to the breadth of the brain case.

Thus, practically the entire facial skeleton was available, with the exception of a small part of the maxilla between the upper border of the infra-orbital foramen and the lower border of the orbit, and the zygomatic arch from its origin at the temporal bone to the origin of the temporal process of the zygomatic bone. Since the teeth of the female maxilla used for the reconstruction are much worn, no attempt was made to restore them in their unworn condition, and the lower teeth were adapted to approximately the same state of wear. The interior of the left orbit is only partly restored.

The effect of the reconstruction may be gathered from the accompanying reproductions. In order to demonstrate more distinctly the similarities and differences between *Sinanthropus* on one hand and the anthropoids and recent man on the other, *Sinanthropus* in all three views is flanked by the skull of an adult female gorilla and that of a male adult North Chinese. All skulls are orientated in Frankfurt plane (orbitale-porion).

With regard to the details, the reader is referred to my study on the facial skeleton of *Sinanthropus* which is now in preparation. For the present, I only wish to point out that *Sinanthropus* is much more ape-like in appearance than any of the known Neanderthal skulls, and that has been expected by any of the investigators who have attempted to reconstruct the face of *Sinanthropus* on the basis of brain cases only. There is in addition one characteristic difference. In the Neanderthal man the lower border of the zygomatic process of the maxilla declines gradually from the zygomatic bone toward the alveolar process, as in the gorilla (see Fig. 1). In *Sinanthropus*, however, a deep notch separates the maxilla from the cheek bone. This notch is very common in recent man and also in the orang. That we are not dealing with an individual variation as regards *Sinanthropus* follows from the fact that the two maxilla fragments which are at our disposal display exactly this same feature.

The facial fragments of male individuals and the male mandible available suggest that the face of the male *Sinanthropus* may be heavier and the upper jaw more protruding than is evident in the reconstruction of the female individual.

Since the entire reconstruction with regard to all essential parts is based on actual findings and not a single detail is imaginary, the skull can be considered as a real standard type of a *Sinanthropus* woman of advanced age.

The reconstruction was carried out with the kind assistance of the sculptor Mrs. Lucile Swan.

FRANZ WEIDENREICH.

Peiping Union Medical College,
Peiping.

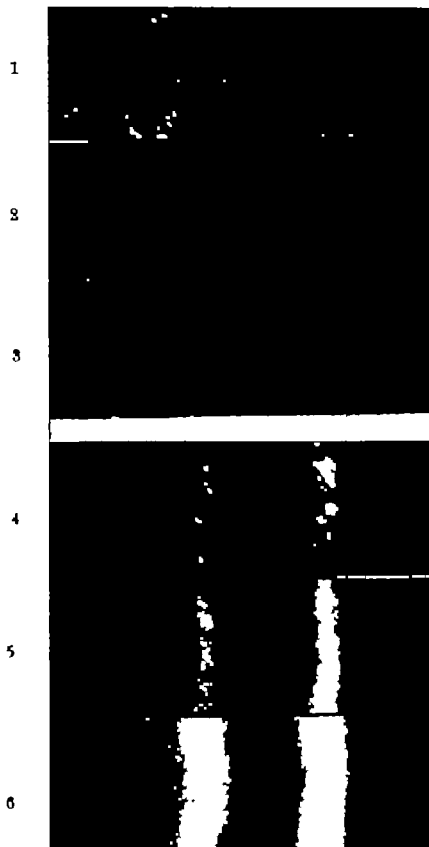
¹ NATURE, 139 (Feb. 13, 1937).

² See Weidenreich, "The Mandibles of *Sinanthropus pekinensis*", 1936.

Structure of Metals

THIS note describes some rather unexpected facts observed when nickel and gold are investigated at high dispersion with X-rays. In these experiments the distance between the film and the specimen is either 20 cm. or 30 cm. The primary X-rays after passing through a pin-hole of about $\frac{1}{4}$ mm. diameter reach the specimen, a flat disk of approximately

1-1.5 sq. cm. surface, and are scattered back to the photographic film. The β_1 line of iron (wave-length 1.75301 Å.) gives with the (400) crystal plane of nickel a glancing angle of $85\frac{1}{2}^\circ$ at room temperature. A lattice change of 1/1,000 produces a shift of more than 7 mm. of the line on the film, and since the position of a sharply defined line can easily be measured to 1/10 of a millimeter, lattice changes of the order of 10^{-4} are observable. No such reflexions are ever obtained when the material is examined in bulk even with the purest and most carefully annealed substances. This is well known. With annealed powders or filings it is different, as is shown for example in the investigation of Owen and Yates¹ on pure nickel.



1, 2, 3. NICKEL FILINGS, HILGER H.S. BRAND, PURITY 99.97 PER CENT. RADIATION, IRON β_1 . CRYSTAL PLANE (400). GRAIN SIZE, BETWEEN 120 AND 200 TO 1 INCH. ANNEALED FROM 700° TO 500° C. FOR 3 HOURS TWICE IN SUCCESSION. DISTANCE, SPECIMEN TO FILM, No. 1, 20 CM., Nos. 2 AND 3, 30 CM. No. 3 SPECIMEN ROTATED DURING EXPOSURE.

4, 5, 6. GOLD. No. 4, HILGER H.S. BRAND, TOTAL IMPURITIES LESS THAN 0.001 PER CENT, FILINGS NOT PASSED THROUGH SIEVE; ANNEALED FROM 600° TO 320° C. FOR TWO HOURS. No. 5, PRECIPITATED PURE GOLD, HEATED AT 600° C. FOR TWO HOURS. No. 6, SAME AS No. 5, BUT SPECIMEN ROTATED DURING EXPOSURE. RADIATION, α_1 AND α_2 NICKEL. CRYSTAL PLANE (422). DISTANCE SPECIMEN TO FILM, 30 CM.

When reflexions are observed under high dispersion as in the present work, very sharp reflexions from the individual crystal grains are obtained, but the surprising fact is that they are scattered over a

comparatively wide range of say about 3-5 mm. on the present photographs, thus indicating lattice variations of the individual crystals of the order of 1/1,000-1/2,000. Extremes are not infrequently found 10-15 mm. from the average position. This average position is found by rotating the specimen in its plane during the exposure. A smooth line now appears on the film, the centre of which is measurable with good accuracy. The lattice constant for pure nickel (Hilger H.S. Brand, 99.97 per cent) thus obtained agrees to 1/10,000 with Owen and Yates' figure.

Photographs made from 99.5 per cent nickel give a larger average spacing. The appearance of the picture is not altered and the spreading of the individual reflexions seems to be the same. Different ways of annealing seem to have little effect upon the appearance of the photographs; on none of the films is there any sign of the narrowing down of the reflexion range. The same holds at higher temperatures near and above the Curie point.

These observations, first made with nickel, hold also for pure gold. Here the α_1 line of nickel as radiation source happens to give high dispersion with the (422) plane in the gold lattice. The reflexions are more irregular in shape, the material not being passed through a sieve. The amount of spreading is of the same order as that of nickel.

It is scarcely to be expected that gold and nickel should in this respect differ from other metals. The conclusions drawn are likely to hold for all metals. The first conclusion is that precision data on lattice dimensions have to be regarded as statistical averages of figures varying over a comparatively wide range of, say, 1/1,000. The reproducibility of the lattice constant of an individual crystal grain is far less than that of the average. It is difficult to see why impurities should be responsible for the effect, since both the less pure and the purest nickel seem to give the same spreading, and that the same should occur with the extremely pure gold with a total impurity of less than 0.001 per cent. The grains themselves must consist of a large number of atoms, otherwise no sharp images could be obtained. This seems to eliminate surface effects. In addition, the nickel filings are kept fairly uniform in size. The crystal grains having different lattice constants cannot possibly all be in equilibrium at a given temperature, and this suggests that the ordinary annealing process is not capable of producing equilibrium.

Further investigations on a considerably larger scale are in progress.

I wish to express my appreciation to Mr. H. Smith for his very efficient help in this work.

ALEX. MÜLLER.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.

¹ *Phil. Mag.*, 21, 809 (1936).

An X-Ray Investigation of the Cause of High Coercivity in Iron-Nickel-Aluminium Alloys

It was discovered by Mishima¹ that very good permanent magnets could be produced by the suitable heat-treatment of iron-nickel-aluminium alloys, of compositions near Fe_2NiAl . In search of an explanation, we have made a comprehensive X-ray examination of slowly cooled iron-nickel-aluminium alloys. The results show considerable divergences

from Köster's diagram² (see Fig. 1), and shed new light on the results of earlier X-ray work on the magnetic alloys^{3,4,5}.

Köster's diagram is here reproduced in a simplified form to facilitate comparison with the new results. The nomenclature has been tentatively changed to

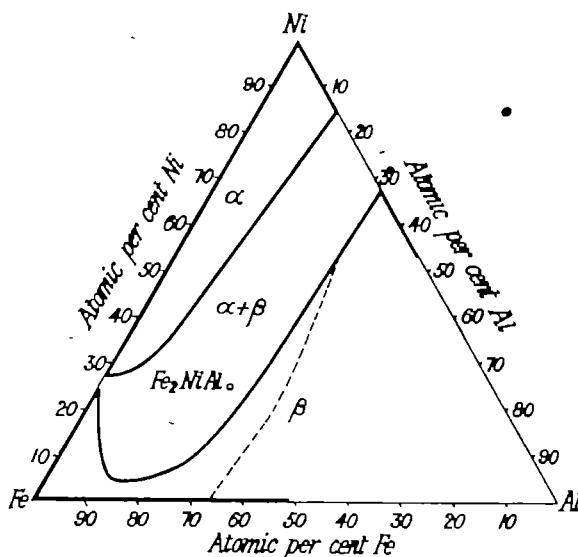


Fig. 1.

Fe-Ni-Al BASED ON KÖSTER'S DATA.

one based on crystal structure. Face-centred cubic structures are α , body-centred cubic structures β .

The β area shrinks with falling temperature. An alloy such as Fe_2NiAl , which is single phase just below the melting point, passes into a two-phase

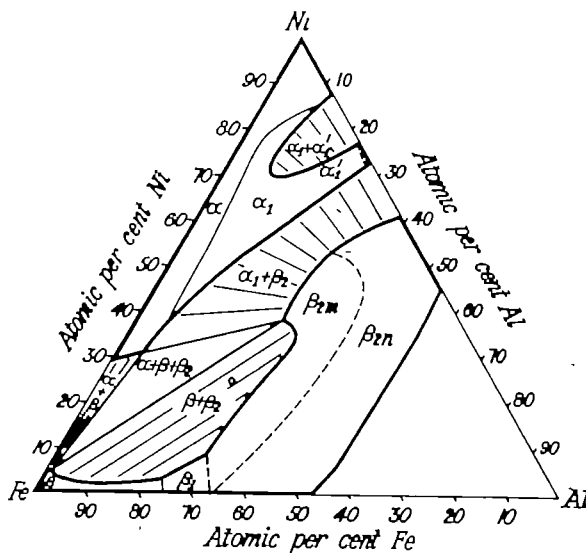


Fig. 2.

Fe-Ni-Al FROM X-RAY DATA.

region on cooling. According to Fig. 1, the face-centred cubic phase would be precipitated in this process, but this is not in agreement with X-ray work. We have therefore modified the diagram to agree with our X-ray photographs.

The new diagram (Fig. 3) contains the same single phase areas as Fig. 1, but Koster's two-phase area is seen to consist of four separate fields, $\alpha + \beta$, $\alpha + \beta_1$, $\beta + \beta_2$ and $\alpha + \beta + \beta_2$. The suffixes 1 and 2 indicate the presence of superlattices and m and n distinguish the magnetic and non-magnetic regions at room temperature. It will be seen that Fe_3NiAl lies in the $\beta + \beta_{2m}$ area after slow cooling. Both constituents are body-centred cubic and ferromagnetic; they differ in atomic arrangement and lattice spacing. In the iron-rich β constituent the atoms are distributed at random; in the β_{2m} constituent there is a superlattice in which cube corners are distinguished from cube centres. The lattice spacing of β is 0.3 per cent less than that of β_{2m} .

Burgers and Snoek have shown that the highest coercivity is obtained if Fe_3NiAl is cooled at a given rate. This permits the initial stages of the decomposition to take place without allowing it to proceed to completion. The original body-centred cubic lattice is preserved, but the distribution of the atoms is no longer uniform. We can now make a concrete picture of this intermediate state. Distributed throughout the parent lattice are little 'islands' of the iron-rich β -phase on the point of separating out. In a state of equilibrium they should have lattice dimensions 0.3 per cent less than the parent lattice, but this is not permitted. So long as the structure remains coherent, the iron atoms are held apart in a condition of immense strain. This is the essential cause of the high coercivity.

Further work on this subject is proceeding in co-operation with the Permanent Magnet Association and the Electrical Research Association.

We are greatly indebted to Prof. W. L. Bragg for his kind interest.

Physical Laboratories,
University,
Manchester.
Sept. 20.

A. J. BRADLEY.
A. TAYLOR.

¹ Mshkina, T., *Stal' u. Nisov*, 53, 79 (1931).

² Koster, W., *Archiv. Eisenhutt.*, 7, 257 (1933-34).

³ Weretschlagan, L., and Kurdjumov, G., *Trak. Phys. U.S.S.R.*, 2, 1 (1935).

⁴ Glocker, R., Pfister, H., and Wiest, P., *Archiv. Eisenhutt.*, 8, 561 (1934-35).

⁵ Burgers, W. G., and Snoek, G., *Physica*, 2 (10), 1004 (1935).

Double Structure of Chromosomes

THE structure of chromosomes has been a matter of such diversity of opinion and interpretation that it is desirable that certain points at least, which can be definitely settled, be removed from the region of doubt. *Trillium* is a plant genus with chromosomes so large that their component threads are far above the limits of resolution with the microscope. They are therefore not subject to the doubts and criticisms sometimes expressed concerning observations on the structure of chromosomes which are much nearer the limits of visibility.

Recent observations in my laboratory, of chromosomes in the root tip mitoses of *Trillium sessile* from preparations of Mr. S. V. Mensinkai, show undoubtedly that the metaphase chromosomes (Fig. 1) consist of four strands twisted about each other in pairs, while the anaphase chromosomes (Fig. 2) contain two spiral chromonemata clearly embedded in a matrix, and cannot by any stretch of the imagination be regarded as single. At the ends of the chromosome the two chromonemata generally converge so as to meet end-

to-end and form a rounded tip to the chromosome. This can be seen at several places in the accompanying figures. In other cases, as at the points marked *a* in Fig. 2, the uncut end of a chromosome shows the two chromonemata diverging or running parallel.



Fig. 1.

METAPHASE CHROMOSOMES OF *T. sessile* ($\times 3000$).

Whether these chromonemata are themselves double, as some cytologists hold, remains to be determined by further observations. It can, at any rate, no longer be reasonably contended that anaphase and telophase chromosomes are single structures and that the split in the threads must therefore occur



Fig. 2.

ANAPHASE CHROMOSOMES OF *T. sessile* ($\times 2200$).

invisibly in the resting nucleus. This being the case, the hypotheses which Darlington¹ and others have put forward on the assumption that the anaphase chromosomes are single structures are invalidated. This includes Darlington's view of the relations between meiosis and mitosis. This hypothesis,

involving the single nature of the leptotene thread, is also contrary to other recent critical observations of the early meiotic threads in *Trillium* and various other plants.

The attempts made by various investigators to use the results of X-ray fragmentation of chromosomes as crucial evidence for the time at which the somatic chromosomes split have resulted in failure. This appears to be because each investigator has been able to interpret his results as supporting the ideas he previously held, so that the method is not discreditable.

R. RUGGLES GATES.

King's College,
London, W.C.2.
Nov. 11.

"Recent Advances in Cytology" (1937).

Blindness in Freshwater Fish

THE cause of blindness in freshwater fish is frequently sought by owners of fishing waters and fish farmers. Usually the blind fish are old fish and have lost the gift of sight in one eye or both due to some growth behind the eyeball or some accident to the front of the eye.

Recently a number of yearling rainbow trout were received from a trout farm in which some fish were blind in both eyes. Apart from the blindness, the fish were in very good condition as regards colour and weight. Investigation revealed the cause of blindness as being due to the presence of about forty living forms of the larvæ of the trematode *Diplostomum volucre* Nord. in the lens. The life-history, or as much of it as is known, is recorded in Plehn's "Praktikum der Fischkrankheiten" and taken from trout, whereas in America it has been taken from Black bass, etc.

So far as I am aware, it has not been previously recorded in Britain.

The life-history is, briefly, as follows: The principal host is a water bird, usually a gull, and inhabits the gut of the bird, where its sexual cycle takes place. The fertilized eggs pass out with the droppings and, if taken up by a freshwater fish, find their way via the gut to the blood stream to be carried ultimately to the lens of the eye, where the eggs give rise to the larval stages of the worm, causing the lens to lose its function.

In some cases the lens becomes so swollen up as to burst through the outer coat of the eye, and liberates the larval forms into the water. If the fish or the lens is eaten by a water bird then the bird becomes infected and can be a further source of infection to other fish.

Whether there is any intermediate stage between the fish and the bird does not appear to be known; and whether the larval form liberated from the fish can infect other fish is not given in the records.

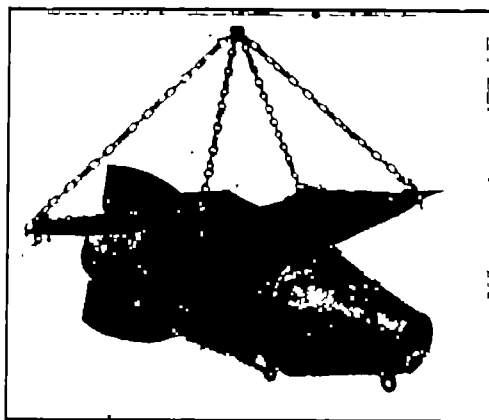
The larval forms in the lens of the infected fish were of varied shape, and only when about to be liberated had they the well-known fluke form. Sizes up to 0.3 mm. were seen.

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Nov. 1.

A Plankton Collector for Fast Towing

DURING the course of an investigation of the *Sagitta* population in a portion of the Irish Sea, it became desirable to sample the waters over a large area. An attempt was made to devise a tow-net which could be used on coasting boats, the speed of which is approximately eight knots. An instrument was designed (Fig. 1) on a similar principle to Hardy's model¹ but with several modifications. It consists of a diving fin to which is attached the plankton collector with an internal conical silk net.



PLANKTON COLLECTOR FOR FAST TOWING. The rear chains were shortened for photographing. (PHOTO. BY P. BOND.)

The body of the plankton collector is a cylinder ten inches long and seven inches in diameter with cones on each end. The front cone is 6½ in. long with a mouth opening 2½ in. in diameter. This size mouth opening gave a ratio of one to 6.5 between the cross-sectional areas of the mouth and cylinder. The front cone is detachable, fitting into the cylindrical body by means of a wide collar. The inner end of this collar is tapered slightly and rimmed. The mouth of a small conical, coarse silk net 10 in. long is fitted over this rim and tied; at this point the incoming water is slowed down to its minimum rate of flow. A small wide-mouth jar was fastened to the end of the net to hold the filtered plankton. The cylindrical body of the instrument is bolted along the short axis of the diving fin, which is 22 in. long and 11 in. wide. To each corner of this rectangular sheet iron fin a chain is attached; all four chains fastening through a shackle by means of which the device is towed.

An early model with two side fins was successfully tested, through the courtesy of Prof. T. B. Abell, in the tanks of the School of Naval Architecture at Liverpool. In use, the instrument made from this model was unsuccessful. It was unstable and would dive only for very short periods. The side fins were later discarded, and a sheer-board was substituted, as described above. In this form it was successfully towed from a motor-boat at about five knots. Catches of living *Sagitta* and additional plankton were taken in the small jar fastened to the end of the net. These catches were comparable to those made at the same time in a coarse silk tow-net.

Owing to lack of time for further tests at increased speeds, the instrument was at once used from a cargo boat running at about eight knots between Liverpool

and Whitehaven. During this trial the diving fin was found to be too light in construction; it bent under the increased pressure, and the body was lost.

It is hoped to continue experiments with this type of collector in the future. The instrument can be made inexpensively, and may be of great service for collecting uninjured living plankton quickly over a wide area in the sea or in lakes. I am indebted to Prof. J. H. Orton for assistance and advice in this work.

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Nov. 15.

¹ Hardy, A. C., *J. Mar. Biol. Assoc.*, 21, 147-177 (1936); "Discovery" Reports, 11, 457-510 (1936).

Refractive Indexes of Helium I and II

THE refractive indexes of liquid helium I and II have been measured by the use of a Wollaston cell as previously described¹.

The values obtained for the index for $\lambda 5461 \text{ \AA}$, with their estimated errors, were as follows:

	Temp. (°K.)	Critical angle	Refractive index	$\frac{\mu^2 - 1}{\mu^2 + 2}$
He I	4.22	78° 28' ± 20'	1.0206 ± 0.0012	0.100
He I	2.26	76° 51' ± 5'	1.0209 ± 0.0004	0.122
He II	2.18	76° 51' ± 5'	1.0209 ± 0.0004	0.122

These values agree with the preliminary value 1.028 ± 0.006 obtained by Wilhelm and Cove² for the index for helium II. The value of μ^2 at 2.18°K . is 1.0545, which corresponds closely to the dielectric constant $K = 1.0558$ ³.

In order to ascertain whether there was any difference in the molecular refractivities of helium I and II, the observing telescope was set on the critical edge in He II at 2.18°K . Then the temperature was raised through the λ -point to 2.26°K , where the density is the same to within 0.00005. In passing from one temperature to the other several times no change in the position of the critical ray resulted. A change of one minute of arc could have been detected easily in this way. Therefore the index changes by less than 0.00007 in passing from a point in He II to a point with the same density in He I.

The work was carried out by Prof. J. O. Wilhelm, Mr. H. E. Johns and Prof. Grayson Smith.

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Nov. 4.

¹ Johns, H. E., and Wilhelm, J. O., *Canadian J. Research*, 15, 101 (1937).

² Satterly, J., *Rev. Mod. Phys.*, 3, 347 (1936).

³ Wolfke, M., and Keenom, W. H., *Leiden Comm.*, 192 A.

Natural Activation of Papain

WORKING with latex of *Carica papaya*, we were able by different methods (dialysis, precipitation, etc.) to separate the natural activator from the enzyme system.

When solutions containing the activator were added to a latex preparation ('centrifugate') which split up gelatin, but not peptone, peptone hydrolysis was induced; with commercial papain, again, the otherwise small peptone hydrolysis was considerably enhanced. No increase in the hydrolysis of gelatin

on addition of the natural activator solutions was observed; in many cases a decrease in activity was actually produced. The activator solutions showed *inter alia* strong sodium nitroprusside and ninhydrine reactions and gave the characteristic cuprous salt on treatment with cuprous oxide in acid solution. The solid residue obtained on decomposition of the cuprous salt showed the properties of glutathione. The admixture of this product with pure glutathione did not produce a pronounced depression of the melting point.

On adding pure glutathione to 'centrifugate' or to commercial papain, the induced or, respectively, enhanced peptone hydrolysis observed even at comparatively low concentration of glutathione reached the value attained on activation by prussic acid. Hydrolysis of gelatin by the same enzyme preparations, on the other hand, was decreased by addition of small quantities of glutathione. When, however, greater quantities of the latter were added, the primary inhibition was annulled, and with comparatively large amounts of glutathione, stimulation of gelatin splitting was observed.

The chemical behaviour of the natural activator, and the corresponding action of the natural activator and of glutathione on the hydrolysis of peptone and gelatin, make it probable that the natural activator is glutathione. A decisive proof on this question must await complete chemical analysis. For seasonal reasons, some months must elapse before the large amount of latex required for the preparation of sufficient material for a full chemical analysis will become available to us. A final and detailed report will be published elsewhere at a later date.

MAX FRANKEL.

R. MARMIN.

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Nov. 2.

Standardization of Potato Slopes for Bacteriological Tests

It is common to find differences in the growth of sub-cultures of the same bacterium on potato slopes, and it also frequently happens that there is a percentage of unsatisfactory slopes in a batch of potato medium after sterilization. Possibly our experience in trying to standardize this medium for work in this laboratory may be of use to other microbiologists.

Thirteen varieties of potato have been tested, and all of them have been used fairly soon after lifting. The cut blocks are washed in running water for at least 12 hours, and then put in test tubes resting on a small wad of cotton wool, and the tube is filled with distilled water until the potato wedge is completely covered; this water is poured away after sterilization just before the tube is inoculated. The substitution of normal saline solution does not improve the final character of the slope. We have tried various methods of sterilizing to see whether this effects the condition of the wedge: steaming on three successive days, autoclaving once for fifteen minutes at three different pressures, namely, 5 lb., 10 lb. and 15 lb., and autoclaving for five minutes on each of two successive days at the same three pressures.

The results from these different methods are not conclusive. In every case the sterilization has proved adequate, since no contaminations have occurred, at least within a period of six weeks, but, on the whole, the wedges remain in better condition after two short

periods of autoclaving rather than after one longer one. The varieties of potato tested which make 100 per cent good slopes after all treatments are Majestic, Epicure, Red King and King Edward; those which are definitely bad are Katriona, Sharpe's Express and King George; while Arran Banner, Duke of York, Dunbar Cavalier, British Queen, Arran Comrade and Great Soot are variable. It is possible that the degree of ripeness of the potato may be one factor which determines the character of the slope in these variable cases.

The bacterial growth obtained on the varieties used is also variable, especially in the case of pigmented species. There is no question in these experiments that Majestic promotes the greatest and most typical growth, while Epicure, British Queen and Arran Comrade are also good. Among the other varieties there is little to choose from the point of view of amount of growth, but the type of growth may be different. The following descriptions of cultures of a soil species of *Flavobacterium* when grown on potato slopes emphasize this point:

Dunbar Cavalier. Scanty, pale yellow streak, just raised, smooth, glistening, dry.

Great Soot. Moderate, cream to yellow, raised, slightly nodular, glistening, slightly moist.

Arran Banner. Moderate, pinkish, raised, slightly nodular, glistening, moist.

Sharpe's Express. Moderate, canary yellow, slightly raised, smooth, glistening, dry.

It seems that for comparative work it is essential to use the same variety of potato, and from all points of view Majestic is a very satisfactory variety.

D. WARD CUTLER.

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Nov. 4.

Axial Spin and Weapons of the Ancients

As one interested primarily in linguistic studies, I should like to suggest two points, one in confirmation and to amplify, the other a query, arising from Sir Gilbert Walker's article on "Mechanics of Sport" in *NATURE* of October 2.

That the ancients were aware, at least empirically, of the steady influence of a movement of rotation about its longitudinal axis on an object also endowed with the motion of translation, is beyond doubt. This spin can be communicated by the thumb and fingers (as in throwing the assegai); or by a cord (the 'becket') which unwinds and is left in the hand. The becket corresponds to the Roman *amentum* and the Greek *ἀμύντα*, which are often mentioned in connexion with the throwing of spears. Sir Gilbert cites becket and *amentum*; but one can go further. In Latin it is curious how constantly the verb *torqueo* ('twist') and its derivatives are used of throwing a spear. Virgil alone employs *torqueo* and its compounds about sixty times of hurling projectiles. This was pointed out by R. F. T. Crook¹, who convincingly deduced that the choice of the verb *torqueo* implied the imparting of an axial spin. The imposing array of evidence which he adduces makes this view much more likely than the older interpretation, that

torqueo referred to a preliminary 'flourish' or brandishing. Last year² I attempted to develop this idea, showing that *πάλλας* was used in Greek of communicating precisely the same twirl to a spear; an explanation which, if true, incidentally provides a very simple etymology for *πάλλας*.

The flight of the arrow raises the question to which I should be glad to receive an authoritative answer. Did the ancients, by feathering their arrows with truncated wing feathers, arranged in cyclic regularity of bias, impart a slight rotary spin to the arrow? Illustrations on vase paintings suggest this arrangement. So, too, the modern practice, apparently. "The fletcher selects feathers from either one wing or other of the bird."³ There is also in Duff's practical manual a diagram of a transverse section of a feathered arrow, showing the screw-like relation of the tips of the feathers (p. 128). A correspondent to *The Times* (Feb. 17, 1936) writes: "It is essential that the feathers should curve the same way, to impart a slight rotary motion to the arrow in flight, and therefore, since the feathers curve differently on each wing, all three (feathers) should be from the same one." On the other hand, I have often heard it stated that the feathered arrow flies steadily—on an even keel, so to speak—like a miniature aeroplane. Sir Gilbert Walker writes of the function of the feathers as merely providing resistance at the rear end (to prevent the arrow slowing round to fly with its length at right angles to its path). This, too, is, I think, the popular idea of an arrow's flight—compare "as straight and steady as an arrow". Does an arrow rotate?

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Nov. 3.

L. J. D. RICHARDSON.

¹ *Classical Rev.*, 50, 46-8 (1916)

² *Trans. Philolog. Soc.*, 101-5 (1936).

³ Duff, J., "Bows and Arrows".

Boron in Agriculture

THE importance of boron in agriculture is now well recognised, and in the recently published monograph on the subject, R. W. G. Dennis and D. G. O'Brien¹ have made an excellent survey of the information available up to the present time. The rapidity with which knowledge on the subject has accumulated may be judged by the fact that only six years have elapsed since the matter was of purely scientific interest, whereas now it has become one of economic importance. New plants for which boron is essential are constantly being discovered, and this year it has been established at Rothamsted that carrots should be added to the list. According to Bertrand and de Waal², carrot contained 2.5 mgm. boron per kgm. dry matter compared with 2.3-5 mgm. in cereals and 75.6 mgm. in beet, all plants being grown in the same soil. This relatively low boron content of carrot possibly indicates that its need for the element is not great, and that in consequence, disease due to its deficiency is not likely to be widespread.

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¹ *West of Scot. Agric. Coll. Res. Bull.*, No. 5 (1937).

² *Ann. Agron.*, 6, 537-541 (1936).

Products formed during the Preparation of Ketene

TRACES of naphthalene have been detected in the acetone condensate obtained during the preparation of ketene by passing acetone vapour over electrolytic copper heated in a silica tube.

The naphthalene was isolated from the acetone condensate by distilling off the acetone and a colourless pungent liquid boiling up to 120° C. The remaining brown tar was steam distilled giving a pale yellow solid which sublimed to colourless crystals, m.p. 79–80° C. These crystals were identified as naphthalene by picrate (m.p. 140–143°; 147°) chlorodinitrobenzene (m.p. 75–76°) and trinitro toluene (m.p. 92–95°) derivatives.

As evidence against the possibility that the naphthalene may have been due to impurities, naphthalene was again detected in similar quantity when extra care had been taken to exclude any such impurities.

It would be interesting to know whether any other investigator has detected such a product.

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Birmingham.
Oct. 22.

Why Do Stranded Whales Die?

WHEN a school of whales was stranded on an Australian coast, much to the discomfiture of local health authorities, I put to various colleagues in the University of Melbourne the simple query: Why do stranded whales die? I received the following answers, and it was amusing to note that in most instances the explanation was coloured by the special study of the colleague interrogated.

(1) The blood now being acted on by gravity collects in the dependant parts and produces anaemia of the brain.

(2) The weight of the body impedes breathing.

(3) Vital organs are crushed by the great weight.

(4) The unaccustomed warmth, especially if there is direct insolation, induces heat stroke.

(5) The unaccustomed temperature interval between night and day gives rise to internal chills and probably pneumonia.

(6) The whales do not die because they are stranded; they are stranded because they are dying.

Perhaps the list can be extended by readers of NATURE.

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Nov. 1.

Points from Foregoing Letters

A COMPLETE skull of *Sinanthropus pekinensis* (female) has been reconstructed by Prof. Franz Weidenreich by means of a recently discovered upper jaw with six teeth together with other fragments of the facial skeleton previously found, belonging to the same species, so that all the essential parts are based on actual findings. Photographs are submitted showing a comparison of the reconstructed skull with that of a female gorilla and an adult male Chinese.

X-ray photographs obtained by Dr. A. Müller from nickel and gold disks under high-dispersion conditions (using the β -line of iron and the α_1 -line of nickel, respectively, as incident radiations) show that the X-rays are scattered over a comparatively wide range. The author concludes that precision data on lattice dimensions have to be regarded as statistical averages of figures varying within, say, 1/1,000. The lattice 'constant' of an individual crystal is less reproducible than that of the average.

An X-ray study of iron-nickel-aluminium alloys has led Dr. A. J. Bradley and A. Taylor to put forward a new explanation of the properties which enable them to be used as permanent magnets. On slow cooling, these materials break up into two body-centred cubic lattices of widely varying compositions, but in the permanent magnetic state the two lattices remain coherent.

Prof. R. Ruggles Gates submits photomicrographs showing that anaphase chromosomes of *Trillium sessile* are double. The demonstration of this fact has important consequences for hypotheses of chromosome structure and behaviour.

Cases of blindness in fish (rainbow trout) are reported by Dr. W. Rushton, due to the presence in the eye lens of the larvae of the trematode, *Diplostomum colversoni*. The life-history of this parasite indicates that part of its existence is spent in the gut of water birds.

A plankton collector suitable for towing at a relatively high speed is described by E. Lowe Pierce. It consists of a metal cylinder with cones at each end and an internal conical silk net, the whole being attached to a diving fin.

According to new experiments by Prof. J. O. Wilhelm, H. E. Jones and Prof. Grayson Smith, reported by Prof. E. F. Burton, the refractive index of liquid helium I at 4.22° K. is 1.0206 and at 2.26° K. it is 1.0269. The latter value is identical with that for liquid helium II at a temperature of 2.18° K. when it has the same density. There is no abrupt change in refractive index at the transition point.

The natural activator of papain has been separated from the enzyme system of the latex of the papaw by Prof. Max Frankel and R. Maimin. Its chemical properties and influence on gelatin and peptone cleavage respectively make it probable that this activator is glutathione.

The unequal development of bacterial cultures grown on 'potato slopes' from different varieties of potatoes is described by D. Ward Outler and Mabel Dunkley. Experiments with *Flavobacterium* indicate that the varieties 'Majestic', 'Epique', 'Red King' and 'King Edward' give the best results.

"Does an arrow rotate?" inquires L. J. D. Richardson, who points out that the Latin word *torquus* may have implied the imparting of an axial spin.

Miss K. Warington directs attention to the growing list of plants for which boron is an essential constituent. The latest addition to the list is the carrot, though its relatively small boron content (25 mgm. per kgm. of dry weight) indicates that disease due to boron deficiency is likely to be rare in this plant.

Research Items

Crystalline Preparations of Viruses

Two papers which describe the preparation and properties of liquid crystalline substances from virus-infected cucumber and tobacco plants have recently been published by Messrs. F. C. Bawden and N. W. Pirie. The first (*Proc. Roy. Soc., B*, 123, No. 832, 274-320; Aug. 1937) shows that such substances cannot be isolated from healthy plants and that crystalline preparations of tobacco mosaic are infective at a dilution of 1 in 10^{10} . Many physical properties of virus mixtures are discussed, and it is interesting to note that filters which pass an infectious filtrate from plant juice will not allow the passage of purified preparations, thus suggesting that the purified aggregates are larger than those which occur naturally in the plant. The other paper (*Brit. J. Exp. Path.*, 18, 275; 1937) considers the relationships between crystalline preparations of cucumber viruses 3 and 4, and strains of tobacco mosaic virus. All such preparations have similar chemical composition, and have many physical properties in common. Precipitation tests and X-ray measurements, however, can distinguish between the cucumber viruses and tobacco mosaic preparations. A reasonable similarity between the chemical and physical properties of a crystalline virus preparation and its pathological behaviour is noticeable.

Invertebrates of Dybes Fjord

DR. KNUD LABSON's paper "The Distribution of the Invertebrates of the Dybes Fjord, their Biology and their Importance as Fish Food" (Report of the Danish Biological Station 41; 1937) is an attempt to link up the number of animals found on the sea bottom with the numbers eaten by the fishes on the same grounds. The *Macoma balthica* community is specially studied for this purpose. The work is in three sections, dealing with (1) the composition of the animal community; (2) the biology of the individual species, and (3) the importance of the species in the diet of the fishes in the fjord. By means of the first and second sections, the author can calculate the proportion between the percentage quantities of the individual species on the sea bottom and in the fish stomachs. *Idothea viridis*, the commonest isopod of the fjord, comes first in numbers as fish food, being eaten by all the fishes investigated (7), except the roach. Next comes *Gammarus locusta* and the third *Leander adspersus*. The roach is entirely a mollusc-feeder and its extremely rapid growth is attributed to its diet, for molluscs are of high nutritive value. *Mytilus edulis*, *Cardium exiguum*, *Hydrobia* sp. (called here *ulca*), *Littorina rudis*, *Neritina fluviatilis* and *Limnaea ovata* are all eaten. There is a great preponderance of molluscs in the community which make up about 88 per cent of the average weight per square metre, the remaining 12 per cent consisting of crustaceans, worms and insects. It is interesting to find that the *Hydrobia* of the fjord, still unnamed, although placed under the heading of *H. ulca*, has no pelagic larval stage, "the whole development taking place in the egg from which the animal enters the bottom stage directly". This suggests that it is another species and not the true *H. ulca*.

Fossil Insects from the Permian Rocks of Kansas

THE *American Journal of Science*, 33, 81-110 (1937), contains a paper by the late Dr. R. J. Tillyard which forms Part 17 of that author's series on Kansas Permian insects. Under the name of *Elmox trisecta*, there is described what is claimed to be the first known Megasecopteran from these rocks, the author not accepting the view that the contemporaneous Protihymenoptera are specialized members of the same order. The new genus *Kansasia* is erected for the third known Palædiotyopteran from the same beds. An apical fragment 8 mm. long of an early dragonfly wing is named *Camptotavineura* and made the type of a new family of Protanisoptera. In the new family Permibiidae there is brought to light what is described as an early group of Psocid affinities. The remainder of the paper deals with Neuropterous fossils and adds considerably to knowledge of that order in Lower Permian times. Most of these appear to be allied to the recent family Berothidae, of which archaic living types still remain in Australia. The basal half of a wing of Sialoid affinities is named *Promartynovia* as the type of a new family of ancient alderflies. It is pointed out that the relationships of these early Sialoidea are obscure, and better material is needed before they will be understood.

Embryology of the Crustacean *Anaspides*

IN *Papers and Proceedings of the Royal Society of Tasmania* for 1936 (1937; pp. 1-35, pls. i-xiii), Mr. V. V. Hickman contributes an important article on the embryological development of *Anaspides tasmanica*. It forms the first account yet published of the development of any of the Syncarida. *Anaspides*, it appears, shows, in its development, a close resemblance to the Leptostraca as exemplified by *Nebalia*. The early stages, however, bear some resemblance to those of certain of the Entomostraca. Thus the holoblastic segmentation, followed by the formation of an evident blastocoel and the development of an invagination-gastrula giving rise directly to the mesenteron, are cases in point. In certain other respects, *Anaspides* also resembles the Branchiopoda. These are evidenced in the mode of origin of the maxillary gland, the long persistence of yolk granules, the prolonged dormancy of the embryo in the winter egg and in the mode of hatching. A further resemblance is seen in the habit of movement in an inverted position (when young) on the underside of the surface film in calm water. The author states that it is hoped to supplement this paper by further examination of the post-embryonic development.

Herbage and Forage Seeds

THE last three bulletins of the series of six on the production of seed of herbage and forage crops have now been published by the Imperial Bureau of Plant Genetics (Herbage Plants), Aberystwyth. Bulletin 22 (price 5s.), by Gwilym Evans, describes the technique which has been evolved at the Welsh Plant Breeding Station for producing seed from their various strains of hay and pasture grasses, special consideration being given to the time and rate of sowing, isolation, manures and fertilizers,

harvesting, seed conditioning and storing. Bulletin 23 (price 5s.), edited by R. O. Whyte, is concerned with the methods used in the production of legume seed (lucerne, various clovers, etc.) in different parts of the world, and is a companion volume to Bulletin 19, already published, which deals with the production of grass seed from a similar point of view. Bulletin 24 (price 2s.), by F. J. Crider and M. M. Hoover, gives an account of the collection of native grass seed in the Great Plains, United States, and will be of particular interest to those in the more arid grassland countries where erosion is a problem, as it contains illustrations of typical grasses which are being produced in connexion with the soil conservation programme of the Great Plains district.

Arctic and Antarctic Diatom Floras

THE report on the diatoms collected during the Australasian Antarctic Expedition, 1911-14 (Scientific Reports. Series C. Vol. 1, part 1. Pp. 82+6 plates. Washington: U.S. National Museum. 9s.) emphasizes the wealth of the diatom flora of the arctic and antarctic areas. Dr. Mann suggests that the high percentage of carbonic acid held in solution owing to the low temperature and the long-continued light during the summer season may be significant in this connexion. In contrasting the two areas, the striking difference is that the arctic species are small and relatively simple in construction, whilst the antarctic forms are large and elegant in form and ornamentation and include many forms common to temperate and subtropical seas. Dr. Mann points out that owing to the distribution of the land masses, wide open seas run down to the antarctic and include various southerly currents, whilst the arctic seas are more enclosed by land masses and even in the Atlantic, the only northward current is that running along Scandinavia towards Spitzbergen. The species recorded are listed and described.

Incompatibility and Sterility in Sweet Cherries

THE results of an exhaustive survey of cherry varieties in respect to the above properties have recently been presented by M. B. Crane and A. G. Brown (*J. Pom. and Hort. Sci.*, 15, 2, 86; 1937). Conclusions drawn from more than 236,000 pollinations are discussed and the results presented in tables which should prove of great value to the cherry grower. Incompatibility in the sweet cherry is due to the failure of the pollen tubes to complete their growth down the tissue of the style, with the result that fertilization cannot take place and the young 'fruit' ceases growth and falls from the tree at an early stage. This is distinguished from sterility, which is expressed by non-viable pollen or imperfectly developed ovules, being more apparent on the female than the male side. Incompatibility is determined by genetic factors which control pollen-tube growth, and it seems that under normal conditions pollen cannot function in the style of a plant carrying the same factors as the pollen. All the varieties examined exhibited self-incompatibility without exception, whilst cross-incompatibility was common and always reciprocally expressed. The yields from compatible crosses showed considerable variation, which though largely due to indirect factors such as age of tree and previous cropping, was undoubtedly due in certain cases to the effect of generational sterility on the proportion of fruits which set and reached maturity. The genetical aspects of the results are discussed and

the practical applications indicated. Though many factors such as disease, nutrition, climate, etc., affect the initial setting of the fruit and the ultimate yield, it is clear that effective pollination and fertilization are essential. In view of the general occurrence of self-incompatibility and the frequency of cross-incompatibility, no variety of sweet cherry should be planted in complete isolation either as single trees in private gardens or as large blocks in commercial plantations. Care should be taken to inter-plant varieties which are known to be compatible and which flower at the same time.

A New Fungus Gall

THE fungus *Oytaria septentrionalis* causes the appearance of a gall upon *Fagus Moorei* in southern Australia. It is rather infrequent to find that an operculate member of the *Perizales* has such an action upon a living tree, and the structure of galls formed by this fungus has been investigated by Miss Janet M. Wilson (*Proc. Linn. Soc. N.S. Wales*, 62, Pts. 1-2; 1937). Wedge-shaped areas of infection appear on the small branches, and although the galls may grow to a considerable size, they do not appear to restrict the growth of that part of the tree upon which they occur. Secondary xylem and phloem, cambium and cortex are all invaded by mycelium of the fungus, and each region is enlarged by the abnormal multiplication of cells. Haustoria of the fungus approach the nucleus of a living cell in the host, and coil around it, but do not cause death. Initial infection appears to be associated with the cambium, and the fungus often lies dormant for a season, before it initiates the formation of a gall.

Ecology of Tomato 'Spotted Wilt' Virus

A VERY extensive study of the incidence of 'spotted wilt' disease in field plots of tomatoes in southern Australia has been made by Dr. J. G. Bald (*Bull. Council for Sci. and Ind. Research*, No. 106, Melbourne, 1937). Records of infection were made for nine years, and yielded a number of interesting results. The degree of infection rose through the growing period in a series of successive maxima which apparently represented the emergence of successive broods of the transmitting insects *Thrips tabaci* and *Frankliniella insularis*. High temperatures usually increased the rate of infection, and within a range of about 15 yards from a source of infection every plant had an equal chance of contracting the disease. It required isolation by distances of 200-300 yards before the spread of infection was seriously reduced. Migration of thrips from overcrowded populations upon plants of *Solanum nigrum* and *Lycium ferocissimum* also accounted for considerable infection in spring, and it was possible in all cases to find a positive correlation between the degree of infection and the relative number of transmitting insects.

Structural Geology of Maryland

VOL. 13 of the reports of the Maryland Geological Survey is of general interest to geologists because it contains a detailed account of the methods used in investigating the structures of crystalline rocks and a fine series of examples of the application of these methods. Hitherto, much of the more recent relevant literature has been in German. The Piedmont Province of Maryland includes complexes of igneous rocks which were intruded as molten masses into

rocks already metamorphosed. Both were then again subjected to forces which further transformed them. Ernst Cloos shows how the various types of rock behave under stress and summarizes the methods by means of which the available evidence can be pieced together to yield a picture of the former conditions and history of the region. H. G. Hershey gives an account of the structure and age of the Port Deposit Granodiorite complex. The ovoidal gneiss-domes near Baltimore are shown by C. H. Broedel to have originated as a result of earth movements which began in Pre-Cambrian time. A volcanic complex in Cecil County has been studied by J. Marshall. The history is one of isoclinal folding, fracture cleavage, intrusion of gabbro, injection of granodiorite followed by dykes and veins, and finally development of cataclastic structures along shear zones. The statement in the preface that "The volcanic activity is the oldest geological incident in the history of this region since the lavas include fragments of all subsequent rocks formed prior to the close of igneous activity after the invasion of the gabbros and granites which now form the rocks of the Susquehanna Gorge" is not very helpful. The Baltimore Gabbro consolidated as a saucer-like body between adjoining domes of Baltimore Gneiss. Made classic by the well-known work of Williams half a century ago, it has now been thoroughly re-studied by C. J. Cohen. Primary flow-lines are distinguished from superposed structures due to subsequent deformations. The volume also contains an account of the Upper Cretaceous stratigraphy of the coastal plain of Cecil County by C. W. Carter.

Sanriku Earthquake Seawaves of 1936

IN 1896 and 1893, and to a less extent in 1897, the north-east coast of Japan suffered from the seawaves resulting from great earthquakes. On November 3, 1936, an earthquake, strong enough, like the others, to cause slight damage on the adjoining coast, occurred in the same region of the Pacific. Mr. N. Miyabe (*Bull. Earthq. Res. Inst.*, 15, 837-844; 1937) has described the small seawaves, about one foot in range, that were recorded at seven stations on the Japanese coast. The interval between the time of occurrence at the origin of the earthquake and the first disturbance on the mareogram, ranging from 28 min. to little more than an hour, enabled him to estimate the distances of the origin from six of the stations, and thus to obtain the position of the epicentre in lat. $38^{\circ}0'$ N., long. $143^{\circ}0'$ E. It is interesting to notice that all four epicentres lie on a curve roughly parallel to the coast, about 90 miles in length and the same distance from the coast and coinciding nearly with the isobath of 3000 metres, the epicentre of the latest earthquake occupying the most southerly position.

Crystalline Vitamin A

ALTHOUGH the existence of vitamin A was proved so early as 1913, its isolation is only very recent, and a provisional standard based on the extinction coefficient of a concentrate has been in use. H. N. Holmes and R. E. Corbet (*J. Amer. Chem. Soc.*, 59, 2042; 1937) now describe the preparation of a substance crystallizing in pale yellow needles, melting at $7.5-8.0^{\circ}$, and having the very high extinction coefficient of 2100, as compared with the highest previous value of 1700 and the provisional standard of 1600. The substance is regarded as pure vitamin A. It was obtained from the liver oils of three different

species of fish by a process of fractional freezing and cold filtration, and the addition of water to a solution in methyl alcohol. The biological assays give about 3 million international units per gram. The molecular weight by freezing point lowering was found to be 294, whilst Karrer's formula, $C_{28}H_{44}O$, for vitamin A requires 286. It was found that extinction measurements with the spectrophotometer should be made instantly after dilution with ethyl alcohol, since the extinction coefficient changes rapidly on standing and indications of a new absorption band appear, perhaps as a result of chemical change. The combustion analyses of the substance gave C = 83.28, H = 10.44, whilst Karrer's formula requires C = 83.84 and H = 10.56 per cent.

Liquid Parahydrogen

THE molecular volumes at saturation of liquid normal hydrogen and parahydrogen have been determined by R. B. Scott and F. G. Brickwedde (*J. Research Nat. Bur. of Standards*, 19, 237; 1937), who find that parahydrogen has a higher molecular volume, the expansivity being only slightly greater than that of normal hydrogen. The change in molecular volume in passing from orthohydrogen (molecules rotating) to parahydrogen (molecules not rotating) is opposite in direction to the change observed with other substances in passing from rotating to non-rotating states. An explanation is given based on the small moment of inertia of the hydrogen molecule so that the orientation of the axes of the molecules of parahydrogen can have a random distribution in the liquid and solid phases, and hence the state of non-rotating parahydrogen is like that at high temperatures in other substances whose molecules are rotating. The discussion involves a detailed consideration of the intermolecular forces for the two kinds of hydrogen molecule, the repulsive forces arising from regions of high electron density in neighbouring molecules being different. It may be mentioned that E. A. Long and O. L. I. Brown (*J. Amer. Chem. Soc.*, 59, 1922; 1937) find no essential difference in the p , v , t relations of normal and parahydrogen gases at low pressures from the boiling point to 55° K.

Conductance of Mixtures of Strong Electrolytes

ALTHOUGH the simple theory of Kohlrausch indicates that the electrical conductance of a mixture of strong electrolytes is additively composed of the separate ionic mobilities, calculations by Onsager and Fuoss based on the modern theory of electrolytes indicate that the decrease in velocity of an ion due to the field effect is a function of the properties of all the ions in solution, and a deviation from the additive law is to be expected. Experimental results found by Bray and Hunt in 1911 showed good agreement between observed and calculated values at low concentrations, but at higher concentrations the observed mixture effect appeared to be about half that calculated. In these experiments, mixtures of hydrochloric acid and sodium chloride were used. K. A. Krieger and M. Kilpatrick (*J. Amer. Chem. Soc.*, 59, 1878; 1937) have now investigated mixtures of lithium and potassium chlorides. The same result is found, namely, that the observed change is about half that calculated by Onsager and Fuoss at higher concentrations and tends to agree with it at lower concentrations. No explanation of the discrepancy is offered.

History of Science and Technology

FOURTH INTERNATIONAL CONGRESS

THE fourth International Congress of the History of Science and Technology was held in Prague on September 22-27 under the presidency of Prof. Guido Vetter. A few days prior to the Congress, Czechoslovakia had been struck a cruel blow by the death of the President-Liberator of the Czechoslovakian Republic, Dr. T. G. Masaryk. The delegates to the Congress assembled on the day of the funeral, and as was to be expected at such a time of national mourning, the Congress opened under a cloud of sadness. The social functions previously announced did not take place, but otherwise the whole programme of work was completed.

The conference, which was most successful, was attended by about two hundred and fifty members, including a distinguished group of Czechoslovakian scholars and scientific workers, as well as by delegates from twenty-four other countries. Official delegates had been sent by the Governments of the Argentine, Austria, Bulgaria, Great Britain, Italy, Latvia, Mexico, Rumania, Spain, Sweden, Switzerland and the United States, while the leading foreign academies of science, scientific societies and universities were also represented. The absence of representatives from Germany, however, was noticeable.

The meeting coincided with the one hundred and fiftieth anniversary of the birth of J. E. Purkyně, the famous Czechoslovak biologist, and delegates were invited to take part in the international celebration and conference which had been arranged by the Purkyně Society to commemorate the occasion. A visit was also made to the tomb of Purkyně at Vyšehrad. It had previously been recommended to the International Academy that the Congress should deal with the development of sciences in the eighteenth century and in the first half of the nineteenth century, while as a second subject the "History of Science in Instruction" was proposed.

The opening session of the Congress was held in the well-appointed Purkyně Hall of the Institute of Medicine, at the University of Charles IV, under the presidency of Prof. Q. Vetter, president of the Congress. The delegates were welcomed on behalf of the Czechoslovakian Government by Dr. E. Franke, Minister of Public Instruction. Prof. Charles Singer, who led the British delegation, communicated friendly greetings and good wishes from Great Britain for the success of the conference, and similar messages of good will were expressed by several other foreign delegates. The inaugural address was then given by Prof. Boh. Němec on the subject "From Newton to Darwin".

On the following day an address on "The Spirit of Science in History" was given by Prof. Singer before one of the plenary sessions of the Congress. He pointed out that the ultimate aim of the scientific mood—as of the other great moods, the religious and the artistic—is to integrate the outer with the inner world. He emphasized that the scientific mood must demand independence of all the other judgments that influence mankind, such as those based on fashion, tradition, taste, nationality or class, and

showed that science is of all studies the most truly man-wide, humane and international.

Prof. G. Loria of Genoa gave an interesting account of a study of the geometric representation of values in the different epochs in the history of mathematics, and indicated the conclusions he had deduced from these researches. Dr. Joseph Mayer of Washington directed attention to the reasons why the social sciences lag behind the physical and biological sciences, which have moved forward with unprecedented rapidity during the last hundred to hundred and fifty years. He showed that, at any rate in the light of the history of science, we can at least understand why there is so much uncertainty, hesitation and apparent misunderstanding in contemporary efforts to solve social problems. Other addresses given before the plenary sessions included "The Biological Cosmologies of the Nineteenth Century" by Prof. Otto Grosser, "The Development of Agriculture in Czechoslovakia" by Dr. F. Lom, "The Beginning of Scientific Life among the Rumanians" by Prof. Valeriu Bologa, "Purkyně and the Cellular Theory" by Prof. F. K. Studnička.

The work of the Congress itself was divided into six main sections, namely, (a) general science, (b) mathematics, (c) natural science, (d) medicine, (e) agriculture, (f) technical science. Approximately one hundred and fifty papers, which covered an extremely wide range of subjects, were scheduled for presentation and discussion at these meetings. A memorial meeting was held on the occasion of the one hundred and fiftieth anniversary of the birth of J. E. Purkyně, under the aegis of the Purkyně Society, in the Pantheon of the National Museum on Saturday, September 25, when representatives of universities and scientific societies commemorated the genius of that eminent man of science. The Minister of Education, Dr. Emil Franke, addressed the meeting on behalf of the Czechoslovak Government, and Prof. B. Němec gave an appreciation of Purkyně's work.

The success of the Congress was assured by the cordial hospitality extended to the delegates by the people of Czechoslovakia, and by the well-organized arrangements made by the committee. The delegates were able to visit the many historical buildings and monuments with which Prague is so richly endowed, and were privileged also to inspect the library of the monastery of Prémonstrats at Strahov. Excursions were also made to Karlstein, Křivoklát, Blatná and Strakonice.

A special exhibition of documents relating to the "History of Science in Czechoslovakia" was arranged in the Clementinum, and in the National Museum by the organizing committee with the co-operation of the National Museum, the National Library and the University, while a catalogue of the exhibits was specially prepared for distribution to the members of the Congress. An exhibition of documents and personal relics relating to J. E. Purkyně was also arranged by the Purkyně Society. Another exhibition, of modern scientific and technical literature in Czechoslovakia, was specially arranged, and attracted much attention.

At the opening ceremony of the exhibition in the Clementinum, the delegates enjoyed a performance to ancient Bohemian polyphonic music sung by the Bohemian madrigalists conducted by Prof. B. Špidra. This improvised concert deeply impressed the visitors, as also did the compositions of Rejcha and Mozart played in the large hall of the Wallenstein Palace by the Prague brass quintette. The performance of Weber's "Oberon" in the Prague German Theatre, and that of Smetana's "Libuše" in the National Theatre, as well as the concert of the Czech Philharmonic Orchestra at the Smetana Hall conducted by Mr. Rafael Kubelik, offered further opportunities for the delegates to

become acquainted with the cultural life of Czechoslovakia.

Among the resolutions submitted and approved at the final meeting of the Congress was a proposal that history of science should be included in the teaching of secondary and high schools, and also a request for the publication of Isaac Newton's correspondence.

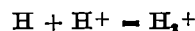
An invitation from the Swiss Government to hold the next congress at Lausanne in 1940 was accepted, and Prof. Arnold Raymond, formerly rector of the University of Lausanne, was elected president. An invitation from the Brazilian Government to an extraordinary congress in 1938 was also accepted.

Overvoltage in Light and Heavy Water

BY means of the polarographic method with a dropping mercury cathode, Prof. J. Heyrovský, in collaboration with Dr. J. Novák, has been able to advance knowledge of hydrogen overvoltage (*Coll. Czechoslovak Chem. Com.*, 9, 207, 273 and 344; 1937). By this delicate method they were able to register significant differences in current voltage curves in light and heavy water, with special reference to hydrogen overvoltage. They find that in 0.001 *N* hydrochloric acid in ordinary water at 20° C. the overvoltage differs from that in 99.6 per cent deuterium oxide by +87 millivolts; in 94.6 per cent D₂O by 63 millivolts; in 76.5 per cent D₂O by 31 mv. and in 49.8 per cent D₂O by 15 mv. At 60° C. the differences with the purest heavy water is +71 millivolts. The factor *b* in Tafel's term, $b \log i$, is 113 millivolts at 20° C. in heavy water and 102 in light water.

The electro-reduction of hydrogen peroxide is similarly inhibited in heavy water. On the other hand, the electro-reduction of oxygen, and of maleic acid in acetic acid solution, and the electro-deposition of thallos ions in heavy water proceed at an unchanged potential or at a distinctly more positive one than in light water. The theoretical significance of these experimental results is discussed by Prof. Heyrovský, who gives a general theory of hydrogen overvoltage which appears to account well for the observed facts. He regards the electro-deposition of the isotopic

hydrions as indifferent, but the evolution of hydrogen, including its molalization, as 5.4 times less in heavy water; 5.4 is the ratio of the ionic products of H₂O and D₂O, and signifies that the rate of dissociation of water is 5.4 times that of deuterium oxide. The molalization takes place through the interaction of the deposited hydrogen atoms with the hydrions of the solution:



The formula finally deduced for the overvoltage is

$$\pi = + \frac{RT}{F} \log \frac{([H^+] + [D^+])^2}{i + \bar{\omega} i^2} (O_{H_2O} K_1 + O_{HOD} (K_1' + K_2') + O_{D_2O} K_2),$$

where $\bar{\omega}$ is the mean adsorption coefficient of the freshly formed hydrogen molecules, O_{H_2O} , O_{HOD} and O_{D_2O} denote the molar fractions of the solvent, and K_1 ($K_1' + K_2'$) and K_2 are the dissociation constants of H₂O, HOD and D₂O respectively.

The validity of the equation has been tested by substituting calculated quantities of light and heavy water, and the observed results are in good agreement with theoretical requirements. The electrolytic separation coefficient for the hydrogen isotopes at cathodes with large overvoltage is dependent on the composition of the mixture and on the current density. The mean value of 5.4 should increase to 50 in concentrated heavy water and decrease to 2.7 in ordinary water.

Employment of University Graduates

YEAR by year some 15,000 students enter the universities of Great Britain. Their intentions, hopes and aspirations and those of their parents and other counsellors are almost as various as their pedigrees, but they are admitted on the assumption that their undergraduate years are to be dedicated more or less to preparation for their life's work, and the shaping of university policies is to a large extent determined by that ideal. In their careers after the completion of their undergraduate courses,

the value of that preparation is tested, and the employment of graduates is, obviously, a matter of concern not only to them but also to university administrators and to the community as a whole.

The University Grants Committee in its quinquennial report published last year dealt at considerable length with problems of student numbers and employment. This year the National Union of Students held a Congress at Southampton on April 1-8, at which these formed the main subject of

discussion, the actual title given to the Congress being "Training for What?" The subject was chosen after a serious and sustained effort on the part of the National Union (in association with local unions) to elucidate some of these problems—an effort frustrated to some extent by want of statistics.

For the university statistician, a student ceases to exist from the moment when he ceases to be an active member of the university, and in the absence of authentic statistical data, only conjectural, vague or partial answers can be obtained to such questions as: How many graduates, with what qualifications, were seeking employment twelve months after leaving the university? How many specially prepared for certain vocations have accepted employment in other fields?

This matter of the lack of official statistics of employment of graduates was repeatedly mentioned in the University Grants Committee's report, but without any indication that the Committee thought anybody ought to do anything about it. The Congress report stresses the importance of a comprehensive knowledge of the actual facts about graduate employment, and takes the view that it is 'up to' the universities to acquaint themselves with the practical results of their methods of undergraduate education. Foremost among the topics dealt with by one of the three sections of the Congress, the Commerce and Industry section, was "the work and functions of a university appointments board", the pressing importance of which had been emphasised last year by the University Grants Committee. The results of the discussion of this topic were formulated as a series of definite recommendations, now published in an appendix to the report, including one to the effect that every university appointments board should be charged with the duty of obtaining information about the employment (including unemployment and mis-employment) of graduates, and tabulating it in standardized forms.

It is worth noting that in the case of the University of Wales, the matter is somewhat simplified by the fact that every graduate is, by virtue of graduation, a member of the Guild of Graduates of the University. A valuable report by the secretary of the Guild on "Graduate Unemployment in Wales", published as Appendix D to the Congress report, shows that the Guild's standing committee is a resourceful and influential body. The report is based mainly on replies to 2,260 questionnaires distributed last November. The fact that only 60 per cent were answered suggests that something more compelling than membership of a guild is needed.

So much for statistics. The Congress discussions ranged over many other important matters, among them being the prospects of increased employment of graduates in primary schools and in the local government services.

As pointed out in an article in *The Times* Educational Supplement of September 4 on "Openings for Graduates", the primary schools present a field of service second to none in national importance. The rapid expansion of staff requirements for secondary schools since 1902 has had a most unfortunate result as regards the staffing of the elementary schools. The idea of attracting recruits for these schools from among university graduates was allowed to lapse and a cleavage of type between the teachers in the elementary and those in the secondary and 'public' schools became firmly established. The graduates who now find their way into elementary schools do

so, in general, with reluctance, having failed to obtain employment in secondary schools (for which their training was designed to fit them) and are liable to be regarded with disfavour by their co-workers on that account. Some approach towards unification of conditions of service in the elementary and secondary schools suggests itself as a promising first step towards remedying this unfortunate state of affairs, and one of the Congress resolutions proposed that the Onslow Committee in its investigations into salary scales should be urged to remedy the more glaring inequalities.

The situation is aggravated by the fact that many of the students in the teacher-training departments not merely dislike the idea of teaching in elementary schools but do not really wish to teach at all. "Many of them," says the report, "had obtained a Board of Education grant because it was the only way by which they could obtain the benefits of a university education, while others had drifted into teaching through the absence of any apparent alternative". While lamenting this result of the Board's system of grants, affecting both elementary and secondary schools, it is well to remember that dissatisfaction with one's work is a complaint by no means peculiar to the teaching profession—or to the present age (Horace satirized it). The Education section of the Congress suggested as a remedy "the institution of a greatly increased number of scholarships or grants which, while they would still cater for the needs of the poor student, would not bind the holder in advance to the pursuit of any particular career".

As regards the recruitment of graduates for the local government services, it is perfectly clear that local authorities are proof against persuasion in the form of impressively worded recommendations supported by apparently flawless arguments such as are to be found in the final report of the Royal Commission on Local Government, the report of the Hadow Departmental Committee on Qualifications, Recruitment, Training and Promotion of Local Government Officers, and the reports of the University Grants Committee. Mr. Chuter Ede, chairman of the Surrey County Council, addressed the Professions and Public Services section of the Congress on this subject. He suggested one-year post-graduate courses in the principles and practices of local government, and that the universities should agitate for the institution of competitive examination for appointments to local government service. Discussion of these and other suggestions led to the adoption of resolutions that the N.U.S. should consider co-operation with professional associations such as the National Association of Local Government Officers and that university authorities should be approached in the matter of courses of training for the public services including courses open to persons already in local government service. It had transpired in the course of discussion that in London and Liverpool time is allowed to local government employees for attendance on university courses, and it was thought that in the general adoption of such an arrangement was to be found a hopeful line of approach to the desired liaison between universities and local authorities in relation to appointments. Sir Richard Livingstone's plea, in his address on September 8 to Section L of the British Association, for adult education of a new type, should help to speed such a movement.

The ever-growing complexity of the modern world is continually throwing up new opportunities for the

employment of trained intelligence. The report takes the view that university students are too prone to ignore all avenues to worthwhile occupations other than the beaten paths of teaching, medicine, engineering, law, civil service, the church and set courses in industry and commerce. "Arts graduates, especially, rarely think of any possible occupation other than teaching". Such considerations point to the need for more recourse to vocational guidance. A first-year course on careers, available for all students, was advocated in an address by Prof. J. H. Jones of the University of Leeds. It should aim at "the development of some conception of citizenship and social responsibility" and should be given, not by an appointments officer but by a number of persons experienced in their profession and in the life and purpose of a university. It should be voluntary, but time should be allowed from existing first-year courses to enable students in all faculties to attend. The Congress recorded its approval of the introduction of such orientation courses coupled with a recommendation of vocational guidance by 'careers masters' in schools and appointments boards in universities, mutually co-operating.

The question of limitation of entry into universities has an obvious bearing on graduate employment. This prickly subject is touched on in the report somewhat gingerly. Fairly general agreement was reached in discussions in the Commerce and Industry section that universities ought to select from among candidates for admission only those capable of a distinctively university type of education, "an education in which the student is not so much taught as provided with the tools for the acquisition of knowledge and technique", others being referred to suitable institutions providing higher education of a technical character. Presumably such a selection would be made after a brief probationary period of membership in the university. The report recognizes that any recommendation from a student body that there should be any limitation of educational opportunities might be open to misconstruction and abuse, and suggests, therefore, that the whole matter should be inquired into further by a thoroughly competent commission. The matter is certainly one of enormous importance, but it is difficult to imagine the desired reform being effected without infringing the autonomy of the universities.

Engineering Progress in the Navy

IN taking office, for a second term, as president of the North-East Coast Institution of Engineers and Shipbuilders, Prof. C. J. Hawkes delivered an address in which he reviewed some recent history of the engineering branch of the Royal Navy, established by Orders in Council just a hundred years ago. He referred in particular to the period of his own service, dating from 1900, when great difficulties were being encountered with large water-tube boilers of the Belleville type. Small-tube Thornycroft boilers had given good results in H.M.S. *Speedy* in 1893. The decision in 1894 to install Belleville boilers in the 25,000 h.p. cruisers *Powerful* and *Terrible* was a momentous one and raised a storm of protest. The trials were satisfactory and demonstrated the weight-saving advantages, but later performance was disappointing, breakdowns were frequent and leakage was excessive, thus giving point and momentum to the attacks in Parliament and Press. The committee set up to investigate, however, confirmed the advantages and greater suitability of the water-tube as compared with the cylindrical boiler for use in the Navy. Improved methods of construction and the installation of special machinery in the dockyard enabled the Belleville boilers to give good service, but owing to inherent defects, including the long water and steam course of about 170 ft., some irregularity in water circulation and the deformation of tubes by local heating, it ultimately gave place to more modern designs.

In 1904, oil fuel as a supplement to coal was sanctioned, and seven years later it was decided that all new cruisers and battleships should be designed to burn oil only. Although this was a change of great national importance, it aroused none of the violent passions associated with the introduction of the large-tube water-tube boiler. From the engineer-

ing point of view and that of the ship as a fighting unit, oil firing has several important advantages over hand-fired coal for steam raising. As native sources of supply are as yet quite inadequate to meet the needs of the Navy even in time of peace, the position is a difficult one, but so necessary is it that the Admiralty has decided to continue its use for steam raising in the Fleet. The production of oil fuel from coal is therefore being encouraged.

Up to 1900 all warships were propelled by reciprocating steam engines; the T.B.D. *Viper* was the first to have turbines. There were early difficulties in operating turbines at cruising speed and at full speed, but these were so far overcome that in 1905 it was decided that all future warships be fitted with turbine machinery and, in that year, the *Dreadnought*, the first turbine-driven battleship, was laid down. At first turbines were direct-coupled to propeller shafts, but from 1911 gearing was used, resulting in increased propulsive efficiency and reduced fuel consumption per shaft horse-power. The lubrication of multiple-thrust blocks was a constant difficulty and the author quotes a case in which, at a certain speed, the flow was reversed and oil from the thrust-block wells overflowed from the oil boxes situated 10-12 feet above the shaft. A system of forced lubrication was thereupon devised and worked without trouble, but the real solution came with the invention of the Michell thrust-block, which alone has made present-day shaft loads practicable.

Prof. Hawkes gave figures to show the saving of weight and space which has resulted from these and other improvements, the more marked as they are accompanied by greater reliability and durability. Further advances may be looked for, but it must be borne in mind that in naval design there are limitations which do not apply to land practice.

Electrification of the Paris-Orléans and Midi Railways

THE paper read on November 18 by Mr. A. Bachellery at a joint meeting of the Institution of Electrical Engineers with the British Section of the French Society of Civil Engineers, shows that considerable progress has been made with the electrification of some of the French railways since Mr. Bachellery read a previous paper in 1923. At that date, only about 15 miles of the Paris-Orléans railway was operated electrically, and on the Midi railway there were three sections operating on different systems and at different pressures.

In 1934 the two railway systems were formed into a single group, the electrification work being under common direction. The new permanent way equipments are now of the 1,500 volt direct current type. The system covers nearly the whole of the mountain lines in the Pyrenees, including the two trans-Pyrenean routes, where there are gradients of more than 1 in 25. Next year, when the line between Tours and Bordeaux has been completed, electric locomotives will be able to run without interruption from Paris to Irun on the Spanish frontier, a distance of about 500 miles. At present electrification covers 23 per cent of the length of the whole system and handles 50 per cent of the traffic.

In 1936 the consumption of electrical energy for the railways was 470 million kilowatt hours, and this effected a considerable economy in the use of coal. The energy is mainly produced by hydro-electric plants belonging to the railways, but part is drawn from steam plants connected with the railways' high-voltage lines.

In some parts of the line it was necessary to adopt

electrification, as with coal the attainable speed and maximum loads were far too low. It is noteworthy that although the companies have made very successful attempts to improve the power and fuel economy of its express steam locomotives, the electrification still makes steady progress in advance.

The weight of the fast passenger trains on the French railways is going steadily up. They now often weigh about 750 tons. This is due to the continued increase in the construction of metal coaches and the growing demand for comfort. The road transport competition has forced them to raise their speed, and this implies a large increase in tractive power. Whilst the continuous rating of the most modern passenger steam locomotives does not in practice exceed 2,500 h.p. at the drawbar, and it is only with great difficulty that the average fireman can withstand the strain that this represents, the performance of the high-speed electric locomotive is at least 50 per cent greater. This easily gives the required acceleration for heavy passenger trains.

The average economy of coal on the companies' electrified lines is roughly 670 metric tons per mile of route, and this warrants the cost of electrically equipping the permanent way. Recent economic and social changes have tended to increase operating expenses; but this increase is far less in the case of electric traction than with steam traction. This is due to the fact that whilst the price of coal is steadily rising, that of the energy generated in the companies' water-power plants is practically constant. The capital spent on electrification by the Paris-Orléans and Midi companies has proved a good investment.

Drilling Mud

MUD-FLUID is now an important factor in oil-field development, but although it has actually been in use for more than sixty years, comparatively little technical literature is available on the subject. P. Evans and A. Reid, being sensible of this position, and particularly of the essential part now played by mud-fluid in rotary drilling, have compiled a paper (*Trans. Min. and Geol. Inst. India*, 32, December 1936) which has for its theme the investigation of the properties of mud-fluid, its manufacture and testing.

In this paper, which forms a complete volume, are incorporated certain results of experimental work carried out in the Burmah Oil Company's laboratories and also a review of literature consulted by that Company's technical staff during the course of research work.

Mud-fluid is best prepared by the combined methods of jetting and churning, and should be manufactured at a central plant to facilitate distribution where there are many rotary wells. Reconditioning of used mud by means of de-gassing and de-sanding is essential, especially where the cost of new mud is high; this can sometimes be done by chemical methods, though mechanical means are more usually employed. Above all, mud-fluid should be adequately and regularly tested. Specific gravity can be controlled by varying the proportions of solid

and liquid. Viscosity should be determined, and in so doing both 'yield value' and 'mobility' taken into consideration, as the flow of drilling mud is not similar to that of a simple liquid such as water. Specially designed viscometers are suggested for determination of this function. As the mud has to flow at high speed in a very restricted space, the pressure needed to pump it through the circulating system of the well is proportionately high, and lines are indicated on which it might be possible to relate physical properties of the mud to pressures required for pumping them.

Thixotropy has also to be taken into account in assessing the value and efficiency of mud-fluid. This is a property which causes certain muds to set to a jelly-like mass, but to return to a mobile liquid when agitated. The change from liquid to jelly and vice versa may be repeated almost indefinitely. Viscosity measurement of thixotropic substances is complicated, as viscosity increases or decreases according to whether the mud is agitated or disturbed.

Various other properties of mud-fluid are discussed and the whole work liberally illustrated by graphical and other results. The book serves admirably to show the present state of knowledge of this somewhat obscure subject, and to indicate the lines on which future research could most profitably be undertaken.

Science News a Century Ago

The Royal Geographical Society

THE meeting of the Royal Geographical Society held on December 11, 1837, was devoted to communications relative to Australia. Captain Maconochie had sent a paper "On the Soil and on the Natives, at Port Philip"; the Chief Justice, Sir John Jeffcott, in a letter to Sir John Barrow, had described the site chosen for the City of Adelaide, and Captain Vetch spoke "On the Political Geography and Geographical Nomenclature of Australia". Regarding nomenclature, he said, "This is a branch of geography usually left to chance or caprice; and it will not be easy to find any department so left, which has been more abused. Good taste, and even common sense, is concerned in rescuing Australia from a barbarous and nonsensical catalogue of names which nothing but a positive necessity should tolerate. Whenever native names exist, and when these names may have existed for ages, it appears something like sacrilege to disturb or change them; such names, too, are generally significant, and often contain in themselves useful information as to the migration of the human race, and the former connexion which existed between tribes, now far separate."

Outburst of η Argus Observed by Herschel

"TOWARDS the close of his residence at Feldhausen [Sir John] Herschel was fortunate enough to witness one of those singular changes in the aspect of the firmament which occasionally challenge the attention even of the incurious, and excite the deepest wonder of the philosophical observer. Immersed apparently in the Argo nebula is a large star denominated η Argus. When Halley visited St. Helena in 1677, it seemed of the fourth magnitude; but Lacaille in the middle of the following century, and others after him, classed it as of the second. . . . Herschel, on his arrival at Feldhausen, registered the star as a bright second, and had no suspicion of its unusual character until December 16, 1837, when he suddenly perceived it with its light almost tripled. It then far outshone Regel in Orion, and on the 2nd of January following it very nearly matched α Centauri. From that date it declined; but a second and even brighter maximum occurred in April 1843, when Maclaur, then director of the Cape Observatory, saw it blaze out with a splendour approaching that of Sirius. In 1863 it had sunk below the fifth magnitude, and in 1869 was barely visible to the naked eye. . . . There is some reason to believe that its variations are included in a cycle of about seventy years. . . ."—(A. M. Clarke's "Popular History of Astronomy.")

The Collège de France

IN its column of Weekly Gossip, the *Athenaeum* of December 16 had the following note: "The French Government," says a distinguished foreigner, by way of comment, on our correspondent's letter last week, "has resolved to create three new professorships at the Collège de France, one to be added to Natural History, for it has been found that since the death of Cuvier the present establishment is insufficient to fully record the progress of the science; and another for the Coptic and Hieroglyphics, the professorship formerly held by Champollion being devoted to general antiquities. The Constitution of the Collège

de France (he observes) does not at all resemble our universities: its object is not to teach the elements of knowledge, but to keep progress with its advance, and to inform the well-informed. It is a noble institution, which we owe to Francis I. There is no similar institution in the world, that I am aware of; it is open to the public, in the most enlarged sense of the words; there is no payment required, no subscription, no obedience to authority, no registration—the doors are always open, and all persons, male and female, may there enter and obtain knowledge. Cuvier's lectures were always attended by many ladies of distinguished rank; and even the lectures of Abel Rémusat, on Chinese literature, were for years attended to by a lady, who made her Chinese book serve as a veil, for the strangeness of the thing excited some surprise and curiosity."

University Events

CAMBRIDGE.—Prof. E. Cartan, of the University of Paris, has been appointed Rouse Ball lecturer for the year 1937–38.

The Treasurer has received through the Professor of Zoology a gift of £500 for the Experimental Zoology Fund from a benefactor who wishes to remain anonymous. His gifts to the Fund now amount to £1,800, and he has intimated that he hopes to continue his support of the fund.

Prof. M. Siegbahn, of Stockholm, has been appointed Scott lecturer for the year 1938–39.

It is proposed that Dr. W. H. Thorpe and Dr. A. D. Imms, of Christ's College, be appointed delegates to the International Congress for Entomology to be held in Berlin on August 15–20, 1938.

H. C. Gilson, of Trinity College, Dr. F. S. J. Hollick, of St. John's College, J. W. S. Pringle, of King's College, and Dr. S. Smith, of St. Catharine's College, have been appointed University demonstrators in zoology.

The Royal Astronomical Society has appointed Prof. S. Chapman, of Trinity College, chief professor of mathematics in the Imperial College of Science and Technology, London, to be a member of the Committee for Geodesy and Geophysics.

It is recommended that the stipend of the Cavendish professor be £1,400, and that he be paid £200 a year, non-pensionable, for administration as head of the Department of Physics.

LONDON.—The title of emeritus professor of anatomy in the University has been conferred on Prof. Thomas Yeates on his retirement from the S. A. Courtauld chair of anatomy at the Middlesex Hospital Medical School.

OXFORD.—Dr. J. V. Harrison has been elected University lecturer and demonstrator in geology.

An inquiry by the University as to the number of students in receipt of financial assistance from sources other than relations and friends in the year 1936–37 was recently completed. Out of a total of 4,920 students, 2,646—that is nearly 54 per cent—were in receipt of assistance. School exhibitions (915), local education authorities' grants (862), open scholarships (602), open exhibitions (405), and grants from colleges (320) were the principal forms of the emoluments.

Societies and Academies

Edinburgh

Royal Society of Edinburgh, November 8.

F. A. E. CROW: The sex ratio in the domestic fowl and its bearing upon the sex-linked lethal theory of differential mortality. Among 2,218,051 live-born chicks the percentage of males was 51.38 ± 0.03 . Among 8,565 dead in shell the percentage of males was 51.03 ± 0.54 . These figures do not support the sex-linked lethal theory. There are significant differences in the secondary sex ratio of different 'breeds' and this fact probably explains the differences in the sex ratio reported by different investigators.

N. GALPIN: Factors affecting hatching weight of chickens. Analysis of data show that chicken hatching weight, egg weight, percentage hatching weight of egg weight, and hatchability, tend to decrease as egg production increases. When reproductive activity falls off the above factors increase. From glandular weight, thyroid activity appeared to be highest during months of high egg production. The high thyroid activity has been related to the decrease in hatchability, egg weight, hatching weight, and percentage hatching weight of egg weight.

F. A. E. CROW and S. S. MUNRO: Gynandromorphism and lateral asymmetry in birds. Three new cases of gynandromorphism and five of simple lateral asymmetry are recorded. Critical examination of all reports indicates that autosomal elimination is responsible for simple asymmetry, and autosomal non-disjunction for gynandromorphism and pronounced lateral size asymmetry in the XY or female type, and for pronounced lateral size asymmetry only in the XX or male type.

Paris

Academy of Sciences, October 26 (C.R., 205, 697-760).

JULES DRACH: The reduction of the general equation of Riccati.

PAUL DUBREIL and MME. LOUISE DUBREIL-JACOIN: The algebraic properties of the relations of equivalence.

ALEXANDRE WEINSTEIN: The spectrum of the equation of the vibrations of framed plates.

MINNAHEM SCHIFFER: A calculus of variation for a family of univalent functions.

FERNAND ALMOND: Some properties of surfaces deduced from their mechanical significations.

ALEXANDRE FAVRE: Study of the Toussaint-Caraffoli hydrodynamic tunnel with the view of obtaining bidimensional movements. Flow without circulation.

ROBERT SILBER: The definition of unitary coefficients and of the polars of the complete aero-plane.

JEAN DUFAY: Remarks on the diffusion of light in the Milky Way.

HENRI MINTEUR: The determination of the distance of the centre of the Milky Way and the constants of the galactic rotation by means of the open clusters.

EMILE SWEIN: The theory of stellar radiation.

JEAN LOUIS DESTOUCHES: The equivalence group of a deductive theory.

JOSEPH BETHENOD: Study of the discharge of a condenser through a gas tube.

MARCEL LEMARCHANDS and WALTER JUDA: Concerning the phenomena of electrolytic overvoltage.

PIERRE GENET: Sodium hydrogen arsenate, NaH_2AsO_4 , and its hydrates.

GEORGES ARRAGON: The structure of two pent-acetylsorbosides.

MME. YVONNE KHOUVINE and YOSHINOBU TOMODA: Tagatose and methyltagatose.

ANDRÉ WAHL and VICTOR LIVOVSKI: The dimethyloxindoles.

CHARLES DUFRAISSE and JEAN HOUPILLART: Researches on the dissociable organic oxides. The hydrogenation of the photoxides. The results of the hydrogenation of naphthacene, tetraphenylnaphthacene (rubrene), anthracene and mesodiphenylanthracene, with Raney nickel as catalyst, are given, and their meaning discussed.

PAUL RIOU, GÉRARD DELORME and HORMISDAS GAMMELIN: The distribution of manganese and iron in the conifers of Quebec province. Analyses are given of various organs of six species of conifers. In all species, the leaves have the highest proportion of manganese, and an increase in the amount of manganese is accompanied by a reduction in the amount of iron.

AURELIO QUINTANILHA: Contribution to the genetic study of Buller's phenomenon.

JULES ALQUIER and MME. ANDRÉE MICHAUX: The calcium/phosphorus ratio in the cutaneous tissue and in the blood of the rabbit in the course of growth.

VICTOR PLOUVIER: Researches on the stabilization of some plants giving hydrocyanic acid.

CHARLES JOYNUX and JEAN GEORGES BARRÉ: Researches on the evolution of the cestodes of Gallinaceae.

STÉFAN NICOLAU: The genesis of the inclusions produced by ultra-virus in general and by the herpetic virus in particular.

ANDRÉ LWOFF and HISTAKE DUBI: Thiazol, a growth factor for the flagellates *Polytoma caudatum* and *Chilomonas paramecium*.

Cape Town

Royal Society of South Africa, October 20.

W. E. ISAAC: Evolution of a growth inhibiting emanation from ripening peaches and plums. Air passed over certain varieties of ripening peaches and plums was found to exercise a marked effect on seedlings of the broad bean (*Vicia Faba*), sunflower (*Helianthus annuus*), and the Canadian wonder bean (*Phaseolus vulgaris*) and also on sprouting potatoes. The Canadian wonder bean was used for most of the experiments. The effects were: retardation of growth in length, increased growth in thickness due primarily to an increase in the size of the cortical cells, decrease of total amount of growth and changed reaction to gravity. Quantitative evidence was obtained of decrease in total amount of growth. Evidence is presented for regarding ethylene, evolved in very small amounts, as the effective growth inhibitor.

J. L. B. SMITH: A new gobioid fish from South Africa.

I. DONEN: A note on the distribution of chemical compounds in the inner and outer portions of the flesh of the Kelsey plum.

W. PUGH: Complex fluorides of gallium and some heavy metals.

F. G. CLAWSTON: (1) The development of teeth in the radula of fresh water Mollusca. There is a rapid increase in the number of teeth of fresh water Mollusca as soon as the radula is put to use after the animal hatches out. Tricuspid teeth in each row are added to from the marginals whose cusps coalesce as the animal grows. Fresh water species possess broad rows of teeth but not so many as some lagoon and land species. The stoutest teeth are those which are exposed to most use. Some increase in size of individual teeth may be expected during the first few months of the animal's existence. The best illustrations of typical teeth of the various fresh-water molluscs are obtained by preparing camera lucida models. (2) South African larval trematodes with forked tails the life-cycle of which is at present unknown. It is considered important to discover the life-cycle of furcocercous cercariae if the various forms are to be recognized. Difficulty is experienced in the differential staining of cercariae. Notes are given on some South African cercariae.

JOHN HEWITT: Descriptions of new forms of the genus *Acontias* Linn. Five new subspecies are described, preceded by an introductory account dealing with the forms occurring in Africa and their distribution.

W. J. COPENHAGEN: Sulphur as a factor in the corrosion of iron and steel structures in the sea. (2) Sulphides in bottom muds of certain harbours of the world. In a previous paper, reference was made to the occurrence of ferrous sulphide in the corrosion product on the surface of iron and steel vessels and structures when immersed for a period in sea-water. In all cases of bottom muds, except open roadsteads, ferrous sulphide was present in the bottom muds in comparatively higher concentration than that of marine muds on the floor of the ocean. The origin of the ferrous sulphide in bottom muds has been investigated and is of bacterial origin, that is, (a) from decomposition products of waste in harbours, and (b) by the reduction of sulphates in sea-water. Ferrous sulphide under certain conditions is oxidized to ferric oxide and elementary sulphur. The latter rapidly combines with exposed iron (in iron and steel structures) and rapid corrosion of the structures ensues.

Moscow

Academy of Sciences (*C.R.*, 16, No. 3, 1937).

I. M. VINOGRADOV: Some new problems of the theory of primes.

B. SALTYKOV: (1) The solution of the integral equation of N. Moisseiev in the theory of the non-regularized geoid figure. (2) The quasi-Stokes form of the integral equation of N. Moisseiev for the non-regularized geoid.

M. KELDYSH and M. LAVRENTIEV: The uniqueness of solution of the Neumann problem.

B. FUCHS: The group of analytical movements of invariant geometry with pseudocircular images.

L. V. KANTOROVICH: The moment problem for a finite interval. (A correction to the note published in *C.R.*, 14, No. 9, p. 531; 1937.)

L. MAGNABADZE: Fundamental problems of the theory of elasticity in two dimensions, for contours with angular points.

I. N. VASOVA: A complex representation of the general solution of equations of the stationary flat problem of the elasticity theory.

V. A. GAVRILENKO: Additional considerations regarding the distribution of velocities in turbulent uniform flow.

V. KUPRADZE: The theory of electromagnetic fluctuations in an even non-homogeneous field.

N. K. MIHAL: The determination of plummet deflections from the anomalies in the horizontal gradient of gravity.

A. I. KURBNOV: Fundamental regularities in the distribution of the dendrophilous lepidopterous fauna (Macrolepidoptera) in the Ussuri province.

B. A. ZENKOVIČ: Weighing whales.

E. ANDREJEVA: Ossification of the skeleton of the extremities in embryos of the Kirghizian fat-tail sheep.

A. A. TERENTIEVA: Development of the hairy covering in the Kirghizian fat-tail sheep.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, December 13

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—F. S. Chapman: "Lhasa in 1937".

Wednesday, December 15

GEOLOGICAL SOCIETY OF LONDON.—Prof. R. M. Field: "Geophysical Exploration of Ocean Basins".

Thursday, December 16

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Charles Sherrington, F.R.S.: "Jean Fernel and Astrology" (Thomas Vicary Lecture (2)).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—General Discussion on "Electrical Engineering Education". Introductory papers by Prof. C. L. Fortescue, Col. H. C. Fraser and F. H. Clough.

Friday, December 17

INSTITUTION OF CHEMICAL ENGINEERS (at the Institution of Civil Engineers), at 6.30.—Dr. R. E. Slade: "The Development of Grass Drying" (Annual Public Lecture).*

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

UNIVERSITY DEMONSTRATOR IN MINERALOGY AND PETROLOGY in the University of Cambridge—Dr. F. O. Phillips, Department of Mineralogy and Petrology, Downing Street, Cambridge (December 14).

SCIENTIFIC OFFICER in the Air Ministry Scientific Research Pool—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (December 17).

LECTURER IN ELECTRICAL ENGINEERING AND MATHEMATICS in the Aston Technical College, Whitehead Road, Birmingham, 6—The Principal (December 18).

LECTURER IN MECHANICAL ENGINEERING in the Oxford School of Technology, Art and Commerce—The Chief Education Officer, City Education Office, Oxford (December 20).

JUNIOR ECONOMISTS to the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1—The Secretary (January 7).

LECTURER IN CHEMISTRY in the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

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Australia's Burden

IN the early years of the twentieth century, it was generally accepted—in fact it had almost come to be regarded as axiomatic—that the 'backward' races must inevitably die out. The white man's burden—to civilize the savage—was being discharged in a process of elimination. Now, however, owing in part to a stern check on the more questionable 'advantages' of civilization, in part to what may be termed compendiously the anthropological approach in methods of administration, there are populations, comparatively speaking extensive, of which the numbers are more or less decisively increasing. The peoples of the greater part of Africa are an instance in point, while even the Indians of North America, for long quoted as a tragic example of degeneration and decay, seem to have entered definitely on the upward grade. Evidence from many quarters affords no uncertain indication, not merely that degeneration and extinction are by no means inevitable concomitants of the spread of white civilization to the remoter parts of the world, but also that under regulation of cultural contact and with such a degree of provision of medical attention as civilization normally brings in its train, native communities may retain, or even actually improve, their level in the matter of population, both in respect of absolute numbers and of relative increase.

In these circumstances it is, to say the least, remarkable that pessimism should still govern the outlook on the problem of the Australian aborigines. We are told of "tribes dying on their feet"; while a recent writer closes a review of the history and present condition of the Australian blackfellow in relation to white civilization by saying :

"As a good Australian I deplore that we must confess failure in dealing with our native races. We have studied them as museum specimens are

studied, we have had humanitarian suggestions for their betterment, but we have utterly failed to keep them alive. Some outside advice is needed, or in a few years, a very few years, there will be none of these unique stone age people left—they will have gone the way of the vanished Tasmanians, the way of death." (R. H. Croll, "Wide Horizons", Sydney, 1937, p. 143.)

It cannot be denied, even when every allowance is made for the difference in theological and socio-political outlook of an earlier day, that the record of Australian civilization in relation to the aborigines is bad. It has been estimated that when white settlement first took place in Australia, the native races numbered three hundred thousand. It is quite possible that this figure is too high ; but it is generally agreed that a little over a hundred years ago they numbered at least one hundred and fifty thousand. Now, a favourable computation places them at about seventy thousand ; and it is probable that the true figure is nearer sixty thousand. One estimate is as low as forty thousand.

Impressive as are these figures, they gain in significance when viewed in relation to the desolation of the abandoned occupation sites on former aboriginal lands, and when interpreted in terms of the complete extermination of those tribes of south-eastern Australia which a little more than a generation ago afforded the anthropologist the evidence, now priceless, of the most primitive form of human society then known among living races—evidence which would be of inestimable value could it now be tested in the field in the light of modern methods of inquiry.

All this, however, belongs to the past ; and it little profits to recall it, except in so far as it is a measure of Australia's debt to the aborigines, and to stress the necessity of a change of heart towards

present conditions, while pointing the way to measures of adjustment in the future. Not indeed that it is intended to suggest here that the Australian people is callous in its attitude towards the blackfellow. There is a growing recognition among individuals that the case of the aboriginal demands a 'fair deal'; and on more than one occasion a wave of public indignation has demanded that his rights should be respected and that he should be adequately protected from the effects and encroachments of white civilization.

Some years ago, not long after the Great War, the late Dr. Herbert Basedow, while on a scientific expedition to Central Australia, was aroused to indignation by conditions among the aborigines; and on his return to Adelaide, he stimulated public feeling to a degree which forced the Government to add a large tract of land to the aboriginal reserves in the centre of the continent to provide them with land adequate for the subsistence of tribes still living at the food-gathering and primitive hunting stages of social development.

Further—a fact to which too little recognition has been given in recent discussion—under all the Governments which are responsible for aboriginal administration, legislative measures have been taken for the official protection of the aborigines. The policy of the Queensland Government, as has been pointed out by the Agent-General in London (*The Times*, December 2), aims at the protection and elevation of tribalized and detribalized aborigines alike, the provision of medical attention, and—a most important function—the care of the cross-bred of superior type. Western Australia is taking measures to carry out the recommendations of the Royal Commissioner, to whose report reference was made in these columns at the time of its publication (see *NATURE*, 135, 798; 1935); while the Federal Government, in addition to its existing regulations for aboriginal protection, has recently appointed, in response to public opinion, an anthropologist as Protector of Aborigines.

Nor must the efforts of the missionary organizations be overlooked. They have done, and continue to do, excellent work, which is officially recognized as part of the organization for dealing with the aboriginal. Unfortunately, in consequence of conditions over which the missions have no control, their efforts in the long run add little towards the solution of the problem.

If, then, it may be asked, both Government policy and public opinion are prepared to help the

aborigines, how does it come about that all efforts are of no avail? Is it really the case that the race must inevitably die out, or is there perhaps some justification for the grave indictment of the Government and people of Australia by Prof. F. Wood-Jones and others? Prof. Wood-Jones in his valedictory address to the Victorian Anthropological Society, on leaving Australia for Manchester, it will be noted, returns to a charge which he made some years ago before the Australasian Association for the Advancement of Science. It is to be judged from the report of his address which has been published in England that he is of the opinion that, in the interval, nothing of any avail has been done to remedy the evils to which he formerly directed attention.

Setting aside the question whether the extinction of the race is inevitable from inherent causes as too large for discussion here, it may perhaps be said that among the many factors operative in present conditions and affecting the future, two stand out. Of these one is the character, mentality and traditions of the aboriginals themselves, the other the general approach of the Australian Governments and still more of the people to the problem.

As regards the aboriginal, it has to be remembered that the race belongs to a very primitive stock, cut off from communication with the rest of the world at a very early stage of racial distribution, that it lives in an arid and difficult country where mode of life for hundreds of years, possibly thousands, has been adjusted with extreme nicety in equilibrium with environmental conditions. Upon this state of equilibrium an advanced civilization has impinged suddenly to throw it out of gear. Only under a prolonged period of tutelage will the aboriginal be able to adapt himself to changed conditions and new methods of gaining a livelihood. That he will be able to do so ultimately, his character and abilities, as now understood, afford assurance; but it must be a form of livelihood which so far as possible should be in harmony with his tradition, aptitudes and mentality. That he is not incapable of such training has been shown by the work which has been done by the missions. It is the duty of the Government by patient inquiry and expert investigation to determine on what lines he can be trained to take his part in the future development of Australia—not as a museum piece, but as an integral part of the community. In the meantime, the provision of land for reserves and of medical attention have

been rendered frustrate by the nomadic tendencies of the tribes, their inclination to drift to centres of white civilization and their mistrust of the white man's 'medicine'. To remove these difficulties in the way of protection should be the task of a sympathetic system of administration.

Secondly, the Australian people cannot be absolved from blame. Outbursts of popular indignation at the treatment meted out to the aborigines are of little avail, even when followed by legislation, if they do not also give rise to a sense of responsibility, constantly vigilant to see that regulations are properly carried out and that abuses are promptly eliminated. When the addition was made to the aboriginal reserves in central Australia to which reference has been made above, it was laid down that no prospecting for minerals would be allowed. Yet within two years, concessions for this purpose were being sought, and it was alleged at the time that the principal agent in the matter was one who had been most active in the agitation for securing the allocation of the reserve. Other encroachments on the reserves have been tolerated. Again, it is generally accepted that it is undesirable that police officers should be asked to undertake protection duties; yet in many instances the protectors are still policemen or officials whose other duties do not allow them to perform their function as protectors with efficiency.

It has been suggested that protection of the aborigines is a duty which should be and could best be undertaken by the Federal Government. Many hold this view. It is a matter that must be judged by the Australians themselves; but it would seem that, provided co-operation and unity

of policy can be secured as between the States, local interest might well serve as a nucleus of that strong and steady public opinion, at present lacking, which is essential to ensure that protective legislation is not only carefully framed, but also effectively put into operation.

It must seem to those who have had the advantage of examining successful systems of administration of native affairs elsewhere, that for the application of modern methods of native control, now accepted as essential for the well-being and future advancement of native races, the urgent need of Australia is a specially trained and efficient service of officers acting as protectors of the aborigines. Reference has been made in this discussion to the administration by the Australian Government of the native affairs of New Guinea and Papua. It is true that conditions there are very different from those of Australia; but they do at least afford this lesson, that for dealing with backward peoples with success it is essential that there should be sympathy and understanding, and that these qualities can be shown best by officers who are trained in the methods of anthropology. They need not be anthropologists in the special sense, but they should be trained to a degree that will ensure that they understand the customs and mentality of the people whom they have to control, and can deal with them with understanding. The cost of such a service in Australia—heavy as it will be—should weigh as nothing by the side of Australia's reputation for fair dealing, and possibly too as against the preservation of a people who one day may find a fitting place in the promotion of Australia's prosperity.

Land for the People

The Hill Lands of Britain:

Development or Decay? By R. G. Stapledon. Pp. 138. (London: Faber and Faber, Ltd., 1937.) 6s. net.

SCHOPENHAUER, in one of his discerning moods, divided authors into three classes: those who write without thinking—the most numerous; those who think as they write; and those who have thought before they write—they are rare. There is no doubt of the class to which the author of "The Hill Lands of Britain" belongs; in fact, he has thought so much, done so much, and has so much to say, that out of very exuberance

of spirit he sometimes forgets that language, like a living thing, has structure as well as function. His few lapses in this direction have prompted a well-known literary critic to pillory him for not being "an elegant, an easy, or a lucid writer". The indictment is far too sweeping: the author's meaning is never in doubt, his message rings clear and true.

Probably few of us realize how much of the green and pleasant land of Britain is sheer waste from the utilitarian point of view. Prof. Stapledon estimates that there are about 18 million acres of land, situated above 700 ft., covering not far short of one third of the land surface of Great Britain,

which produce little or nothing for supplying the needs, material or recreative, of our people. He describes these depopulated upland areas and indicates how and why they should be mobilized for national service. On some future occasion, we hope that he will write a companion volume on the reclamation and improvement of the thousands of acres of derelict and semi-derelict land that now disfigure the lowland countryside.

Agriculturally, the productivity of our hill lands, and of much land officially designated as 'rough-grazings', could be greatly improved by fairly simple means. Briefly, the necessary operations consist in breaking up the matted surface with tractor-drawn plough or cultivator, applying lime and phosphate, and, where economically possible, sowing suitable grass seeds together with plenty of wild white clover. This is not theory; the author and his co-workers at Aberystwyth have shown how it can be done on the uplands vested in the Cahn Hill-Improvement Scheme. To maintain and improve the fertility of farmed hill land, the fields should be kept under sown grasses for a period of two to six years; more use should be made of cattle for grazing, and crops like oats, kale, hardy green turnips, rape and Italian rye-grass should be grown for providing winter 'keep'.

It is not suggested that all the 18 million acres are immediately improvable, but about 25 per cent is; and the cost should not be unbearable. About £5 million a year should suffice for purchase and development of this land in the early years of a twenty-five year programme, and revenue would soon come in as rentals and taxation; for the author has come reluctantly to the conclusion that successful exploitation of the uplands for the national good can be achieved only through State ownership. The State would also benefit from the large amount of employment the scheme would give, and from the substantial addition that would be made to our supplies of home-grown food.

It must not, however, be thought that Prof. Stapledon's plans and ideas are confined to agricultural improvement and intensification. He has a great deal to say about populating our derelict upland districts, and providing urban dwellers with facilities for visiting and staying in them; about roads, tracks and transport, regional planning and education of the 'whole man'. In the last two chapters particularly, "The Non-Material Needs of the Nation" and "Dangers Inherent in Planning", he lets himself go, and gives us what almost amounts to a philosophy of right living (*savoir vivre*). For executing his plans, he does not look to the 'pure' scientist, with his nose impinging on the test-tube and his eye glued to the microscope, but rather to the scientifically educated man, like the engineer, who besides knowing how to turn knowledge into action, has rubbed shoulders with his fellow-men, and learnt to assess their faults and foibles as well as their virtues and capabilities. Nor can the author contemplate a multiplicity of administrative authorities, such as are now so common; he would absorb them into one supreme *ad hoc* authority, composed entirely of experts, like social biologists, agriculturists, foresters, engineers, surveyors, and psychologists. Although the last word would be with Parliament, all plans and administration would be carried out by experts on a wide regional basis. Excessive standardization would have to be avoided at all costs; development and happiness of the individual would be the supreme end.

"The Hill Lands of Britain" covers essentially the same ground as that of the author's larger work, "The Land: Now and To-morrow" (see NATURE, 137, 923; 1936), which it supplements and to some extent revises. There are many good things in it which have not been mentioned, but enough has been written to indicate that it represents a valuable epitome—scientific, practical, full of common sense and of uncommon vision. E. H. T.

The Cathode Ray Tube

(1) **The Low Voltage Cathode Ray Tube: and its Applications.** By G. Parr. Pp. x+177+6 plates. (London: Chapman and Hall, Ltd., 1937.) 10s. 6d. net.

(2) **Television Cyclopaedia**
By Alfred T. Witts. Pp. 151. (London: Chapman and Hall, Ltd., 1937.) 7s. 6d. net.

THE use of the cathode ray tube for television reproduction was suggested by A. A. Campbell Swinton so early as 1908, and although many

alternative schemes were explored in the succeeding twenty-nine years, the suggestion has borne fruit in its application to the present public television service in Great Britain. This remarkable stride in the development of radio communication has been made possible by the detailed technical improvement of the cathode ray tube, first as a laboratory tool and finally as a picture-reproducing device for use in the hands of the general public.

(1) The book by Mr. G. Parr deals with the sealed-off type of cathode ray tube operating at

accelerating potentials up to 3,000 volts. The fundamental principles of cathode ray tubes, both of the gas-focused and high vacuum types, are discussed, and the manner in which they may be operated to demonstrate their properties and performance is described. Two chapters are devoted to the various types of time base which may be utilized to delineate the wave-form pictures on the screen of the tube, and various engineering and industrial applications of the cathode ray tube are described. A concluding chapter outlines the manner in which the tube is applied to reproduce the television picture by the two principal methods which have been developed in Great Britain.

The book forms a very useful summary of the present stage of the development of the cathode ray tube, and its bibliography of some four hundred references should prove useful to those who wish to delve deeper into the subject.

(2) Since the subject of television involves a

knowledge of the technical aspects of both optics and radio communication, it is perhaps not surprising to see the issue of the "Cyclopaedia" by Mr. A. T. Witts. In this work, a large number of the terms used in television technique are arranged in alphabetical order and described by text, which ranges from a simple definition to a short article occupying two or three pages. Line diagrams accompany the text where this is considered to be useful.

On account of its arrangement in dictionary form, the book does not provide a suitable means of learning the principles in the science and practice of television; but it should prove a very useful work of reference to those who already have some knowledge of the subject. Although the work is not free from some errors and omissions, these are generally of a minor character. The reviewer must confess to his ignorance of the meaning of the word "defraction", which is used several times on pp. 133-34, but is not defined.

The New Cytology

Recent Advances in Cytology

By Dr. C. D. Darlington. Second Edition. Pp. xvi + 671 + 16 plates. (London: J. and A. Churchill, Ltd., 1937.) 21s.

THE first edition of this book, published in 1932, contained much useful data in the form of tables, diagrams and photographs, together with theories regarding chromosome behaviour. No serious student of cytology could ignore the book, which was a mine of information, and which sometimes annoyed and always stimulated the experienced worker. The second edition is not a mere reprinting of the first, but contains a great deal of extra material which will interest cytologists. Again we find tables, diagrams and illustrations, and signs of considerable assiduity by both the author and the publisher. So great are the additions of new material that the book is larger by more than a hundred pages, in spite of the fact that the large chapter on the "Evolution of Genetic Systems" has had to be omitted.

The changes that have taken place in cytology during the past five years can be seen by comparing the contents of the first and second editions. Very full descriptions of mitosis, meiosis, structural changes, polyploids, chiasmata, crossing-over, secondary pairing, origin and behaviour of sex chromosomes, and apomixis will be found in the second edition. The theories propounded to account for the phenomena appear more stabilized and their comparative importance can be more easily grasped in the new edition. Indeed, it would

appear that the main principles of chromosome behaviour in so far as they bear on genetical problems are now in a form acceptable to most cytologists. For the presentation of this alone the second edition is a valuable contribution. Other subjects, however, such as salivary gland (polytene) chromosomes, the prevalence and behaviour of inversions and "cell and chromosome mechanics", which have developed to a large extent in the last five years, are given prominence.

Considerable attention is paid in the book to the underlying causes of chromosome movement, spindle formation, and centromere action. Chromosome mechanics would still appear to be in a controversial state. It will be interesting to see if the various theories put forward in the second edition will be accepted in the future to the same extent as those of the first edition are at the present time.

As in the previous edition, there are a large and useful list of references and a glossary which contains many new terms. The majority of these are the production of the author and his co-workers. One can only imagine the number of new terms evolved by other cytologists, and the resulting difficulty in mutual understanding. An error in the definition of the *W* chromosome has crept in, while considerable humour is to be found under "Golgi Apparatus" and "Matrix". There has been more care in proof-reading, and in the preparation of the index, which, in the second edition, is a useful guide in searching for particular

information in the maze of inter-related facts, remarkable theories and astonishing phraseology. Even "quart in a pint pot" has been indexed. The index has been arranged in different type so that illustrations and diagrams may be distinguished from the letterpress. Led by the index to "epigenesis", one is rewarded by: "This is the principle of co-operation which is an *a posteriori* statement of the *a priori* doctrine of epigenesis". The remarkable changes in cytology

are also reflected in the relegation of *parasyngapsis* and *telosynapsis* to the glossary.

This is a difficult book; but remarkable changes are still taking place in cytology. The author and publisher are to be congratulated on the production of a research monograph, profusely illustrated with diagrams and photographs, many of which are original, and containing a mass of data which will greatly stimulate workers in the field of cytology.

F. W. SANBOME.

Bird Life

(1) The Book of Birds :

the First Work presenting in Full Color all the Major Species of the United States and Canada. Edited by Dr. Gilbert Grosvenor and Dr. Alexander Wetmore. Vol 1: Diving Birds, Ocean Birds, Swimmers, Wading Birds, Wild Fowl, Birds of Prey, Game Birds, Shore Birds, Marsh Dwellers, Birds of the Northern Seas. Pp. viii + 356. Vol. 2: Owls, Goatsuckers, Swifts, Woodpeckers, Flycatchers, Crows, Jays, Blackbirds, Orioles, Chickadees, Creepers, Thrushes, Swallows, Tanagers, Wrens, Warblers, Hummingbirds, Finches and Sparrows. Pp. 374. (Washington, D.C.: National Geographic Society, 1937.) 2 vols. 5 dollars.

(2) The Birds of the Malay Peninsula :

a General Account of the Birds inhabiting the Region from the Isthmus of Kra to Singapore with the adjacent Islands. By the late Herbert C. Robinson and Frederick N. Chasen. (Issued by authority of the Federated Malay States Government.) Vol. 3: Sporting Birds; Birds of the Shore and Estuaries. Pp. xxi + 264 + 25 plates. (London: H. F. and G. Witherby, 1936.) 35s. net.

(3) Check-List of Birds of the World

By James Lee Peters. Vol. 3. Pp. xiii + 311. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1937.) 15s. net.

THE resources of the National Geographic Society have made possible the issue of a remarkably effective popular book on the birds of the United States and Canada. The text is contributed by a number of American ornithologists of high repute, whose names guarantee it as authoritative, and the extent to which the two volumes are illustrated is truly lavish. Prior publication in the Society's widely circulating magazine, over a period of years, has covered so much of the cost that the price is a low one for the value given.

Each important group of birds receives a chapter, in which an introductory account is

followed by details of the separate species. Other chapters are interpolated to deal more generally with such topics as the study of migration by the ringing method or the mechanical recording of bird-song. The treatment of some questions is perhaps superficial, and the style at times rather journalistic, but the information essential to a work of this kind is well presented.

The outstanding feature is the full use that has been made both of colour drawings and of photographs—there are more than two hundred of each. The coloured plates by Major Allan Brooks are beautifully clear, and well adapted for purposes of identification: all important species are depicted, often in more than one plumage. The photographs are from various sources and reach a high standard. They have obviously been selected to give an impression of the lives of the birds rather than of their mere appearance, and in this way they admirably supplement the portraits provided by the artist.

(2) Mr. Chasen now presents the third of five instalments of a guide to the bird-life of Malaya, the death of the author of the first two volumes having been the chief cause of a gap of eight years in publication. The work is a sumptuous one, and intended primarily for local use. Its general arrangement is unusual in that the division into volumes is based on habitat instead of following a strictly systematic order. Each species, however, is dealt with on a uniform plan, a description of the bird being followed by particulars of its range, nidification and habits. The information is lucidly set forth, and the plates by Mr. Grönvold are excellent.

(3) Mr. Peters is engaged in producing a work of reference of much value to ornithologists. The information given is restricted to nomenclature and distribution, but the utility of an up-to-date standard list of all known birds is obvious. The present volume covers the pigeons and the parrots, these two orders including between them more than sixteen hundred forms.

Why Aeroplanes Fly

By Arthur Elton and Robert Fairthorne. (The March of Time Series: Mechanics, 1.) Pp. xii+82. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 2s. 6d. net.

THIS readable book discusses the subject more broadly than the title suggests, giving a chapter upon the uses of aircraft, even going into the question of its military values. The text follows faithfully the ideal laid down in the preface of giving "the reading public a detached, simple and untechnical explanation" of the subject matter; so much so that the reviewer feels inclined to suggest that the authors under-estimate the ability of the said reading public to understand the simple ideas of natural physics and mechanics. Nevertheless, it is almost entirely free from those loose and often inaccurate statements that are usually the inevitable accompaniment of the simplification of scientific matters.

It is easy to find faults of omission in any book which has obviously been kept down in size, but there are some cases in which the authors, having embarked upon an explanation, should not have left it unfinished. For example, when discussing high wing loading as a means of increasing carrying capacity, the attendant dangers of high landing speed are mentioned, but there is nothing about the many thoroughly tried and proved methods of increasing the speed range and reducing the landing speed. One would have been inclined to have accused the authors of being out of date but for the fact that in the next paragraph they mention retractable undercarriages as a means of reducing drag, a much more modern development.

Mention of a possible "new kind of engine made like a rocket" is a case of loose terminology. This surely means that the whole aircraft would be functioning on a rocket principle.

In general, a good book for the lay reader who has been so out of touch with the modern world that he is quite ignorant of the technical aspects of flight. The illustrations are particularly good, well chosen and well produced.

The Geology of South-Western Ecuador

By Dr. George Sheppard. With a Chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. Thomas Wayland Vaughan. Pp. xiv + 275 + 13 plates. (London: Thomas Murby and Co., 1937.) 25s. net.

DURING the past twelve years Dr. George Sheppard has published a series of papers on various aspects of the geology of Ecuador. In this volume, which is probably the first published in English on the geology of Ecuador, he puts on record his collected data and his conclusions. The present climate and physiography are described together with the effects produced by this type of climate. The origin of the Tertiary Clay Pebble Bed of the Santa Elena region is a matter of controversy. It has been suggested that it is a crush breccia on a regional scale, but Dr. Sheppard takes the view that it was originally of the

nature of a series of extensive mud streams similar to those which have been observed at the times of the heavy rains. He puts considerable emphasis on the results which may arise from these rather exceptional climatic conditions.

Some have regarded the Guayaquil Limestone as Cretaceous, but examination of the contained Foraminifera places the age as Eocene, and probably in the upper part of the series. In consequence of this and other evidence, Dr. Sheppard makes the tentative suggestion that the Guayaquil Limestone and the Soca Shales are of the same age.

Dr. Wayland Vaughan has contributed the chapter on the Tertiary Larger Foraminifera, and other chapters describe the geological structure, the igneous rocks and cherts, at some length. The final chapter deals briefly with the occurrences of petroleum.

An abundance of material is presented which provides food for thought on many points, but in giving his conclusions the author does not expect to go unchallenged on all the issues. G. D. H.

Plant Life Forms

By O. Raunkiaer. Translated by H. Gilbert-Carter. Pp. vii+104. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 5s. net.

THIS type of botanical text will not be familiar to many British botanists, and therefore, although the original was written in Danish by Prof. Raunkiaer so far back as 1907, the point of view will be fresh and, indeed, invigorating.

Plants can be classified vegetatively into trees, shrubs and herbs, but this does not take the botanist very far. Most plants have to pass through a period of much-curtailed activity—winter in temperate countries and dry season in the tropics—and during this period, their growing parts, namely, the buds, must be afforded some means of protection. The degrees of protection vary according to the requirements of the different species. Prof. Raunkiaer describes the various means of protection, and these are illustrated by examples and drawings.

From this point of view, the plants are divided into the following main groups: (1) Phanerophytes, plants whose buds and apical shoots project into the air during the unfavourable season; (2) Chamaephytes, with buds and apices on shoots at or near the soil surface; (3) Hemikryptophytes, whose shoots die back just before the unfavourable period, so that surviving buds, etc., are protected by withered leaves and the soil; (4) Cryptophytes, whose surviving buds, etc., are either beneath the soil or at the bottom of water; (5) Therophytes, plants which pass their complete generation from seed to seed, that is, survive the unfavourable period as seeds. These groups are still further subdivided.

The value of plant life-forms to the study of plant geography can be well imagined, and a brief account of this is given at the end of the book.

Botanists will welcome this attractive book, and should be grateful to Mr. H. Gilbert-Carter for his excellent translation from Prof. Raunkiaer's original.

The Pleistocene History of the West Midlands*

By Prof. Leonard J. Wills

THE OLDER DRIFTS

The 'Older Drifts,' as already pointed out, are essentially either north-western (or Welsh) or north-eastern in composition. We may now examine them to determine whether they record more than one glacial epoch. For this purpose we can divide the region into two parts along a line running roughly from Derby—Lichfield—Tamworth—Coventry—Stratford-on-Avon to Moreton-in-the-Marsh.

East of this line two distinct sets of glacial deposits can be recognized on lithological and stratigraphical grounds. The older of the two, as developed in the north, is of Pennine origin, and was carried by ice travelling from the north-west; but near Coventry and Rugby, drift occupying an analogous position contains chalk and flints, and can be described as a sort of chalky boulder clay. Its apparent southerly limit is shown in Fig. 1. In the intermediate district little is known, but near Hinckley and perhaps also at Bedworth part of the older series consists of well-bedded, probably lacustrine deposits. The oldest drifts on the Blythe-Avon watershed near Stratford-on-Avon, and the 'Campden Tunnel Drift' near Moreton appear to be Welsh in origin with a slight eastern admixture. They have both been regarded as probably older than the Great Eastern glacier (Tomlinson).

Throughout all this eastern region the upper or more recent drift has been derived from the north-east and often consists of a true chalky boulder clay. It has generally and, I think, correctly been referred to the Great Eastern glaciation of Harmer.

Between the lower and the upper boulder clays in the Hinckley-Coventry-Rugby district there is a persistent bed of gravel and sand. Somewhat similar deposits, the Jurassic gravels of Miss Tomlinson, underlie the 'Main Eastern' boulder clay of the Stratford area. The 'Ditchford' or 'Paxton' gravels of the Moreton district occupy an analogous position with respect to the chalky 'Moreton Drift' (Tomlinson and Dines). In the Jurassic gravels near Stratford a single tooth of an archaic form of *Elephas antiquus* has been found, which is suggestive of interglacial conditions. Near Coventry both cold and warm climate fossils have been recorded by Shotton. In

view of the close association of these deposits with two glacial series, the presence in them of tundra and temperate fossils is not so contradictory as would at first sight appear, especially as we must allow that vast lengths of time may, in a watershed area, be represented by comparatively thin deposits.

I consider that the facts in this eastern region support the idea of two distinct glaciations within the Older Drifts, with interglacial conditions between them (*First Interglacial*).

West of the Derby-Moreton line the area of the Older Drifts is sharply limited on the north by the southern edge of the later Main Irish Sea glacials (Fig. 1), which has already been discussed. Except in the Lower Avon valley, the older drifts are here Welsh.

The interpretation of these drifts is extremely difficult, partly because it is likely that if there have been two glaciations, they will be recorded by similar deposits which might occur each separately or both together on the same surface, and partly because of the great dissection and destruction that they have undergone. Many of the deposits, too, are gravels and sands that belonged rather to outwash fans than to the ice sheet itself. On the other hand, we have, as already pointed out, the river terraces to help us, by providing a record of the progressive deepening of the valleys and of the contemporaneous opening up and development of new lines of drainage on surfaces, each of which appear to grade with one or other of the terraces, and which for this reason may be regarded as of approximately the same age as the terrace in question.

We may consider the Lower Avon and Lower Severn vales first. Here the highest deposit, namely the Woolridge Terrace, is developed between Tewkesbury and Gloucester, and up the Leadon valley at heights between 200 and 285 O.D. I have elsewhere suggested that the Leadon valley deposits were laid down by water travelling west of the Malvern range and forced to take this course by the filling of the Severn vale by the Welsh ice, when at its maximum. At this stage, too, the ice seems to have carried Welsh boulders to the Moreton-in-the-Marsh district and to have been responsible for certain very high-level drifts in Worcestershire. For these reasons I picture it as stretching over the vales of Severn and Avon

Continued from page 997.

to the Cotteswold escarpment. A slight retreat would have allowed outwash material to be laid down below Tewkesbury. Patches of this have survived at Woolridge (260 O.D.), Norton Hill (283 O.D.), and Corse Hill (250 O.D.). These and some other very high deposits seem to belong to this early stage and to be the most likely equivalents of the lower boulder clays of the Upper Avon valley and of the Pennine drifts of the Trent, Soar, and Wreak valleys.

If we accept this view, it follows that the retreat of this *First Welsh Glacier* was connected with the 'first interglacial' episode for which we have discussed the evidence in the Upper Avon valley. In the Lower Severn vale the Bushley Green Terrace, containing a temperate shell fauna and lying at a considerably lower level than the Woolridge Terrace, appears to belong to this time. The Bushley Green correlates with the Avon No. 5 Terrace of Miss Tomlinson, but for several reasons I picture the latter as somewhat later in date though graded to about the same level. On this view the Bushley Green and Avon No. 5 Terraces cover the 'first interglacial' episode and the on-coming and maximum stage of the Great Eastern glacier in the Avon Vale.

What then of the rest of the region? There are certain data and several lines of reasoning* which in my opinion justify us in postulating the existence during the Great Eastern Glaciation of a Welsh ice sheet reaching across the Stour and Salwarpe valleys, and covering the Black Country, East Worcestershire and the Warwickshire Plateau (Fig. 2). There is, however, no clear-cut evidence to prove whether it was the shrunken First Welsh, or, as I think more likely, a *Second Welsh* ice-sheet which, as the first interglacial epoch passed away, grew and invaded the northern part of the same region, incorporating to some extent in its deposits the drifts of the earlier advance.

The retreat of this glacier is illustrated diagrammatically in Fig. 2.

The first position shown is indicated by a line with double offsets. This line conforms with Miss Tomlinson's maximum 're-advance' in the Blythe valley; with the considerable development on the Ridgeway of drifts with both north-eastern and north-western erratics which may have owed their origin to the combined efforts of the two glaciers; and with the gravels and sands of the Stoulton-Besford area which I have just referred to as grading to the same level as Avon No. 5 Terrace. As the two sheets withdrew, the drainage down the Avon was responsible for the formation of some parts of the same terrace. It appears necessary to imagine the Severn valley from Worcester downwards as having already been

established, possibly as a marginal flow along the edge of the First Welsh Glacier.

The second stage deserves more elaboration; but this cannot yet be achieved, owing to want of data. The line indicated with three offsets must therefore be regarded as a composite representation of several that it would be necessary to draw in order to satisfy even the evidence we now possess. East of Birmingham the line represents a lobe in the Tame basin connecting near Tamworth with the Eastern ice of the Anker and Trent valleys. This disposition of the two sheets would enable us to account for the Blythe valley lake suggested

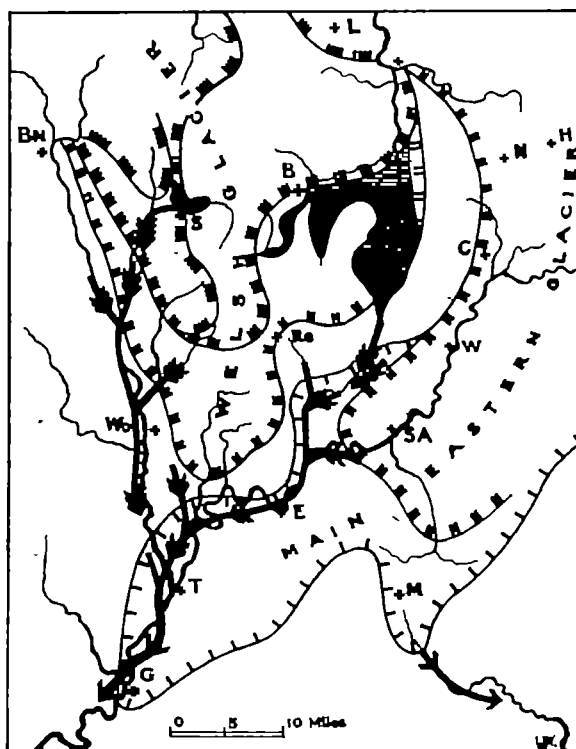


Fig. 2.

POSSIBLE SUCCESSIVE STAGES OF RETREAT OF THE SECOND WELSH AND OF THE GREAT EASTERN GLACIERS. HORIZONTAL HULLING INDICATES GLACIAL LAKES; ONE-BARRED ARROW, BUSHLEY GREEN TERRACE OF SEVERN, AND WOLVERCOTE TERRACE OF EVENLODE; TWO-BARRED ARROWS, AVON NO. 5 TERRACE; THREE- AND FOUR-BARRED ARROWS APPROXIMATE TO THE KIDDERMINSTER TERRACE.

in the Birmingham Memoir and described by Miss Tomlinson. It drained southwards by the Kingswood Gap to the Alne valley during the Stratford stage of the Great Eastern Glacier (Tomlinson).

Ice approximately in the position shown for this stage could also account for the Cole valley lake, the Moseley gravels, and the barrier of sands which turn the Cole eastwards near Castle Bromwich. Fig. 2 also indicates a lake in the upper Rea

* These are outlined in the printed address.

valley, south-west of Birmingham. This expresses the hypothesis that certain clays, such as the 'india-rubber clay' of California and the similar deposits at Parson's Hill, King's Norton, may have originated as lake clays when the Rea valley was obstructed by ice that impounded water up to about 550 O.D.

The line further coincides to the south-west of Birmingham with the gravel deposits of Rowney Green near Alvechurch, which may be regarded as marginal in origin. The lobe stretching southwards complies with the necessity for an extension into the lowlands of an ice-sheet that was mighty enough to overspread the high ground of the Black Country and the Lickey Hills. Drainage from this was carried away along the Salwarpe into the Severn, and was responsible for part of the erosion of these valleys before the Kidderminster Terrace came to be formed. It will be noted that the overflow from the Blythe lake coupled with drainage from the retreating Eastern glacier produced similar erosion-effects in the Avon valley before Avon No. 4 Terrace was laid down.

Returning to the melting glacier, the next event seems to have been the splitting of the ice on the high ground of the Black Country. The lobe on the west I picture as occupying the low ground west of the coalfield and of the Clent-Lickey range as far south as the Salwarpe valley. It was this ice that held up the lake or lakes near Wildmoor and Barnt Green which have left their record in the horizontally bedded high-level sands and gravels of that district.

As the ice shrank back the thick mounds of sand and gravel in the Stour vale and near the Churchill brook were deposited. These clearly antedate the Kidderminster Terrace and so fall into their correct position in the scheme.

The final stage, indicated on Fig. 2 by a line with five offsets, was suggested to me by Mr. T. H. Whitehead. There is much evidence to justify the assumption that in pre-Glacial times the Stour flowed northwards as far as Hinksford, where it rounded the end of the then unbroken Bunter Pebble Bed escarpment. Ice in the position shown on the map would, as already suggested, have impounded a lake in the upper Stour valley, the overflow from which might have initiated the present gorge of the Stour through the Bells Mill Gap. The sands of the so-called Kingswinford Eaker can be regarded as having originated in this lake.

All the records of the further retreat of the Welsh ice sheet have been obliterated by the invasion of the later Main Irish Sea glacier.

The evidence relating to the Older Drifts that we have been considering is scattered, difficult to

interpret and usually ambiguous; but nevertheless I feel some confidence in the correctness of the main features of its interpretation, namely, that there were two glaciations involved. In the first the ice movement was from North Wales and the Pennines towards the south-east: in the second there was a similar, but less powerful North-Welsh dispersion with some slight intermingling of Irish Sea material. Simultaneous with this, however, in the east and in the Avon valley was the Great Eastern glacier.

By the end of the First Glacial epoch the general trend of the lowest parts of the Severn seem to have been established as marginal channels bordering the ice which lay thickest in the Salwarpe-Piddle Brook depression. The first and the second glaciations were probably separated by truly interglacial conditions (First Interglacial).

The Second Glaciation came to an end in the *Second or Great Interglacial* epoch which intervened between the deposition of the Older and Newer Drifts. In the area under review we find at this stage that the present directions of the rivers had been determined, and that the valleys of those days can be recognized and their depths defined by the Kidderminster-Avon No. 4 Terrace, and perhaps by the 'High Terrace' with *Hippopotamus* in the Trent valley. There is, however, one exception to this statement. I refer to the Iron Bridge gorge. This section of the present river was non-existent at this time, and in its place was a high watershed. The diversion of the Upper Severn across this waterparting belongs to the story of the Newer Drifts.

NEWER DRIFTS

(a) *The Main Irish Sea Glaciation.* I can only refer in the very briefest way to the events that have occurred since the 'Great Interglacial.' I have already mentioned that the Newer Drifts in the Midlands were the product of the *Main Irish Sea Glacier*, and I have attempted to define its maximum extent on Fig. 1. This glacier belonged to the *Third Glaciation*.

The oncoming of this glacier seems to have coincided with the deepening of the Severn valley below the Kidderminster Terrace level, in preparation, as it were, for the great floods of sand and gravel that were fed into it as soon as the ice crossed the old watershed near Iron Bridge and at the head of the Worfe and Smestow valleys. These deposits are now the Main Terrace, correlatives of which are the Second Terrace of the Avon and probably the low terraces of the Trent and Tame.

As the ice had been moving upstream in its invasion of the Dee and Mersey basins, it must

have impounded the drainage during the advance, as we know it did later during the retreat; but there seems to be no record of an overflow into the Severn catchment during this growth stage. As the ice melted back from the maximum position shown on Fig. 1, a series of important drainage changes took place. First, at an early stage when the ice still covered the watershed at Iron Bridge and at the head of the Worfe, but had melted back enough to expose the upper Penk valley, a small lake was impounded just north of Wolverhampton which flowed out south-westwards over the watershed near Tettenhall, forming the Tettenhall Gap. This overflow was responsible for the great train of gravels full of Irish Sea erratics that follows the Smestow Brook down into the Stour.

Dixon has traced various ice fronts trending in a general north-easterly direction across the country between the Penk and Newport, Salop. These are marked by terminal kames and by beaded asar.

The Worfe valley was an important line of drainage from the ice front until the latter came to lie on the north side of the watershed. In this position a lake was impounded near Newport, and Dixon has shown that this drained across the watershed at Gnosall into the Church Eaton brook and so into the Trent. He named it Lake Newport.

I have elsewhere described the detailed evidence relating to the way in which the waters of the Upper Severn came to be diverted through the Iron Bridge gorge into the drainage basin of the present Middle and Lower Severn. This diversion was brought about during the melting back of the Main Irish Sea Glacier on the watershed region near the Wrekin, through the development of a system of marginal channels and glacial lakes. The detailed evidence substantiates a hypothesis suggested independently by both Lapworth and Harmer, the main feature of which was that a lake was held up by the ice sheet on the north-west side of the pre-Glacial watershed at Iron Bridge; and that this lake drained away across the divide, and thus initiated a gorge that became so deep that it has permanently retained the Upper Severn drainage which formerly went out to sea either by the Dee or by the Mersey. This lake I named Lake Buildwas.

At this stage then there were two lakes, Buildwas and Newport, on the north-west side of the watershed, one draining to the Trent and one to the Middle Severn. They were separated by the ice where it impinged on the Wrekin. When the glacier melted back farther and allowed the lakes to join and form 'Lake Lapworth,' so nearly at the same level were the outlets that it was a mere

matter of chance that the Upper Severn went permanently to the Bristol Channel and not to the Humber. As it happened, the Iron Bridge outlet was, or at any rate soon became, the lower. It took all the discharge and has retained it ever since.

These glacial accidents have been the factors that have determined much of the geography of the Midlands; for they diverted into the relatively small pre-Glacial catchment basin of the Lower and Middle Severn great volumes of water which have rejuvenated the river, especially in its middle reaches, on a stupendous scale. The rejuvenation is still operative, and can be seen to-day in the erosive activity of every tributary of the Middle Severn.

Climatic conditions during the Main Irish Sea glaciation were extremely severe. Solifluxion and melt-water floods were on a correspondingly grand scale in the periglacial region. There are vast spreads of local, often angular, detritus at the foot of the Cotteswold and Malvern Hills, and in the valleys draining the high ground of Enville and the Clent-Lickey range, which resulted from these conditions. Most of these grade down to the Main Terrace level in the adjacent valley, and may be correlated with that terrace and thus with the third glaciation; though some seem to be still younger and to correlate with the Worcester Terrace and the Welsh Re-advance.

(b) *The Welsh Re-advance* or Little Welsh Glaciation.* The fourth and last glacier to reach our area was an extension of the Upper Severn valley-glacier down as far as Shrewsbury, to which Whitehead has given the name *Welsh Re-advance*. There is strong evidence that the lowest of the important Severn Terraces, the Worcester Terrace, was being formed during this re-advance.

The problem of the Welsh re-advance is one among many relating to our glaciations that await solution, and yet can never be solved by work in one restricted area. The cry is always for accurate data in neighbouring areas. I close this address, as I began it, by an appeal for amateurs who are willing to undertake conscientiously and scientifically the recording and co-ordinating of every scrap of evidence in the district in which they live, whether it be a glacial or a periglacial one. If this were done so carefully that no temporary exposure escaped record, data would gradually, but I think quickly, accumulate by which some at least of the many outstanding problems of glacial correlation and interpretation would reach solution.

* The map, Fig. 1, does not attempt to show the limits of this along the Welsh borderland, as worked out by Dwenyhouse and Miller and by Charlesworth, since they lie wholly outside the Midlands.

The Soviet North Polar Station

WHEN the Soviet polar station was founded on an ice-floe near the North Pole on May 21, 1937, it was expected that the floe would drift slowly, perhaps erratically, but on the whole towards the northern coast of Greenland. The outflow of ice from the Arctic basin by the East

Service give some details. Until early November the drift was steadily southward along the meridian of Greenwich, with deviations of about seven degrees of longitude to east and west. Then during November the course became south-east towards Spitsbergen, and on November 30 the position was lat. $82^{\circ} 51' N.$, long. $7^{\circ} E.$ Thus the station is now approaching the course of the final stages of the drift of Nansen's *Fram* in 1896. The *Fram*, with a slower and less decided course, moved on the whole to the south-west from the vicinity of the New Siberian Islands to lat. $84^{\circ} N.$, long. $15^{\circ} E.$ and then southward. Thus there would appear to be a certain parallelism between the two drifts, with the suggestion that the quicker drift of the Soviet station is due to its being in the main trend of the current while the *Fram* was in the peripheral regions, where wind may at times have controlled the course.

Until November the floe with the Soviet station was moving definitely towards the East Greenland current, which is the main outlet of the ice of the Arctic Ocean. This current may well have been drawing it in that direction. The change of direction in November is more difficult to explain. Possibly wind action may be a factor of some importance as the pack approaches the periphery of the basin and there is less congestion, as is suggested regarding the *Fram's* route, or there may be eddies on the margin of the main stream.

On December 12, however, the floe was reported to be in lat. $82^{\circ} 8' N.$, long. $7^{\circ} 45' W.$, so that it is now moving towards Greenland.

If the drift continues, as seems probable, the position of I. D. Papanin, E. Krenkel, E. L. Federov and P. P. Shirshov will become one of extreme danger, although their wireless messages make light of their peril. Rumbblings in their ice indicate cracking: dissolution may quickly follow if the floe reaches the edge of the pack and feels the influence of ocean swell. That will be some time yet, but probably will occur during the winter and not as had been hoped in summer daylight. Until March there will be no daylight at the station: darkness will materially increase the difficulty of aeroplanes finding an adequate landing place for the rescue, and the explorers have no

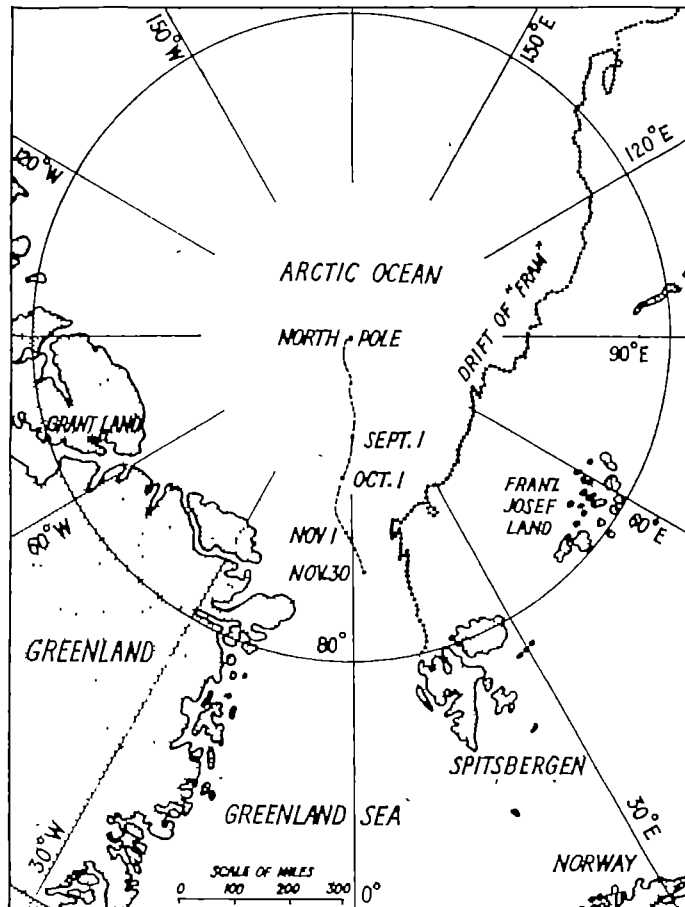


CHART SHOWING DRIFT OF THE SOVIET POLAR STATION (broken line)

Greenland current, the observed westerly drift of floes to the north of Greenland and the heavy hummocky ice off Smith Sound and Grant Land, Nares' misnamed palæocrystic ice, all point to the probability of a more or less rotatory drift within the Arctic basin. There can be little doubt that some of the Arctic pack-ice is carried, at least at times, by such a drift, which is no doubt partly due to the earth's rotation and is assisted by the prevalent atmospheric circulation.

The Soviet station, however, has not closely followed the anticipated course. News in *The Times* and the Soviet Union Year Book Press

vessel. There are reports that the Soviet Government intends to send an ice-breaker to the rescue. This plan holds out more hope. On the other hand, the floe may continue its drift towards north-east Greenland. In that event the explorers may be able to effect their own rescue by travelling over closely packed ice, held by the land, to the safety of the shore. It is much to be hoped that these gallant men, who have risked much in the cause of scientific investigation, succeed in reaching safety.

Up to the present, their meteorological records alone have been published, but it is clear that the ocean soundings are going to prove of great interest, as showing a uniformity of depths in high latitudes and defining the width and depths of the ridge connecting Greenland and Spitsbergen. Other oceanographical discoveries were referred to in a previous article in NATURE (139, 990, June 12, 1937).

R. N. R. B.

Obituary Notices

Sir Jagadis Chandra Bose, C.S.I., C.I.E., F.R.S.

BY the death of Sir Jagadis Chandra Bose on November 23, a few days before his seventy-ninth birthday, India has lost one of her foremost sons and science one of its most picturesque figures. In India, and indeed elsewhere, Bose's concern for the well-being and progress of his native country has for long been widely known. His reputation as a physicist has been established for several decades. But it is at present not possible, and will not be possible for some time to come, to assess the true value of his contributions to physiology.

Bose's physiological work still remains in an isolated position in spite of decades of indefatigable work on his part, many volumes of published experimental work, and sometimes even unique facilities granted, not only in his own country, but also in Great Britain, the United States and on the Continent, to bring his results personally before the public by means of lectures and demonstrations. (In his earlier days, such facilities were not always available, and it is a tribute to his fighting instinct that he was able to obtain them in the end.)

The reasons for Bose's isolated position in the science of physiology are many and varied. Although he was a pioneer in his own field, he seldom discussed his results with those of his contemporaries. His scientific work was at times almost dramatic, with the result that even at the early stages he attracted much attention from the non-scientific world. Diplomats and high Government officials attended his discourses; Romain Rolland was loud in his praises of him; Rabindra Tagore wrote poems eulogising his work; and Bernard Shaw was attracted to one of his lectures. Naturally, lay publicity and interest followed such distinguished example; but all this was unhealthy to Bose, the man of science, when so little of his work had received scientific confirmation.

Jagadis Chandra Bose was born in the village of Barukhal in Vikrampur, a large area in the Dacca District, on November 30, 1858, the son of Bhagaban Chandra Bose. But Bose's father soon migrated as deputy magistrate to Faridpur, the centre of the next District, and it was there that Bose spent his childhood days. Bhagaban Chandra Bose had a profound

sense of public duty, and it was doubtless from this source that Jagadis Chandra Bose's supreme love and work for his fellow countrymen had their origin. Bose's father, too, had to grapple with the severe problem of the dacoits in his area, and his success won unstinted praise from the authorities. Such factors were no doubt operative in eliciting that note of strenuous and persistent courage in facing adversities and of untiring combativeness against every difficulty so inherent in Jagadis's character throughout his life.

By his father's wish, Bose received his primary education at the vernacular school in Faridpur, and not the English school. Thus did he at an early age come into contact with the problems of the peasant, and those problems always occupied his mind afterwards. At nine years of age he entered St. Xavier's School in Calcutta, where his taste for natural history veered round to one for physics under the influence of Father Lafont. He graduated B.A. at the age of twenty years.

At this time, his family was financially embarrassed, but chiefly through the help of his mother, Bose was enabled to leave Calcutta for the University of London to study medicine. In later years, he was never tired of describing the thrills he experienced in studying zoology for the first time under Ray Lankester. But his health forced him to leave London, and, having gained a natural science scholarship, he entered Christ's College, Cambridge, in 1881. His first year there was one of indecision, but he was an assiduous student of physiology under Michael Foster and embryology under Francis Balfour. In his second year, he settled down finally to botany under Vines and Francis Darwin, chemistry under Living and physics under Rayleigh. He took the Natural Sciences Tripos, obtained his B.A. and at the same time took a London B.Sc. In later years, his former teachers, Lord Rayleigh and Prof. Vines, were appreciative of his researches in physics and physiology, and were sponsors for their presentation before the Royal and Linnean Societies respectively.

Bose returned to India at the age of twenty-five years, and, after serious opposition from the Educational Service and from academic authorities, was appointed professor of physics in Presidency College,

Calcutta. Here his lectures were brilliant and his influence over the students profound. Thus finally did he gain the full approbation of the Principal of his College and the Director of Public Instruction.

Having thus overcome preliminary opposition and difficulties (though there were many more in store), Bose determined that henceforth his life should be devoted not to professional survival or family honour, but to the pursuit of scientific truth. How tenaciously he adhered to that resolution throughout his career is practically common knowledge. Through it, especially in his own country, he won the love and admiration of everyone.

Bose's first researches were on electric radiation, and within a year the Royal Society undertook the publication of his investigations and provided financial help for their continuation. About the same time he was awarded the degree of D.Sc. in the University of London. Thus did his first piece of research work win authoritative approval. Kelvin too was enthusiastic in his praises of Bose's physical researches: but all this meant chiefly one thing to Bose—that India was coming forward in scientific research. So at that time he decided that India should have its own scientific research institute: but he was still faced with much opposition so he concluded that anything done in such a direction must be done by himself. However, it was not until another twenty-five years had passed, during which both he and his wife practised the strictest economy, that he was able to realize his dream and open the Bose Research Institute in Calcutta.

Having justified his claim as a physicist, Bose received every encouragement from his own Government and from the Imperial Government.

About the same time that Lodge was extending Hertz's work on electrical radiation in England, Bose was doing similar work in India. With his perfected apparatus, he carried out his now familiar work on electric waves. He was able to verify the laws of reflection and refraction, determine refractive indices and wave-lengths (by curved gratings) and exhibit polarization and double refraction by pressure and unequal heating. In 1896, this work received the highest praise from Sir Oliver Lodge and Lord Kelvin, and Bose was acclaimed as the first Indian to win distinction through scientific work. On the Continent and throughout Asia, too, his work in physics received distinct approval from such men as Lippmann, Quincke, Warburg, Lenard and others, and as the outcome of it all, British men of science, including Lister, Kelvin, Dr. Gladstone, Poynting, Stokes, Sylvanus Thompson successfully appealed to the Government to establish a well-equipped physical laboratory in Presidency College. But there was much delay, and the laboratory did not materialize until 1914, shortly before Bose retired from the chair. Further experiments with his electric refractometer were communicated to the Royal Society in 1898 when he described determinations of the indices of refraction of various substances and the influence of the thickness of the air-space on total reflection of electric radiation. In 1900 he contributed a communication to the Royal Society on molecular changes

produced in matter by electric waves, in which he made some interesting observations concerning the phenomenon of fatigue in metals. This marked the beginning of his interest in response in the inorganic and in the living.

At the beginning of this century, Bose's well-known, though little understood, work in physiology began, and he read his first paper on the response of inorganic and living matter before the International Conference of Physics meeting in Paris in 1900. This paper caused considerable discussion, and he read a similar paper at the British Association meeting at Bradford in the same year. Here he described the magnitudes of changes produced in the molecular structure of inorganic and living substances due to an electric stimulus, and was able to show that from this point of view both types of substances are similar. On this basis, he constructed an artificial retina that enabled him to explain many phenomena of vision which up to that time had been obscure. Both physicists and physiologists attended this paper; the physicists were enthusiastic, but the physiologists were cool.

At the invitation of Rayleigh and Dewar, Bose continued his researches along these lines in the Davy Faraday Laboratory of the Royal Institution. He then returned to India. Though during 1900-3 he continued his researches both in England and in India on the theme of response in the inorganic and the living and had his papers read before the Royal Society, they were not published owing to the opposition of some physiologists. A paper was read before the Linnean Society of London under the sponsorship of Vines, Horace Brown and Howes. In this he discussed the electric responses in ordinary plants under mechanical stimulus. His experimental results showed, he claimed, that the response of the ordinary plant organism, so far as fatigue, temperature, poisons, anaesthetics, etc., are concerned, is identical with that of animal muscle and nerve. Similar results communicated to the Royal Society in 1903 were not published. But from 1902 until 1919 he published six volumes of his experimental investigations and conclusions and many papers on his 'physics of physiology'. In his "Responses in the Living and Non-Living" he claimed to have demonstrated "a complete parallelism . . . between plant response on the one hand and that of animal tissue on the other" and, referring back to his earlier physical experiments on the 'electric eye' he claimed to have shown that "there is not a single phenomenon in the responses, normal and abnormal, of the retina which has not its counterpart in the sensitive cell constructed of inorganic material".

Thus did Bose's earlier work in physiology meet with much active opposition: but this gradually subsided and eventually some of his work appeared in the publications of the Royal Society and other societies. On November 30, 1917, he was able to realize his dream of a quarter of a century and open the Bose Research Institute in Calcutta. This includes departments of physics and plant and animal physiology. Active research continues there. The funds were supplied by him and from Government grants.

Bose had a genius for designing delicate and sensitive apparatus for his physiological investigations, fertility in initiating new lines for observation and a clear style of setting out his experimental results and theoretical deductions. Nevertheless, by his resonant recorder and oscillating recorder he actually did for the first time record the delicate movements of leaves of *Mimosa* and *Biophytum* without distortion. He also devised apparatus for demonstrating the effect of sleep, air, food, drugs, excitation, impulse, etc., on plants. He also demonstrated an instantaneous record of growth and death. Thus, according to him, did the plant automatically record its own physiological life-history. In 1919, he announced that he had obtained in plants very definite mechanical and electrical response to wireless impulses, and claimed that the "perceptual range of the plant is inconceivably greater than ours: it not only perceives, but also responds to the different rays of the vast æthereal spectrum". His high-magnification crescograph which magnified the growth of a plant ten million times was received with enthusiasm in England in 1919-20. Doubt had originally been cast on the crescograph really recording growth magnification, but after demonstrating his apparatus in University College, London, a letter appeared in *The Times* of May 4, 1920, over the signatures of some of the leading British men of science stating that "the growth of plant tissues is correctly recorded by this instrument and at a magnification of from one to ten million times".

Bose received the C.I.E. for his scientific work at the Delhi Durbar in 1902. In 1911 he was awarded the C.S.I., and in 1915 he retired from the chair in Presidency College as emeritus professor on full pay. In 1917 a knighthood was conferred upon him, and in 1920 he was elected a fellow of the Royal Society.

Comment on Bose's praiseworthy work in physics would be superfluous: but he would be a daring man who attempted any precise evaluation of Bose's work in plant physiology at this stage. His work was prolific and his publications voluminous. He published a large number of books, and the "Transactions of the Bose Research Institute" contain much of his own work and much carried out in collaboration with others. Most of this work has been received in silence, and has neither been confirmed nor openly refuted. In any event, never will it be truthfully said that Bose was not a potent stimulus to contemporary physiologists, especially at the height of his career. A leading physiologist once said that Bose's "more general conclusions will probably not attract so much attention as the new experimental methods he employed". But the application of Bose's methods in experimental physiology by other investigators is still to come.

Of Bose, the man, nothing but the most gracious and kindest thoughts can be entertained. He was a great patriot and took a deep interest in Indian culture; and his wider interests are shown by his former membership of the International Committee on Intellectual Co-operation of the League of Nations. Sir Jagadis is survived by Lady Bose, who for many years was a source of encouragement to him.

Dr. K. J. Saunders

DR. KENNETH J. SAUNDERS, whose death at the age of fifty-three years occurred at Eastbourne on November 22, was an orientalist and authority on the religions of Asia of no little distinction.

Dr. Saunders was educated at Clifton College and Emmanuel College, Cambridge, of which University he was a D.Litt. From 1909 until 1912 he was a lecturer of Trinity College, Kandy, and it was in this period, through his contact with the Buddhist monks of Ceylon, that he acquired an insight into the practical working of the Buddhist faith. This determined his line of approach to the comparative study of the religions of the East as 'ways of life', which he demonstrated most strikingly in his studies of similarities in the doctrines of Buddhism and the teachings of Christ. He was also strongly impressed by the influence of Buddhism in the spread of the culture of India and Ceylon to other countries in Asia. These views on the place of Buddhism in the life and culture of the East were strengthened by a period of residence in Burma, when work for the Y.M.C.A. brought him into intimate contact with native students; and they were confirmed and deepened by pilgrimages to Buddhist shrines and centres in other parts of Asia, especially China and Japan, which he visited after the Great War.

Dr. Saunders was later appointed to the chair of comparative religions in Berkeley University, California, which he held until 1935. In the two following years, he was engaged in lecturing on Asiatic history; but a breakdown in health prevented him from taking up his duties on appointment to the recently founded Spalding chair for the study of comparative religions in the University of Oxford.

We regret to announce the following deaths:

Dr. O. C. Bradley, principal of the Royal (Dick) Veterinary College, Edinburgh, since 1911, on November 21, aged sixty-five years.

Mr. Edward T. Browne, a governor of the Marine Biological Association of the United Kingdom and a generous benefactor to science, well known for his zoological work on medusæ, on December 10, aged seventy-two years.

Prof. J. Henderson, professor of natural history in the Colorado Museum, an authority on invertebrate palæontology, on November 4, aged seventy-two years.

The Rev. Walter Howchin, emeritus professor of geology in the University of Adelaide, aged ninety-two years.

Prof. A. Hutchinson, O.B.E., F.R.S., formerly professor of mineralogy in the University of Cambridge, lately master of Pembroke College, on December 12, aged seventy-one years.

Prof. Hans Molisch, formerly professor of botany in the University of Prague, on December 8, aged eighty-one years.

Mr. George Philip, chairman of Messrs. George Philip and Son, Ltd., geographical publishers, and author of several valuable library atlases, on December 8, aged sixty-seven years.

News and Views

Population Statistics

SIR KINGSLEY WOOD, the Minister of Health, has taken to heart the criticisms of the schedule of the Population (Statistics) Bill which have been brought forward, both in and out of Parliament, since its publication. The revised schedule omits altogether the comprehensive Clause 3, which made it possible to demand information upon "any other matter", and was much disliked. The questions now to be asked are definite and simple. On registration of birth: the age of the mother; the date of marriage; the number of former children of the mother. On registration of death: whether the deceased was married; if a woman, the date and duration of marriage; the number of children; the age of the surviving spouse. The information so obtained will not be disclosed to the public. These are not provocative questions and it may be expected that they will be approved by Parliament. The history of this Bill shows our democratic institutions at their best. We have, first, a Bill with a vague and complex schedule, calculated to give rise to objections, and covering more ground than was really required; then an excellent, critical debate in the House of Commons, and a good, general discussion in the newspapers; and, finally, the revision and simplification of the Bill by a sensible Minister.

Air Raid Precautions

IN his speech on the motion for the third reading of the Air Raid Precautions Bill in the House of Commons on December 7, Sir Samuel Hoare emphasized that air raid precautions, on however great a scale, cannot assure complete immunity to the population of Great Britain or any other highly industrialized European country. The most that can be done is to minimize the catastrophe and loss of life and to ensure the essential defence service. It is also impossible to concentrate on passive defence a disproportionate amount of money and man-power. Air raid precautions have their proper place in a general scheme of defence finance and preparation, and Sir Samuel expressed the opinion that the execution of the Government's plans would go far to prevent panic and ensure the continuance of the essential services. When the Bill reached the Statute Book the Government proposed to make much greater use of experiments in co-operation with local authorities and to strengthen the air raid precautions organization of the Home Office. In addition, very considerable steps are already being taken in Government Departments to organize air raid precautionary methods. About fifty instructors drawn from different departments have received training at the civilian anti-gas school and are giving instruction to the staffs of departments. About eighty instructors trained in the same manner have been supplied to the Post Office, and it is hoped by the end of the year that

there will be more than 150 instructors in the Post Office service alone. Seven gas chambers are being constructed in various Government buildings in the London area by the Office of Works, and the Office is also carrying out an extensive structural survey of existing Government buildings. The most suitable accommodation will be ear-marked for refugees to which the staff will be collected on receipt of an air raid warning.

STRUCTURAL precautions against air attack will be considered in all new Government buildings, and in the new Whitehall buildings it is proposed to construct a roof of solid concrete to resist small incendiary bombs and some resistance to penetration of high explosive bombs generally. The solid concrete floors would offer further resistance to bombs which penetrated the roof, while the second floor below the roof would be strongly reinforced to retain debris if the top floors collapsed. A strongly reinforced floor would also be provided on the ground floor level to provide protection for staff collected in the emergency refuge accommodation in the basement. Interesting to scientific workers as are these details of Government plans, they will equally welcome Sir Samuel Hoare's frank admission of the limitations of air raid precautions and his reminder that the very precautions proposed run counter to the ideals and chief movements developed in civilized life after generations of progress. In protective clothing, lighting, evacuation, we are setting the clock back for generations, and Sir Samuel Hoare averred the Government's determination to lose no opportunity of trying to reintroduce sanity into the world and remove the conditions which have made such provisions inevitable.

Administration and the Aborigines of Australia

CORROBORATION in part of recent criticism of the treatment of the Australian aborigines (see p. 1029 of this issue of NATURE) comes from a source carrying a weight that cannot be disputed. Dr. Donald Thomson, an anthropologist appointed by the Federal Government to act as a special patrol officer in Arnhem Land, now relinquishing his post to take up a Rockefeller Foundation fellowship at Cambridge, has made a statement, according to the Canberra correspondent of *The Times* in the issue of December 9, in which he comments severely on the policy in aboriginal administration being pursued in the Northern Territories. His criticism, as reported, is directed mainly against encroachment on native lands. In the selection of Groote Eylandt as a flying-boat base, he maintains, every interest but that of the aborigines has been considered. It seals the doom of a tribe of three hundred aborigines, "in many ways the pink of the surviving Australian tribes"—a view which anthropologists conversant

with the Australian material will endorse. He went on to state that the Arnhem Land Reservation is no reservation at all. It is being encroached upon in many ways, the natives are diminishing rapidly, while two watering places for pearlers, which have been established on the coast, are destined to be 'plague spots' which will extend throughout the reserve. That criticism is not entirely ill-directed has been admitted by Mr. Lyons, the Prime Minister, who, while deprecating exaggeration, concedes that there is room for improvement—indeed that improvement is "imperative and urgent". He announces his intention of calling an early conference of Federal and State representatives to consider the future of the aborigines.

Mr. G. O. Harrison

MANY graduates of the University of Birmingham will be interested to learn that Mr. G. O. Harrison, chief workshop assistant in the Physics Department, is retiring after nearly fifty years service. Mr. Harrison began as laboratory boy to Prof. J. H. Poynting when the latter was engaged on his gravitational experiments at Mason College. When Röntgen discovered X-rays, Mr. Harrison, on the instructions of Prof. Poynting, made the first X-ray tube constructed in the Birmingham district and successfully used it to make a radiogram of Poynting's hand. For the next two years, the Physics Department, with Mr. Harrison as radiographer, became a centre to which the hospitals of the city sent patients to be 'X-rayed', the well-known surgeon Jordan Lloyd being one of the first to avail himself of the new facility for seeing the 'insides' of his patients. The rays were also applied to dentistry, the method employed being very like that in general use to-day. In the course of this work, Mr. Harrison discovered that X-rays could be seen, that is, that they produced on the retina (suitably prepared by darkness) the effect of light, shadows of interposed metal objects being clearly distinguishable. This formed the subject of a letter to *NATURE* (July 15, 1897, p. 248). Mr. Harrison's skill as a glass-blower and his versatility as an instrument maker have been of great value to a long series of research workers in the Physics Department, whose good wishes will go with him in his retirement.

New Surgical Research Laboratories

THE Bernhard Baron Laboratories of the Royal College of Surgeons of England were opened by the Earl of Athlone on December 8. These laboratories, which occupy the fourth, fifth and sixth floors of the main College building, were made possible by a gift of £30,000 from the Bernhard Baron Trust. The object of the laboratories is to provide facilities for experimental work on problems bearing on surgical diagnosis and treatment and for the investigation by experimental methods of more fundamental biological problems. In addition to six large laboratories, the research unit is provided with complete animal accommodation, a fully equipped operating theatre, X-ray and photographic rooms and a pathological laboratory. The laboratories are furnished with

movable units, which allow of the remodelling of the laboratories to suit the individual requirements of those who use them. One of the most interesting features is the use which has been made in the building of Empire timber for furnishing, flooring, etc. Ample provision is made for twenty research workers, and the staff accommodation is well arranged on the sixth floor, which leaves the floor below a complete research unit. Pathological, X-ray and photographic rooms are on the fourth floor. The detailed equipment of the research rooms is interesting. Use is made of gas plugs instead of gas taps, electric power and light outlets are grouped in such a way as to facilitate the assembly of electrical equipment for experimental work. The operating theatre has been designed as a model theatre for animal work, and is completely equipped with modern, steam sterilizing plant, X-ray viewing screens, diathermy and telephone installation.

Visual Purple and Vision

DR. R. J. LYTHGOE delivered the Thomas Young Oration of the Physical Society, entitled "The Structure of the Retina and the Role of its Visual Purple", on December 9. The key to the understanding of the processes by which the energy of a light wave causes impulses in the optic nerve lies in the retina. It is found that about 400 rods of the retina must be served by one nerve fibre after the demands of the cones, the organs for visual acuity, have been satisfied. The conger and other deep-sea fishes have retinas almost exclusively composed of rods, and these rods are fine and filamentous. The fineness of the rods in the conger's retina cannot result in a higher resolving power of its eye, since some 1,600 rods must be attached to one nerve fibre. It is suggested that visual purple, the light-sensitive substance found in the rods, is adsorbed on their surfaces and that the large number of rods in the conger, by increasing the quantity of visual purple, improves the animal's vision at low illuminations. The increase in visual purple will not have a great effect on animals living at very great depths where only a narrow band of wave-lengths is transmitted. Deep-sea fishes also improve their vision at low illuminations in other ways, namely, by having large aperture eyes and also by the movements of pigment which protect the rods and their visual purple during exposure to light. The eyes of the monkeys have been shown to possess a remarkable adaptation to habit, day-hunting species having a cone type of retina, night-hunting forms having mostly rods, whilst in addition the retina is lined with tapetum, which appears to act by reflecting light back on to the rods. Recent work on visual purple has shown that the quantum efficiency of the bleaching process is about unity, and in addition visual purple has a high extinction coefficient. The 'bleaching' of visual purple by light results in the production of a yellow substance, and there are probably other intermediate products. The presence of these coloured breakdown products in high concentration might considerably modify the perception of light of different wave-lengths.

Estuary Channels and Embankments

IN the Vernon-Harcourt Lecture delivered at the Institution of Civil Engineers on December 8, Dr. Brynson Cunningham discussed "Estuary Channels and Embankments". The two chief objects of the engineering treatment of estuaries are the regulation and improvement of the navigable channel and the protection of adjacent low-lying land from tidal inundation. From the point of view of navigation, defects arise from three main causes: (1) a shifting, unstable channel; (2) a narrow bed, with inadequate depth of water; and (3) a bar. In carrying out estuary training works for the removal or amelioration of the first defect, certain principles have to be observed in order to avoid risks and possibilities involved in the confinement of the stream within a definite course. The design of different types of wall was considered by Dr. Cunningham. As regards shallowness of the river bed, the principal remedy, although not of a permanent nature, is dredging by means of floating plant of various types. The cause and origin of bars were next discussed, and the peculiar conditions attached to dredging operations in exposed situations were set out with particulars of some of the latest and largest dredgers engaged on that class of work. Dealing with estuary embankments, Dr. Cunningham pointed out that in the case of the Thames alone, there are more than 40,000 acres of serviceable marsh-land, utilized for a variety of purposes, which have to be protected at high water in this way, while, in the maritime provinces of Holland, whole districts lie so low as to be permanently below sea-level. The embankments on the Thames, the Trent and at the mouths of the Schelde and the Maas were illustrated and the nature of their construction explained, including the design of sluices for dealing with the drainage of inland water.

Television on a Large Screen

ACCORDING to reports in *The Times* of December 8 and 10, two demonstrations have been given recently of the reproduction of the London television programmes on a large screen. In the first case, Mr. J. L. Baird showed the B.B.C. television programme on a large cinema screen. The receiver utilized a cathode ray tube, on the luminescent screen of which a small picture, 2 in. square, was first formed. This was then projected optically on to the large screen to give a picture about 8 ft. by 6 ft. At all times the picture, it is stated, was quite clear as viewed from both the front and the back of the theatre; the focus was good and there was never sufficient interference to disturb the enjoyment of the audience. The second demonstration was given by Messrs. Scopphony Ltd., using the pioneer optico-mechanical methods developed by that company. In this case, two receivers were available, one giving a screen picture 6 ft. by 5 ft. suitable for a medium-size hall, and the other being a home receiver providing a picture 2 ft. square. The first receiver was demonstrated to a large audience, who saw a very acceptable reproduction of the afternoon television programme. The pictures were free from flicker and were bright

enough to be seen in comfort by everyone present. It seems likely that these two demonstrations will mark a new stage in the progress of the technique of television reproduction.

Thermionic Valve Data

THE modern thermionic valve has now become of world-wide importance, not only in connexion with radio broadcasting, but also in its many applications in scientific and commercial instruments, and in industrial processes. Unfortunately for those who have to make constant use of valves of the usual receiving type, their popularity and rapid advances during the past decade have resulted in a multifarious range of valves for different purposes. In spite of several earnest attempts, no satisfactory means of classifying these valves has been standardized, and the various manufacturers have accordingly adopted different and arbitrary codes for designating the types of valves which they supply. Amidst this confusion and in the absence of adequate co-operation between manufacturers in different countries, it is natural to find that the number of types is constantly increasing and is now quite unnecessarily large. Pending the time when more uniformity is arrived at, however, the *Wireless World* has been fulfilling a useful public service for the past ten years by issuing a list of valve types with the appropriate technical data. A search through these lists reveals in a striking manner not only the growth in the number of valves, but also the increasing amount of information which is needed about a valve in order to select a suitable type for any purpose. The issue of the *Wireless World* of November 25 contains the latest of these lists in the form of a nineteen-page supplement. The data here provided cover more than 900 current valve types, both British and American, as many as fourteen numerical characteristics being given for some of the valves. A useful guide to valve bases is also provided. Such a publication cannot fail to be of great utility to all scientific and technical workers who make use of the modern thermionic valve.

Accessions to the British Museum (Bloomsbury)

AMONG the accessions to the collections of the British Museum (Bloomsbury) announced in December are a number of antiquities from the Near East and Egypt. Of these, among the more noteworthy are those obtained by Mr. M. E. L. Mallowan's excavations of last season on sites in northern Syria. Clay tablets from Chagar Bazar, dating from about 2000-1900 B.C., deal with accounts, mostly relating to corn. Although the names of the months are Babylonian, the tablets appear to indicate that the district was then under the dominion of Assyria. Objects from another site, Brak, are of considerable importance in the prehistory of western Asia, as they include black-on-white pottery, similar to that found by Sir Leonard Woolley at Achanah near the mouth of the Orontes, and bearing out his conclusion as to the international importance of that region as an emporium linking the Mediterranean and the

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Further Tributes to the late Lord Rutherford

Prof. Stefan Meyer

Institute of Radium Research, Vienna

THE world is poorer through the passing away of its leader in radioactivity and nuclear physics, Lord Rutherford, who was a unique personality, and what every single one of us has lost scientifically and personally is impossible to say in words. But asked to add a personal contribution to the tribute in NATURE, I am glad to be allowed to tell how much he was admired and loved in Austria.

Schweidler's and my first contact with him dates from the beginnings of radioactivity, when he was in Montreal. The deflection of Becquerel rays by a magnetic field, discovered in Vienna in 1899, was one of the foundations for his classification of these rays, and led to a correspondence that was never interrupted. We remember with pleasure his congratulations when a few years later we succeeded in proving the identity of the long-lived induced radioactivity with radio-lead and polonium as he had predicted. Our first personal meeting was in 1910, at the Congress of Radiology in Brussels. There, international co-operation in radioactivity was inaugurated and the International Radium Standards Committee set up, the members being B. B. Boltwood, M. Curie, A. Debierne, A. S. Eve, H. Geitel, O. Hahn, St. Meyer, E. Rutherford, E. Schweidler and F. Soddy. This Committee, which after the death of H. Geitel, B. B. Boltwood and M. Curie, and after F. Soddy's resignation, with H. Geiger, S. C. Lind, J. Chadwick, I. Curie-Joliot, J. Joliot, O. Hönigsmid and A. Piccard as respective successors,

survived all troubles of the Great War and the following years, and Rutherford always expressed his conviction that the Committee ought to continue. He was president of the Committee, and so late as April 1937 he signed two certificates for the new Washington standards. The first consequence of the constitution of the Committee was a meeting in Paris in 1912, which was attended by M. Curie, A. Debierne, O. Hahn, St. Meyer, E. Rutherford, E. Schweidler and F. Soddy. There, quite pure radium preparations, obtained from Paris and Vienna, were compared and the primary standards designated, a fact as important for radioactivity as the creation of the standards of the metre and kilogram.

In the summer of 1913, Rutherford, accompanied by his wife and B. B. Boltwood, visited me in Bad Ischl, where also Hönigsmid, Mache and Schweidler from Vienna had assembled. I think it was his only stay in Austria, and he enjoyed the country and the people on his trips in his car. The 'Dirndl' costumes in Ischl, which caused his chauffeur to ask what race lived in Austria, and a Tyrolean hat Boltwood bought and wore continually, were a source of unending amusement for him. At that time we wanted to organize a radiological congress in Vienna for 1915. The War prevented the realization of this plan, but it could not loosen the friendly relations between Lord Rutherford and Viennese physicists. In the same way as at that time R. W. Lawson was enabled to continue his work at the Vienna Radium Institute, Rutherford did his best to procure concessions for our compatriots in England.

The Vienna Academy of Sciences can be proud of having appreciated at an early date Rutherford's exceptional genius. The Academy so early as 1908 helped him in his work by the loan of 300 mgm. radium free of cost. In 1912 he was made corresponding member, and in 1928 honorary member. After the War it seemed as though the radium preparations still in the possession of Rutherford would be confiscated as 'enemy property'. After prolonged correspondence, Rutherford got the preparations released (1921). In 1927, when the financial difficulties of the Vienna institutes were at their climax, he bought the radium and so enabled research in Vienna to be carried on for some time. Already in 1921 he had written to me: "There seems a growing sense in our governors that it is about time they tried to help all countries to get on their feet again"; and in 1927 he wrote: "I am very sensible of the generosity shown by the Vienna Academy of Sciences and the Austrian Government in loaning me such a valuable preparation for such a long period. The use of the material has rendered possible the long series of investigations in Radioactivity by myself and my students and has been an invaluable aid in my researches". Again, when he had bought the preparation, he said: "I hope in this way to show my appreciation of the generosity of the Vienna Academy and also to help the Radium Institute to continue its radioactive investigations".

I saw Lord Rutherford for the last time in 1932 in full vitality in Münster, where the whole session of the Bunsen Gesellschaft was under the spell of his personality. In the following years he received my daughter and my son in the kindest manner in Cambridge, in spite of the numerous claims on his time, and gave them many proofs of his friendly feelings. Whoever came in close contact with him will cherish the memory of how he attracted all, not only through his surpassing scientific greatness, but also through his human kindness and personal charm.

Prof. A. Norman Shaw

McGill University, Montreal*

MEN of science the world over are mourning the death of Lord Rutherford, one of the greatest discoverers of all time.

McGill graduates are feeling an additional personal loss. His former students have for long been

*From a message printed in the *McGill Graduates' Bulletin*.

proud to recall that they received training and inspiration from the greatest of all McGill professors. The fact that Rutherford laid the foundations of his major work when here has lent an added prestige to McGill University throughout the world, and created an unending stimulus for his successors. At McGill he was given his first opportunity for leadership in research, and the degrees we gave him marked more truly the graduation of McGill under his influence with a new and higher degree of science.

Rutherford was responsible for the greatest outburst of original investigation which has occurred in Canada. For several years brilliant scientific papers on discoveries in radioactivity and atomic physics poured out at the rate of nearly one a month from the able group which had gathered around him from centres as far apart as Poland, Germany, France, England and the United States. The influence of his work and ideals soon penetrated into all walks of science in Canada, increasing the demand for higher scientific training and investigation.

Old friends and pupils of Rutherford have memories even more deeply cherished than the recollections of his work itself. His lively humour, boyish zeal, and kindly human interest in the affairs of those around him, his untiring help in time of need, that remarkable driving ability by which he could obtain almost incessant work willingly given, his uncanny and unerring instinct for the next best step, his hatred of pretence and untested generalization, his outspoken frankness, his uniform fair dealing, his capacity to pick able men and later place them in their life's work, his friendliness and approachability, his dominating voice and personality when deeply stirred—these attributes and more will be recalled as hall-marks of one man, Ernest Rutherford. In our lifetime we shall not see his like again.

Prof. Niels Bohr, For.Mem.R.S.

University of Copenhagen

I AM thankful for the invitation of the Editor of NATURE to write a few words about my relations with Lord Rutherford that have been so decisive for my work and have filled so large a place in my life. Indeed, neither in the short article about Rutherford's relationship to his pupils, which I had the pleasure of contributing to the Cavendish Laboratory Supplement to NATURE of December 19,

1926, nor in the short tribute to Rutherford's memory, which I had the sad duty of giving at the Galvani Congress on the announcement of his untimely death and which appeared in NATURE of October 30, 1937, did I find opportunity to give a proper expression of my personal indebtedness to him, who was to me everything that an inspiring leader and a fatherly friend could be.

From the moment I was admitted into the group of students from very different parts of the world working under Rutherford's guidance in his laboratory in Manchester, he has to me appeared as the very incarnation of the spirit of research. Respect and admiration are words too poor to describe the way his pupils regarded the man whose discoveries were the basis of the whole development in which they were enthusiastically striving to partake. What we felt was rather a boundless trust in the soundness of his judgment, which, animated with his cheerfulness and good will, was the fertile soil from which even the smallest germ in our minds drew its force to grow and flourish. His simplicity and disregard of all external appearance perhaps never disclosed themselves more spontaneously than in discussions with his students, who were through his straightforwardness even tempted in youthful eagerness to forget with whom they were talking until, by some small remark, the point of which they often first fully understood after they had left him, they were reminded of the power and penetration of his insight.

The stimulus Rutherford gave his pupils was, however, in no way limited to times of daily intercourse. Thus when, returned to Denmark, I pursued the line of work which I had taken up in Manchester, it was to me a most encouraging feeling to know that I could always count on his warm interest and invaluable advice. Indeed, looking through our correspondence from those days, I can hardly realize how in the midst of all his work he could find time and patience to answer in the kindest and most understanding way any letter with which a young man dared to augment his troubles. Especially close our relations became during my stay for the first years of the Great War as lecturer in Manchester and when, in times full of anxieties, he kept up the spirits of the small group left in the laboratory and, in the short moments of leisure from the great practical duties entrusted upon him, steadily went on preparing the road to new discoveries which should soon lead to such great results.

In later years, it was each time to me the greatest source of renewed encouragement to visit him in his home in Cambridge, where, in spite of never-ceasing work and an ever heavier burden of duties, he shared so quiet and simple a life with the companion who, always in contact with what was deepest in his character, from early days stood by him in every joy and sorrow. With age the vigour of his spirit did not abate, but found outlet in ever new ways, and his genial understanding and sympathy with all honest human endeavour gave to his advice in any scientific or practical matter a value treasured in wider and wider circles. To every one of us to whom he extended his staunch and faithful friendship an approving smile or a humorous admonition from him was enough to warm our hearts, and for the rest of our lives the thought of him will remain to inspire and guide us.

Prof. G. Hevesy

University of Copenhagen

WHEN, early in 1911, I had the privilege of joining the Langworthy Laboratory of Physics in the University of Manchester, that part of radioactivity which may be called the classical one was approaching completion. The sequence in the three series of disintegrations and the life-period of their members had with but few exceptions been already ascertained, mainly by the work of Rutherford and his pupils. This very laborious task, often requiring for its performance much ingenuity, was initiated by the theory of successive transformations put forward by Rutherford and Soddy in 1902; this proved to be the fundamental theory of radioactive research. The successful completion of the main task of classical radioactive research further enhanced the great authority of the leader of the Laboratory and the spirit of contentment prevailing in the Laboratory.

The chapter on the properties of the radioactive radiation, though greatly advanced in those years, was far from being complete. Rutherford, although he personally carried out experiments on the heating effect of radium and its emanation with the assistance of his faithful and able laboratory steward, Kay, and encouraged all the numerous researches going on in his laboratory, concentrated his interest chiefly on the experiments on α -particles. Of all Rutherford's spiritual children, none was more deeply loved by

him than the α -particle, and none requited his affection more generously. The conception of the nuclear atom was put forward by him on the basis of the experimental results on the scattering of the α -particles obtained by Geiger and Marsden. In witnessing the birth of this conception, his pupils had a unique opportunity of seeing the working of Rutherford's great mind. To be struck by the remarkable behaviour of a tiny percentage of the α -particles investigated, to ascertain that the observed effect was genuine, to ask for a reason which would account for the effect and to accept the most straightforward solution, was a typical sequence of the truly 'Rutherfordian' way of picking out and solving problems.

In a recent speech at Guildhall, Lord Baldwin characterized his fellow countrymen as being profoundly distrustful of the men called clever. To some extent the late Lord Rutherford shared this feeling by distrusting those who wanted to build up science on purely deductive lines. He was fully convinced that the line of advance followed by him so successfully, based on the application of sound common-sense considerations to experimental observation of the right phenomena, is the most trustworthy road to progress. This deep conviction did not prevent him, however, from early recognizing the fundamental importance of ideas moving largely on deductive lines, put forward by a young man joining the Manchester Laboratory shortly after the introduction of the conception of the nuclear atom. The union of Rutherford's nuclear concept with Bohr's ideas proved to be an immensely fruitful one, the importance of which even far exceeded Rutherford's early expectations. When some time after the birth of the nuclear conception, I asked Rutherford, during conversation in his hospitable house, if the origin of the β -particles accompanying radioactive disintegration is to be traced to the nucleus or not, he answered that he did not know, and suggested approaching Bohr with this question, thus showing the great appreciation of Bohr's insight in atomic processes he already had in these days.

In later years, when Rutherford spoke of the old Manchester days, he repeatedly remarked that we did not then fully realize what great times we were witnessing. Those Manchester days were the greatest period of Rutherford's scientific genius. With increasing age and still further increasing fame, Rutherford's great and kindly interest in his former and present pupils, his deep

and sympathetic understanding of the difficulties experienced by them and mankind in general, have grown in like measure. For those who had the privilege of knowing intimately the personality and achievements of Rutherford, his death removes one of the great attractions of life.

M. le Duc de Broglie

Paris

I FEEL it a great honour that I have met Lord Rutherford of Nelson so frequently and that, only a few years ago, I was called upon to write, in NATURE of May 7, 1932, an appreciation of the great services which he has rendered to science. Now that we have lost him, we can see more clearly the magnitude of the part he has played during the past forty years in creating, to a great extent, the physics of the atom and of the nucleus.

One could give striking examples of the way in which he concentrated on the fundamental implications of any hypothesis which he adopted, and followed their consequences to the point where he was able to show clearly the need for the introduction of new ideas.

He, and the physicists of his school, probed the atom with swiftly moving electrified particles, and interpreted their results by means of the equations of classical mechanics. They were thus able to show the existence and the smallness of a central, heavy, positively charged nucleus, in the neighbourhood of which the ordinary laws of electrostatics begin to break down and to reveal new phenomena.

Bohr showed how classical mechanics must be modified to give rise to the atomic model which bears the names of Lord Rutherford and himself, and has recently emphasized the fundamental difference between interactions inside and outside the nucleus. In the first case, spheres of action encroach upon each other to such an extent that a particle cannot make contact with this region without affecting simultaneously all the parts which compose it. On the other hand, outside the nucleus, considerations proper to a two-body problem are still applicable.

In a more general fashion, the extraordinarily brilliant way in which the Cambridge school, led by Lord Rutherford, made use of formal mechanical models of the atom led to such progress in the knowledge and description of phenomena that physicists changed their outlook after the manner

of explorers who, on the far side of a mountain range, discover a new country. It then became clear that concrete images and quasi-classical theories had been pushed to the extreme limits of their usefulness and that, to make further progress, it would be necessary to introduce new ideas. Thus Rutherford's name is honoured equally by those physicists who regret the passing of the old mechanical theories of the atom and by those who prefer the more abstract ideas which have replaced them.

The great man of science whose ashes now rest in Westminster Abbey close to his illustrious predecessors was taken from us at a time when the tremendous advances in nuclear physics were giving to his work the fullness it deserved, and, in the future, they will testify to the vigour and fertility of his genius.

Prof. J. Stark

President of the Physikalisch-Technischen
Reichsanstalt, Berlin

I AM glad of the opportunity afforded by the Editor of NATURE to write a few words about the late Lord Rutherford. I have admired Rutherford for the last thirty years, as one of the greatest research workers in the field of physics. When, in 1902, his fundamental publications on the transmutation of radio-elements appeared, I was so charmed by the clearness and elegance of his experimental demonstration and by the importance of his discovery that I wrote him an enthusiastic letter to Montreal and congratulated him on his discovery. For this discovery, Rutherford received the Nobel Prize in Chemistry. But he afterwards made more discoveries, chiefly of a physical character, which merited the Nobel Prize in Physics. I have therefore proposed several times to the Nobel Committee for Physics that Lord Rutherford should be distinguished by the award of the Nobel Prize in Physics also.

It is unnecessary to speak of the importance of Rutherford's discoveries for the development of research in atomic structure, for they belong already to the generally known fundamentals of atomistic research and will always be valid. Rutherford's was the spirit of a great man of science, who, basing his conceptions on reality, tries to solve great problems by watching and carrying out suitable experiments and careful

measurements, and is not influenced by dogmatic theories. If future generations choose Rutherford as a model, physics will not become numbed by learned knowledge and dogmatic formulae, but will achieve results through practical experimentation.

Prof. Otto Hahn

Kaiser Wilhelm-Institut für Chemie, Berlin

At the request of the Editor of NATURE I gladly write a few lines in memory of my never-to-be-forgotten professor, Lord Rutherford.

In the autumn of 1905, I went to work with Prof. Rutherford in the Macdonald Physics Building at Montreal, and this visit was primarily responsible for my decision to change over from organic chemistry to radioactivity.

In addition to other problems, Rutherford was at that time working on the magnetic and electric deflections of α -rays, which he had recognized as helium atoms. A large variety of transformation products was investigated in the course of time, and I was fortunate in being invited to take part in some of this work. We determined the magnetic and electrostatic deflections of the α -rays from radiothorium, a substance which, by a stroke of good fortune, I had discovered shortly before in Ramsay's laboratory. The apparatus was fitted up in a dark cellar. The Toepler pump functioned slowly and not always satisfactorily, and many photographs had to be taken, for there was a very real danger of radioactive contamination. Rutherford was not to be discouraged by initial failure, however, and he was able to establish conclusively that the α -rays from radiothorium and from its transformation products are also helium particles.

Nothing could deviate him from his infective enthusiasm for work, which was imparted to all the members of his institute. Of these, apart from my German friend Max Levin from Göttingen, I should mention in particular Dr. A. S. Eve, who was later appointed successor to Rutherford in the Macdonald Physics Building. I recall with gratitude the never failing fatherly friendship and readiness to help which Rutherford showed towards us two foreigners. Love of our professor and of our work formed a bond of union also with the other members of the research department, H. L. Bronson, R. K. McClung and R. W. Boyle; it was the link in our happy family circle.

All gatherings, whether of a scientific or of a social nature, bore the mark of Rutherford's outstanding personality, although he was then barely thirty-four years old. There was a combined physical and chemical colloquium at Montreal, and it happened not infrequently that the beloved α -particles slyly found their way into the discussion which followed a lecture on one or another problem of organic chemistry. Quite unintentionally, but nevertheless to everyone's joy, the most topical problems of radioactivity had again suddenly become the focus of the conversation.

At the same time, Rutherford was so sincere and unassuming in his dealings with his students and with the everyday things of life, that we two Germans in particular were constantly filled with surprise and admiration. We had no doubt imagined that such a distinguished professor would be an unapproachable person, conscious of his dignity. Nothing could have been further from the truth. I still possess a small photograph which shows him clearing away the snow from the entrance to his house. In this house we were often evening guests, listening in rapt attention to the intimate piano-playing of Mrs. Rutherford or to the spirited narrative of the Professor.

Early in the year 1906, a photographer came to the Macdonald Physics Building to take a photograph of Rutherford working in his laboratory, for publication in the columns of NATURE with an article by Dr. A. S. Eve on the Macdonald Physics Building. Rutherford was at first reluctant, but later he granted the photographer permission to take a few flash-light photographs showing him seated at his α -ray apparatus. The photographs were duly taken, and they were also quite good. In the opinion of the photographer, however, the already famous professor was not dressed elegantly enough for the readers of NATURE. Not even cuffs were to be seen peeping from the sleeves of his coat! But the photographer found a way out; I was to lend Rutherford my loose cuffs. They were so arranged that they protruded well beyond the ends of his sleeves. The photographer expressed satisfaction with the new photograph. As a result, in one of the volumes of NATURE for the year 1906 (NATURE, 74, 273), we see not only Prof. Rutherford seated alongside the apparatus with which he carried out his epoch-making experiments on the α -rays, but also one of the cuffs of a young research student, who treasures his sojourn with one of the greatest masters of physical research as one of the most beautiful memories of his life.

Prof. E. Fermi

University of Rome

THE unexpected news of Lord Rutherford's death reached me at Bologna, when I was taking part in a meeting for the bicentennial celebration of Galvani's birth. A large group of physicists from all nations were assembled there, and it was quite apparent how deeply everybody felt the loss that science had suffered, by the passing away of a man whose efforts had opened up to physics one of the widest and as yet unfathomable fields of investigation.

Lord Rutherford certainly belonged to that highest class of experimenters—very few in the history of human thought—who appear to their admirers to be led by some sort of instinct always towards the successful attack of fundamental problems. If we consider most of his experiments, we are impressed by the fact that they are conceived so simply as to be easily understood and appreciated by a layman; their performance does not require a complicated piece of machinery, nor even often exceptional experimental skill. But it is not exaggeration to state that such simple experiments, as for example the discovery of the positive nucleus inside its cloud of electrons, or the method for producing artificial disintegrations by α -particle bombardment, are milestones in our knowledge of Nature.

Lord Rutherford will be remembered in the history of science not only on account of his personal contributions but also as a teacher, in the highest meaning of this word. One of the largest and most successful groups of investigators developed around him and learned from him not only the principles and the methods of research, but also the necessity of endurance and steadiness as essential requirements of the man of science.

Prof. L. Wertenstein

Free University of Poland, Warsaw

I THINK that the concluding remark of Prof. Chadwick's tribute to the memory of Lord Rutherford in NATURE of October 30, p. 751: "we lost . . . our leader" can be applied not only to his immediate collaborators but also to those who, like myself, have worked on radioactivity and have followed for years the progress of his work.

Although in the science of radioactivity most was done by Rutherford and his school, he is also responsible for a great part of what has been done elsewhere, because he opened up new fields of research and stimulated enthusiasm to such a high degree that it was impossible not to try to attain something approaching his splendid achievements. Every branch of physics has had leading men at different epochs, but we workers in radioactivity have been exceptionally fortunate in having such a leader.

I remember, when a young student in Mme. Curie's laboratory, the impression created by the appearance of every new paper of Rutherford's in the *Philosophical Magazine*. I would say, and many of my colleagues will believe me, these papers were considerable events in my life. A young scientific worker aims at perfection and looks for some ideal to follow: this perfection, this ideal, was to be found in Rutherford's way of showing simplicity in what seemed intricate, of attaining with apparent ease what was thought unattainable, of putting aside every obstacle as if it were merely a shadow. The uprolling of the magnificent film: "the α -particle", with the thin-walled tube and electrical counting, the crystal analysis of the γ -rays, it was more than science; it was an immediate contact with Nature, as if radioactivity itself chose him to unravel its secrets. We followed and admired him, but he took at times steps too large for us ordinary mortals, and when the paper on the nuclear atom appeared most of us could not believe it. I remember it gave me many sleepless nights, and I envy Chadwick for having listened to its first announcement; was it not the greatest day in the history of modern physics?

To have Rutherford's approval of one's work was a high reward for any worker in the domain of radioactivity. When Danysz focused the magnetic spectrum of β -rays, when Rosenblum discovered the fine structure of α -rays, what an immense joy it was for them to receive Rutherford's letters of congratulation. If such was the effect of his written word, no wonder so many wished to get nearer to him.

Although I occasionally saw Rutherford before the Great War, it was in 1925 that I had the opportunity of knowing him better and of working for some time in the Cavendish Laboratory. I chose for myself a small area in the enormous territory he has won for science; I was interested at that time in the physical properties of radon,

one of those emanations the nature of which as chemical elements was established by Rutherford. I was happy enough to add some minor points to this problem, but if I mention it, it is simply because this work enabled me to live in the atmosphere of the great man. It was rather outside the main line of research pursued in the Cavendish Laboratory, but I am sure Rutherford did not disapprove anyone taking up one of the favourite themes of his earlier period, and when he spoke about it, it was as if he recalled a great adventure of his life. I learned to know his attitude in science. A man of science is often a dignified, perhaps a melancholy person: seeing him one would say: "science is a difficult thing". It was not so with Rutherford: he made you feel that science is, first of all, beauty and happiness. One would quote Goethe's words, "Der Anblick gibt den Engeln Stärke". This strength poured from his deep voice vibrating with the joy of creation, and even his laughter, which was so often heard during discussions of the utmost importance, was deeply rooted in the sources of this happiness. He liked others to be happy too and when he knew a physicist—of any nationality—was a 'good man', he was ready to help him if necessary. The atmosphere was contagious with genius, and during my stay in Cambridge I realized what a wonderful 'climate' it was for the highly gifted men who formed Rutherford's surroundings. Only a few names can be found ranking with Rutherford, but even more unique was the association of a great man of science with collaborators like Chadwick, Blackett, Ellis, Cockcroft and many others.

Rutherford has left us, but he survives in the hearts of all students of radioactivity and nuclear physics throughout the world. We mourn him, but our eyes are turned on those who are most deeply affected. While assuring them of our sympathy, we feel that the great inheritance is in good hands.

Dr. P. Kapitza, F.R.S.

Institute for Physical Problems, Moscow

THE death of Lord Rutherford is unanimously deplored by all men of science, but especially is it felt by his numerous pupils.

Rutherford's pioneering work, which started forty years ago, has now developed into what we call the science of nuclear physics, and of this

science we can call him the creator, since most of the new ideas and discoveries in nuclear physics have been due to Rutherford or to his pupils.

In the history of science, it is difficult to find another case when an individual scientist has had such great influence on the development of science. I think this was mainly possible because Rutherford was not only a great research scientist gifted with exceptional ingenuity, enthusiasm and energy essential for pioneering work, but because he was also a great personality and teacher. His ideas and personality attracted young research students, and his abilities as a teacher helped him to let each of his pupils develop his own character.

His way of dealing with his pupils, whom he called his "boys", was most instructive; when a new research man came to him, Rutherford would first look for any originality and personality in the young man's work. Rutherford would always prefer the man to work on his own ideas rather than to have just another assistant working under his guidance. As soon as Rutherford discovered any sort of originality in his pupil, he would do everything possible to develop it to the utmost; he would encourage him in difficult moments and moments of depression, would not be exigent in case of mistakes, but on the other hand would 'put on the brakes' when the young man became too optimistic, drawing premature conclusions from an experiment not thoroughly completed. The pupil of Rutherford would very soon learn that the judgment of his professor was always very reliable and invariably to the point; especially good was Rutherford in judging what ought to be done. Once he told me how Moseley went to him, before starting a new problem, and suggested three subjects; Rutherford advised him to choose the work which led Moseley to his famous results on the relations between the wave-length of X-rays emitted by elements and their atomic numbers.

Fairness in acknowledging the originality of the work and ideas of his pupils kept a very healthy spirit in the laboratory, his personal kindness and good will to his pupils gaining the greatest affection that a pupil can have to his teacher. I worked in Rutherford's laboratory for fourteen years, first

closely under his direction and later independently, on magnetism, which was rather outside the scope of his line of work, but he continuously took interest in my doings, and to his interest, encouragement and friendship I owe a great deal in the accomplishments of my research.

Rutherford was fond of his pupils, and to have young research people was indispensable for him, not only because it gave better possibilities of working out a larger number of problems, but also because, as he often used to say, the young students kept him young. This was indeed quite true, for he kept not only young, but if I may say so, even 'boyish', to the end of his days. His enthusiasm, energy and gaiety never changed during the years I knew him, and he himself used to say that in research he always felt a young man; he had the same ambition and the same curiosity all through life, and always felt in attacking a new problem that he stood on the same footing as his research men. The young research people helped Rutherford not to age also in another respect, for with his pupils he had to keep up to date in his ideas. He was never in opposition to the new theories, which a large number of physicists of his age would never recognize or else ignore, and I never heard him speak about the "good old age" in physics, when the fundamental laws of Nature were clear and no uncertainty existed.

I cannot think of any country from which young research people did not come at some time to work in his laboratory, in Montreal, Manchester or Cambridge. During my own time in Cambridge, I can remember students working in the Cavendish not only from Great Britain and the Dominions, but also from the United States, Chile, China, Czechoslovakia, Denmark, France, Holland, Germany, India, Italy, Japan, Norway, Poland, the Soviet Union, Switzerland and other countries. Most of them now occupy professorial chairs, and some of them have gained an international reputation in science. I am certain that in all these countries there will be men of science who will sincerely mourn Rutherford's death not only as the greatest research physicist since Faraday, but also even more deeply as their teacher and friend.

interior of western Asia. Brak has also afforded from its early levels objects belonging to a Sumerian civilization of the Archaic period, revealed in this area for the first time. Among other accessions are the now famous inscriptions on potsherds from Lachish, which are deposited by the Weylcome Trustees. These inscriptions, the Lachish letters, are the earliest known example of written Hebrew, and refer to events mentioned in the Bible and relate apparently to the siege of Lachish by Nebuchadnezzar. The Egypt Exploration Society, at the instance of Dr. Alan H. Gardiner, has presented to the Museum the antiquities allotted to it from the Society's excavations on the site of Seabi in the Egyptian Sudan, which were exhibited at the Society's rooms in July last. It will be remembered that these excavations are of special importance for the light they throw on the earlier years of Akhnaton's rule.

Introduction of Plants into British Colonies

THE Colonial Office has performed a useful service to growers and exporters of plants and also to the British Colonies, by the issue of a digest of the legislation on plant introduction in force at the end of December 1936 (London: H.M. Stationery Office, 1937; 1s. net). Introduced pests and diseases have occasionally done much damage: instances cited are 'brown hardback' (*Phytalus Smithi*), causing serious losses to the sugar planters in Mauritius; the 'wither tip' disease, largely responsible for the ruin of the lime industry in Dominica; and the 'witchbroom' disease of cacao, now causing so much havoc in Trinidad. Since then, in 1876, Malta first instituted an ordinance "to prevent the introduction of diseases affecting agricultural produce", enactments have grown in number and diversity, and there is now real need for their comprehensive survey, such as is rendered possible by this publication, with the view of gradually simplifying procedure and introducing where possible more legislative uniformity.

To this end the third Imperial Mycological Conference, held in London in 1934, urged the adoption of a uniform type of health certificate throughout the Empire; and a standard form accepted by all Colonial Governments appears in the appendix to this summary. Furthermore, the geographical grouping of some Dependencies permits a measure of common action in these matters which has great practical advantages, and the colonies of West Africa have entered into a plant exchange convention under which each Dependency enacts similar legislation. A similar convention now links the Union of South Africa, Southern Rhodesia and the Belgian Congo, to which Northern Rhodesia and Nyasaland have since become parties. Proposals have also recently been approved for a similar arrangement in respect of East African Dependencies, and the necessary legislation is under consideration. This useful summary may supply the basis upon which further common action may be based that may lighten restrictions upon trade without removing

the necessary check upon the control of distribution of disease.

Manchester Scientists' Peace Association

THE Manchester Scientists' Peace Association, which has recently been formed with the objects of co-ordinating the influence and efforts of men of science of the Manchester district in the cause of peace, and of promoting a scientific and objective attitude to peace problems, held its first public meeting in the Milton Hall, Manchester, on December 13. The meeting was addressed by Prof. H. Levy, who stressed the importance of applying scientific methods to problems involving social relationships. He asked his audience not to be frightened by the feeling that the interaction of science and society is a political issue; politics it may be, but it is none the less amenable to attack as an objective problem. The professional politician, educated as a rule in the classical tradition, is frequently unable to appreciate this, and the entry into politics of more men of scientific training is most urgently required. But whether actively engaged in politics or not, the scientific man, especially if he has brought children into the world, cannot evade the responsibility of ensuring to the best of his abilities that the powers of science are used for the benefit, and not for the destruction, of the coming generation. A general meeting of the M.S.P.A. is to be held on January 17, at which a constitution will be proposed, officers elected and a programme of activities discussed. Particulars can be obtained from the provisional honorary secretary, Mr. D. C. Henry, The University, Manchester.

Impacts of Science

IN his Streetfield Memorial Lecture on October 15, entitled "Chemical Changes and Chances", Sir Martin Forster described some of his early experiences and the development of science in his early years which not only give a vivid and happy picture of Streetfield's personality but also afford a highly suggestive glimpse of the reactions of discoveries and personalities in the same period. He recalls being assured in November 1892 that all the most important discoveries in organic chemistry had been made, and then refers briefly to the way in which Nef, Claisen, Fischer, Pope and others rapidly enlarged our ideas of valency, intramolecular change, the configuration of sugars, the Walden inversion, etc. In discussing the reactions of science on industry, Sir Martin stresses the factor of the reaction of personality to background, and the rarity of finding a brain in which chemical and commercial instincts are co-equally powerful. He endorses Mr. Cronshaw's conclusion regarding the languishing of the dyestuffs industry in Great Britain and repudiates the unjustified condemnation of the business man in which chemists sometimes too readily indulge. On the contrary, he asserts that, in his experience, business men take reasonable trouble to ascertain the facts with which they have to deal, and he cites examples of benefits which the world enjoys through their enterprise.

IN the latter part of his lecture, Sir Martin discusses a number of problems arising out of the impact of science, and makes many shrewd comments on the attitude of chemists in such matters, which should stimulate a more rational attitude and wider scientific outlook in determining the conduct of the scientific worker as a citizen. In particular, he refers to the need for a practical attitude to the question of national defence if our liberty of thought and action is not to be lost, and of the need for more practical solicitude, enlightened by wider scientific outlook with increasing inter-communal tolerance and courage, to face ugly facts if the problem of productivity and distribution is to be solved. Equality of opportunity cannot be completed without equality of reception, which the human divergences render chimerical. The development of a community is the algebraic sum of self-development by its component members, although noteworthy material and ethical advance follow mainly from the deeds and ideals of its ablest members. The pursuit of science still does not liberate us from common human failings, and Sir Martin considers that one of our most serious problems is to prevent greatly increased comfort and opportunity for amusement from robbing our young people of self-reliance and ambition. On the solution of this problem the progress and happiness of our race will depend.

The Roads of France

IN a paper on "Transport in France" presented by F. J. Wymer to the Institute of Transport on October 19, it is said that the image which generally lingers longest in the mind of an Englishman who has motored through France is a section of 'route nationale' stretching ahead of his car into the far distance, with poplar trees passing the eye on each side like the pales of a fence. The same type of road was to be found 1,700 years ago in Great Britain from Dover to London and York, from Southampton to London and Chester, and many other roads, as the system in France is, like our own, undoubtedly descended from that of the Roman Empire. In contrasting the present roads in Great Britain with those in France, it has to be remembered that no hostile force of any appreciable dimensions has landed upon the shores of Britain for nearly a thousand years; our defences have been upon the sea and so the roads were built with this end in view. Hence the roadways of England tended mainly to be local links from village to village and so in a meandering way passed through a maximum number of towns and villages. In France they were designed on a plan connecting by the most direct routes the capital with the military centres. Having such different road systems, it is interesting to note that both France and England seem to be following similar tendencies in developing their systems unlike other great European countries. In France, after the Great War it was decided, instead of concentrating upon a few selected routes, to improve the standard of the whole system just as is being done in Great Britain. In France, the roads are being modernized by widening,

by the elimination of level crossings, by the re-designing of road junctions and the provision of modern surfacing.

THE construction and upkeep of the French roads depends upon their status. The 'routes nationales' are maintained by the State and the 'routes départementales' by the departments. The smaller roads known as 'chemins vicinaux de grandes communications et d'intérêt commun' are looked after by the communes, but sometimes the départements give them financial assistance. The 'chemins vicinaux ordinaires' and the 'voies urbaines' are kept up by the communes and municipalities alone. Taking 125 francs to the pound sterling, the total sum expended annually on the construction and upkeep of the road system is nearly eight million pounds, or about one seventh of the amount expended upon the roads of Great Britain. As a whole the roads of France are on a lower standard than those of Great Britain, and it is difficult to draw a direct comparison between expenditure in different countries as 'values' and 'exchanges' are always altering. Taxes are imposed on road vehicles, and also on their fuels. The total sums collected by the French treasury from this source amount to nearly four times the annual expenditure on the roads.

Golden Gate Fair

THE completion of "Treasure Island" in San Francisco Bay has added about 400 acres of new territory to the United States. This man-made island will be the site of the 1939 Golden Gate International Exposition. It was formally delivered to the Government by the U.S. Army Corps of Engineers, who made the reclamation on November 21. The site of the Fair is an outstanding engineering achievement. It is happily situated between the world's two largest bridges. A special feature of the Exposition will be British Empire Day, which will be celebrated on May 27, 1939. A committee headed by Mr. A. G. Charlton, the British Consul General, is making plans for the occasion. In spite of the fact that the last of the filling material within the 17,760 ft. seawall has only recently been placed in position, two million pounds' worth of building construction work is already in progress. Large concrete and steel hangars have been completed. This Pageant of the Pacific will celebrate not only the completion of the San Francisco-Oakland and Golden Gate Bridges, but also the latest developments of science and engineering skill. These will include the Halls of the Mineral Empire and of Science, the Palaces of Business Progress, including electricity and communications, and pavilions devoted to Agriculture and Homes and Gardens. A new type of architectural design which is called 'Pacific' will combine Eastern and Western styles in a harmonious way. To beautify the grounds, £300,000 will be spent on landscape gardening and horticulture. The western States jointly with California will be hosts at this Pageant of the Pacific. British Columbia has announced that she will participate. Fifteen foreign nations have

already stated their intention to take part in the Exposition. A view of the 400-acre island reclaimed from the sea in San Francisco Bay is shown in the *Electrician* of December 10.

Meteorology in the Navy

THE Admiralty has announced the re-institution of a Naval Meteorological Branch of the Hydrographic Department, a branch which was created during the Great War but was merged with the Meteorological Office in 1920 when the latter institution was taken over by the Air Ministry, and then became the Naval Division of the Meteorological Office. Capt. L. G. Garbett, who has been its superintendent, is to be the chief superintendent of the reconstituted Naval Meteorological Branch of the Hydrographic Department, under the Hydrographer of the Navy, and will be assisted by three naval officers and a civilian staff. Although the change is being made only for administrative convenience, and does not coincide with any drastic change in naval meteorological practice, the applications of meteorology to naval operations have steadily increased in recent years, especially that part of meteorology concerned with the wind structure and the physical state of the upper atmosphere, which are of such importance for flying operations. For this reason, the existence of an efficient meteorological service organised especially in accordance with naval requirements has become a matter of even greater importance than formerly. The Meteorological Office, under the Air Ministry, has also greatly extended the scope of its activities, and will remain the principal seat of meteorological learning and research.

Palestine Journal of Botany and Horticultural Science

IN 1935-36 three numbers appeared of a new journal with this title, under the editorship of Dr. H. R. Oppenheimer; the journal is published at irregular intervals; each volume contains 10-15 sheets, of 16 pages each, and is sold abroad at the rate of one shilling per sheet. Papers published deal mainly with the plants and plant problems of Palestine or with experimental work in plant physiology or horticulture. From its descriptive nature, botanical work in a new country needs a local publication medium to record observations which are, in the main, of interest to the inhabitants of the new country, though they also attract the attention—of systematists especially—of all countries. It is to be hoped that this new venture, which includes brief Hebrew summaries of the main items in the last number of the volume, may find enough supporters in Palestine and amongst those interested in systematic botany and horticulture to enable it to continue. It is announced that Dr. Israel Reichert, mycologist and plant pathologist, joins the editorial board from the publication of the second volume; this suggests that plant pathology will be more strongly represented in future numbers. The third number contains an editorial appreciation and photograph of G. Moesheyoff, assistant in plant physiology at the Hebrew University, who died at the age of twenty-

three years as the result of wounds received during the recent disturbances at the defence of the colony Koryath Anavim. The agent for the journal in Europe is W. Junk, The Hague.

Gift to University of Melbourne Medical School

THE University of Melbourne has received from the trustees of a large estate in Australia the sum of £50,000, to be held in trust and the income applied to the Medical School, and especially to raise the status of the pre-clinical chairs. The salary attached to the chairs of anatomy, physiology, pathology and bacteriology, hitherto £1,200 (Australian) a year, is to be raised to £1,700 a year, in addition to which the University pays 2½ per cent to a superannuation fund. It is hoped by this means to strengthen the scientific portion of pre-clinical education, particularly in the second and third years, thus improving the fundamental basis for the following three years of the present six-year course.

A New Species of *Sempervivum*

DR. W. B. TURRILL describes a new species of *Sempervivum* in the *Gardeners' Chronicle* of October 23. It is *S. octopodes* Turrill, and was discovered on Mt. Peristeri in north Macedonia, by Dr. R. Seligman, during an expedition with Dr. Giuseppe. A full Latin diagnosis appears in the paper, and it is encouraging to note that the variety *apetalum* promises to become a good plant for the garden. Both type and variety have been cultivated by Dr. R. S. Wale, but the variety is much more amenable to horticultural treatment than the typical species.

Official Statistics

THE Guide to Current Official Statistics of the United Kingdom for 1936 (London: H.M. Stationery Office. 1s.) has been published. It is compiled on the lines which have now become familiar. The main part of the volume is an alphabetical list of subjects with reference to the official volumes available. Secondly, there is a numerical list of publications arranged under the headings of various departments. The volume reveals the wide range of subjects upon which official statistical information is available.

Thomas-Gilchrist Basic Process

A PAPER by F. W. Harbord at the autumn meeting of the Iron and Steel Institute gives an account of the history of the Thomas-Gilchrist basic process from 1879 to the present date, from the preliminary experiments in a six-pound converter to the present-day production of ninety million tons of basic steel per year. As a contribution to the history of modern steel-making this paper is of real value.

Announcements

THE King has been pleased to appoint the following members of the medical profession engaged in public health work, both in central and local government, as honorary physicians: Sir Arthur MacNalty, chief medical officer, Ministry of Health and Board of

Education; Sir Edward Mellanby, secretary of the Medical Research Council, formerly professor of physiology in the University of London; Mr. J. H. Hebb, director-general of medical services, Ministry of Pensions; Mr. J. C. Bridge, senior medical inspector of factories, Home Office; Sir Frederick Menzies, medical officer of health and school medical officer to the London County Council; Mr. A. S. N. MacGregor, medical officer of health for Glasgow.

DR. M. C. G. ISRAELS, assistant director of the Department of Clinical Investigation and Research in the Manchester Royal Infirmary, has been appointed by the Council of the Royal Society to a Foulerton Research Fellowship. The appointment will date from January 1, 1938; and Dr. Israels proposes to carry out research on the nature and aetiology of leukaemias and allied conditions.

PROF. A. S. SPILHAUS has recently been elected a foreign member of the Royal Meteorological Society. Prof. Spilhaus is assistant professor of meteorology in New York University, and previous to this he was connected with the South African Weather Service. He has published a number of short papers which have appeared in the *Bulletin of the American Meteorological Society* during the last two or three years, all of them showing marked originality, particularly in designing meteorological apparatus.

At the Coronation Inventions Exhibition held at Sheffield and Leeds, the double award of the Founder's Silver Medal and the Institute of Patentees' Silver Medal has been made to Dr. S. C. Blacktin for his electrotor dust and smoke meter (see *NATURE*, 140, 982, Dec. 4, 1937).

MR. E. GRAHAM CLARK has been appointed secretary to the Institution of Civil Engineers in succession to the late Dr. H. H. Jeffcott.

DR. F. HEATHCOAT, lecturer in chemistry and fuel technology at the College of Technology, Rotherham, has been appointed to the post of vice-principal and head of the Chemistry Department at the Technical College, Swansea.

MR. J. C. TREVOR will read a paper entitled "Some Anthropological Considerations of Race Crossing" before the Eugenics Society in the rooms of the Royal Society, Burlington House, London, W.1, on December 21 at 5.30. The meeting is open to the public.

A SPECIAL exhibition, illustrating the "Childhood of Animals", which will be open from December 20 until March 31, is being arranged by the Department of Zoology at the Horniman Museum, Forest Hill, S.E. The exhibition will comprise such objects as a baby koala, clinging to its mother's back; the adults, young, nests and eggs of various typical or striking species of birds; the life-history of a butterfly; and models of larvae of the frog and a marine

worm. It is thought that Christmas, which so peculiarly belongs to the children, would be an appropriate time for the opening of such an exhibition.

THE annual Conference of the Geographical Association will be held in the London School of Economics on January 4-6, under the presidency of Prof. Patrick Abercrombie. Prof. Abercrombie will deliver his presidential address entitled "Geography, the Basis of Planning" on January 4. Further information can be obtained from the Geographical Association, c/o Municipal High School of Commerce, Princess Street, Manchester, 1.

THE twenty-fifth election of Beit fellows for scientific research will take place on or about July 8, 1938. Each fellowship is of an annual value of £240 and is tenable for two years. Fellows will be attached to a department of the Imperial College of Science and Technology. Not more than three fellowships will be awarded. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

UNDER the terms of administration of the Clough Memorial Research Fund administered by the Edinburgh Geological Society, a sum of approximately £30 is available annually for geological research in Scotland and the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Applications for grants are invited for the period April 1, 1938-March 31, 1939. Further information can be obtained from the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh.

THE following appointments and promotions have recently been made in the Colonial Service: A. P. S. Forbes, agricultural officer, Nyasaland; G. M. Gates, veterinary officer, Nigeria; G. R. Groves, horticulturist, Bermuda; F. M. Levin, meteorological assistant, British West Africa Meteorological Service, Gold Coast; W. B. Mason, inspector of plants and produce, Gold Coast; L. S. Matthews, meteorological assistant, British West Africa Meteorological Service, Nigeria; J. D. F. O. McDonald (senior plant pathologist, Kenya), director of agriculture, Cyprus; S. J. Saint (assistant director of agriculture and chemist), director of agriculture, Barbados; F. Flippance (assistant curator, Gardens Department, Straits Settlements), superintendent, Botanical and Forestry Department, Hong Kong.

ANNOUNCEMENT is made of the forthcoming publication of an "Annual Review of Physiology", in which it is proposed to review the developments of the preceding year or biennium in the major fields of physiological research. The series will appear under the auspices of the American Physiological Society, Inc., and the Annual Review of Biochemistry, Ltd. The new review will conform in general style and format to the "Annual Review of Biochemistry". Prof. J. Murray Luck, Stanford University, California, will serve as managing editor.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1066.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Origin of Yolk Lecithin

We administered labelled (radioactive) sodium phosphate to a hen by subcutaneous injection and, after the lapse of 28 hours, removed 34 yolks from the ovary having an aggregate weight of 30.6 gm. The lecithin of each yolk was then extracted and the phosphorus content and radioactivity determined. The blood plasma, blood corpuscles and the liver were treated in a similar way. The results obtained are seen from the accompanying table, in which for sake of simplicity the specific activity (activity per mgm. P) of the blood plasma phosphatide phosphorus was taken to be 1.

SPECIFIC ACTIVITY (relative activity per mgm. P)

Extracted from	Phosphatide P	Non-phosphatide P
Plasma	1	0.63
Corpuscles	0.37	0.23
Liver (alcohol + ether extract)	1.24	1.18
Liver (ether extract)	1.22	—
Yolk, 30-100 mgm. (average)	0.044	1.44
Yolk, 690 mgm.	0.55	1.38
Yolk, 2,510 mgm.	1.18	1.48
Yolk, 4,500 mgm.	0.7	—

Before interpreting the figures obtained, we wish to recall the following facts. We found that while labelled phosphorus in sodium phosphate exchanges rapidly with the phosphorus in bone phosphate, it does not exchange with lecithin phosphate¹. Furthermore, when the labelled P is first put into the blood, 1 mgm. P will show, for example, 10,000 activity units; as a result of a rapid exchange going on chiefly between bone phosphate and the inorganic phosphate of the blood, 1 mgm. will soon correspond to less than 10,000 activity units; in the case of the hen, we found the above-mentioned activity to amount after the lapse of 28 hours only to about 10.

When doing research with labelled P we are mostly, as in the present case, interested in the quantitative determination of the amount of a phosphorus compound synthesized in the body after the administration of the labelled P. The above-mentioned rapid change in the sensibility of our indicator with time makes it, however, very difficult to obtain the result desired; a high activity of the phosphorus compound in question being quite compatible with the new formation of only a small part of the compound in question and vice versa. In the experiments discussed in this note, there can, however, be little doubt that the phosphatide molecules present in the liver of the hen were to a very large extent formed within 28 hours, that is, after the administration of the labelled P.

In experiments which we were able to carry out through the kindness of Prof. Lundsgaard and Dr. Blixenkron on isolated livers of cats and in which no skeleton or other organs were present, the difficulties mentioned above do not occur. In these

experiments we found that within 2.5 hours of perfusion, about 1 per cent of the liver phosphatide gets labelled and is thus newly formed. In the living organism, the liver metabolism is certainly not less effective than in an isolated liver, and therefore there can be scarcely any doubt that within 28 hours a great part of the phosphatide molecules present in the liver was newly formed.

As the specific activity of the blood plasma and also of the yolk lecithin do not differ greatly from that of the liver lecithin, we have to conclude that the lecithin molecules present in the blood are also to a large extent newly formed within the last 28 hours. That the difference between the specific activity of the phosphatide P of the liver and yolk, as is seen in the table above, is smallest in the case of the 2,500 mgm. yolk is just what we should expect. Such a yolk is to a large extent formed² within 28 hours, while that is to a less extent the case both for smaller and larger yolks. We thus conclude that the yolk lecithin was taken up from the plasma, the plasma lecithin being replaced by molecules formed at least mainly in the liver. In the case of the hen experimented on, within 28 hours about 40 mgm. yolk lecithin P was formed, the phosphatide P present in the total plasma was 20 mgm., and that in the liver 38 mgm. The large drain on the liver P necessitated the formation of a large part of the liver phosphatide, which was synthesized from labelled blood and thus became active.

It is of interest to note that the blood corpuscle lecithin P only shows one third of the specific activity of that of the plasma lecithin P. This finally disposes of the theory according to which the place of formation of the blood lecithin is the blood corpuscles. We also carried out *in vitro* experiments in which blood was shaken for some hours with labelled sodium phosphate, and determined the amount of labelled phosphatide formed; it amounted only to 1/1,000-1/2,000 of the total phosphatide present in the blood.

Mr. A. H. W. Aten extracted the phosphatides from the organs of a hen only 5 hours after administration of the radioactive sodium phosphate. Taking the specific activity of the plasma inorganic P to be unity, the following values were obtained for the specific activity of the phosphatide P: liver 0.54, plasma 0.44, ovary 0.039, yolk, maximum 0.034, and intestine 0.11. The above figures show clearly that the liver of the laying hen is responsible for the formation of most of the phosphatides, which are then carried by the plasma into the ovary.

In an egg removed from the oviduct the yolk phosphorus was found to be scarcely active; from this we must conclude that this yolk had not grown within the previous 28 hours. The shell P of this egg showed the specific activity of the inorganic plasma P.

Some of the labelled phosphorus used in our experiments was prepared by us from sulphur under the action of neutrons emitted by a radium-beryllium mixture most kindly put at our disposal by Prof. Niels Bohr, and some of it was a generous gift from Prof. Lawrence of the University of California. We should also like to express our best thanks to Miss Hilde Levi for her assistance in this work.

L. HAHN.

G. HEVESY.

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University of Copenhagen.
Oct. 28.

¹ Skandim, *Arch. Physiol.*, 77, 148 (1937). The work of Arton and his colleagues (*NATURE*, 139, 836 (1937); *Arch. internat. Physiol.*, 49, 32, 37) is also based on the assumption that phosphatide P does not exchange.

² Comp. Gerhartz, H., *Arch. internat. Physiol.*, 186, 215 (1914).

An Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves

RECENTLY there has been much interest in those catastrophic ionospheric disturbances which are supposed to produce 'radio fade-outs' on high-frequency radio waves and short-lived disturbances in the terrestrial magnetic records. In a recent report, Dellinger¹ has given an account of the results of these disturbances, based on more than a year's observations by workers in different parts of the world, and he states that "ordinarily the intensities of the waves received from radio stations on frequencies below about 1,500 kc./s. are not perceptibly affected during a fade-out". He mentions, however, that Bureau² has found an increase in the number of atmospherics on frequencies between 27 and 40 kc./s. during many of the disturbances; this is the only evidence so far published that the propagation of low-frequency waves is affected at these times.

We have been engaged, for some years, in studying the phase of the downcoming wave received at Cambridge from the low-frequency sender at Rugby (frequency 18 kc./s., distance 90 km.) by a method which has been described elsewhere³. The variation of phase of the abnormal component (that is, the component of the electric vector which is parallel to the ground) of the wave near sunset is usually observed to be of the form shown in Fig. 1. Other evidence leads us to suppose that the equivalent reflection height in the daytime is about 65 or 70 km., and that Fig. 1 represents an increase of this height by about 12 km. during sunset. On some occasions a very marked, but short-lived, disturbance in the ordinary behaviour has been noticed, an example of which is shown in Fig. 2.

On these occasions it appears that the normal sunset increase of reflection height is temporarily interrupted, and replaced by a decrease. It is of interest to investigate how far these phase anomalies at low frequencies are related to other phenomena which are supposed to be produced by catastrophic ionospheric disturbances. In an analysis of the results so far obtained, we have compared the times of occurrence of the low-frequency phase anomaly with the times of fade-outs, increases in atmospherics, and magnetic anomalies occurring on the same days. The times of fade-outs and increases of atmospherics have been taken from published data supplemented by data supplied by our colleagues in Cambridge.

The magnetic data have been taken from the published hourly mean values of the magnetic declination

observed at Abinger. A curve drawn through the hourly mean values of the declination was compared with a similar curve drawn through the monthly mean values, and the times and magnitudes of

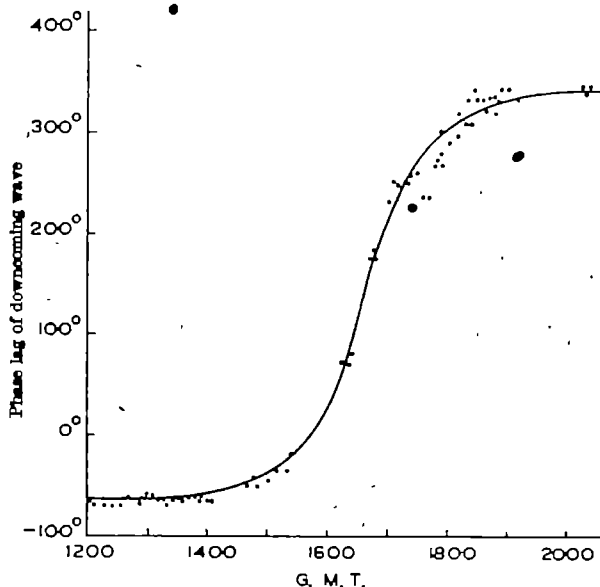


Fig. 1.

FEBRUARY 25, 1937.

magnetic anomalies were noted. A departure from the mean of more than two minutes was classed as an anomaly, since departures of magnitudes greater than this were found to be infrequent on days which showed no low-frequency anomaly.

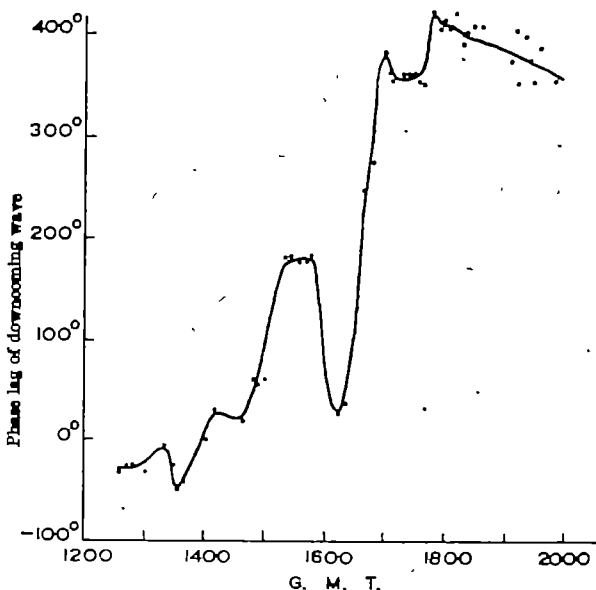


Fig. 2.

NOVEMBER 6, 1936.

Low-frequency phase anomalies were noticed on eighteen days. Of these, seven coincided with reported fade-outs, to within about a quarter of an hour. Whenever a fade-out was reported at a time when detailed observations were being made on the

low frequency, an anomaly was observed. On three occasions the low-frequency anomaly coincided with a reported increase in atmospheric observed on a frequency of 27 kc./s. On the remaining eight days no fade-out or increase of atmospheric was reported, but the low-frequency phase anomaly was associated with a magnetic anomaly, occurring within one hour of the observation.

We conclude that a catastrophic ionospheric disturbance has a marked effect at the level of reflection of the low-frequency waves (70 km.), this effect being most evident as a decrease in reflection height of the waves.

Our experiments have not shown any clear indication of a change in reflected wave amplitude at the time of the phase anomalies. The change in received amplitude of atmospheric noticed by Bureau may be the result of a change in reflection height altering the phase relation between the interfering downcoming and ground waves, or it may be due to a real change in the amplitude of the downcoming wave, which occurs in his case but not in ours, either because the reflection is much more oblique, or because the frequency of his observations is different from that of ours.

K. G. BUDDEN.

J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge.
Nov. 9.

* Dellinger, *Bur. Stand. J. Research*, 19, 111 (1937).

* Bureau, *Comptes rendus*, 203, 1257 (1936).

* Best, Ratcliffe and Wilkes, *Proc. Roy. Soc., A*, 155, 614 (1937).

Effect of a Magnetic Field on the Electrodeless High-Frequency Discharge

THE following experiment, which originated from an investigation of the magnetron, seems to be of more general interest as it happens to confirm some recent theories (especially those of Prof. V. A. Bailey) on what happens to wireless waves in the upper atmosphere.

It is well known that the electrodeless high-frequency luminous discharge can be started by comparatively low voltages in a gas at very low pressures. It is only necessary to place the bulb of low-pressure gas between two plates connected across a tuned circuit coupled to a medium-power wireless generator. If the pressure is so low that the mean free path is long, any electrons present will vary in speed in unison with the voltage alternations, and if the maximum speed attained (which depends on the amplitude of this voltage) is sufficient to produce ionization by collision, a discharge may be started. It seemed likely that if instead of allowing the speed of the electrons to rise and fall they were continually accelerated a discharge would start with a much lower voltage. This can be done by applying a fixed magnetic field perpendicular to the electric force which causes the electrons to move round in orbits; the time of turning through 360° depending only on the magnetic field strength. If this strength is so adjusted that this time is equal to the periodic time of the high-frequency voltage, a sort of resonance occurs (if the free path is long enough) and the electrons move round faster and faster in orbits which get bigger and bigger. The condition for resonance is that the product of the wave-length in metres and the field in gauss should be approximately 110.

It is necessary, however, if the orbit in which ionizing speed is attained is not to be too large, so that the experiment can be conducted in a bulb of reasonable size, that a short wave be used. The following experiment was done with a 6 metre wave-length and a field of about 18 gauss. As the pressure of air in the bulb was reduced, it was found that down to pressures of about $\frac{1}{10}$ mm. of mercury, the potential required to start the discharge was unaffected by the magnetic field, but a further reduction in pressure and consequent increase in the mean free path had a most striking effect. At $\frac{1}{10}$ mm. the field reduced the starting potential by a factor of 5, at $\frac{1}{100}$ mm. by a factor of about 40, and at the lowest pressure which could be read on the gauge—something less than $\frac{1}{100}$ mm.—the discharge still started quite easily with the magnetic field on but it could not be started at all without it.

In the upper atmosphere, the magnetic field is less than 1 gauss and the wave-length for resonance is therefore much longer than the above, but there is no bulb to limit the orbit size. The electric force in a wireless wave is of course far too small to work the electrons up to ionizing speed before a collision, but the resonance results in the transfer of considerable energy from the wave to the medium, with the consequences explained by Prof. Bailey.

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Nov. 15.

Interpretation of Atomic Constitution

A WARY man hesitates to cross swords with a skilful fencer, but it is cowardly to decline to face difficulties. Colonel Moore-Brabazon might well have asked for other explanations—Why two electricities? What is the difference between the so-called positive and negative electricities? What is negative energy? Why does not the electron explode? However, he is probably prepared, like the rest of us, to accept Nature as we find it, and the paths that we follow are forced upon us rather than chosen.

It is permissible at least to emphasize the *protean* forms of energy which exist, for the transmutations of energy are quite remarkable. For example, work generates a proportionate quantity of heat (kinetic energy). The energy $w = Jh$, where h is in heat-units and J is Joule's constant; alter the units and state $W = H$, or energy equals heat generated.

Again, energy is proportional to mass ($w = mc^2$, where c is the velocity of light). Change the unit of mass, and energy equals mass, or $W = M$.

So, too, energy may leave an atom as a photon and $w = hf$, where f is the frequency of the wave and h is Planck's constant. With another change of units, it follows that $W = F$, or energy is frequency. Altogether it follows that energy = mass = heat = frequency!

The conservation of energy is the conservation of mass and is the conservation of frequency, and frequency may be as important as energy. But no one supposes that mass is merely a number—the first blow dispels that illusion.

Most remarkable is the fact that in certain circumstances a photon, in the shape of a high-frequency gamma ray, will *materialize* and give rise to an electron and a positron, so that 'light' becomes two masses, if you like, two charges, if you will, two waves, if you prefer it, but certainly two entities,

very similar in character, mass, velocity, momentum, energy, and properties in a magnetic field except for swerving opposite ways and therefore having opposite charges, whatever that may mean.

There is no reason why a neutron may not have so much electrical energy within it that its mass may be electrical: But why lay down the law about things of which at present nothing is known? There is no *credo* in science, and no one knows what force, or mass, or energy are, but they have measurable properties. Measure them and keep the balance sheets!

Electrons are used in countless valves for telephony and wireless sets—but as for defining an electron—whose job is that? A thing is known only by its properties.

The mass of an electron increases with its velocity, particularly at speeds approaching the velocity of light. This was known in theory before it was verified by experiment in pre-relativity days. Does a neutron also increase in mass with velocity? This is a difficult point involving experiments that are far from easy. Two of my Cavendish friends answer yes, the neutron will increase in mass with speed, following relativity principles.

The nucleus of an atom is a small region compared with the atom itself. The nucleus seems to be composed of those things which come out of it, such as protons, neutrons, alpha particles. But these elements when *inside* the atom may have a very different character, and the interior may be a seething collection of electrical waves, having frequency, energy, mass, which may not need to be "held together". No one knows how an electron continues to exist or why it does not violently explode. Small-scale phenomena need not resemble large-scale happenings. It is remarkable to what extent many macroscopic results do hold good in the microcosm, but it is quite certain that quantum theory is needed to explain spectra, and that everyday mechanics will not suffice for the atom and its behaviour.

Five years ago, Bohr was writing: "As soon as we inquire more closely into the constitution of even the simplest nuclei, the present formulation of quantum mechanics fails essentially . . . but it is interesting to note that the energy liberated by the formation of the nucleus, as calculated from the so-called mass-defect by means of Einstein's relation ($E = mc^2$) is in approximate agreement with the binding energy of the protons to be expected on quantum mechanics from the known nuclear dimensions".

Physicists will move on from strength to strength, astonished at their great successes in forty years. Unfortunately, only those who spend an arduous life-time in theory and research are able to appreciate fully both their achievements and their failures.

If these views have any merit it belongs to others; if any errors they are my own.

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Physiological Patterns and Mental Disturbances

THAT a diminution in the oxygen tension of the inspired air can produce mental changes is an established fact. Far less certain is the possible correlation between psychotic manifestations as seen in clinical practice and an impoverished supply of oxygen to the central nervous system. It was thought that further light might be shed on this possibility

by estimating the gaseous content of arterial blood and also of that drawn from the internal jugular vein of the same subject. In a group of patients in which the diagnosis of schizophrenia appears certain, this procedure has been carried out according to the method used by Lennox¹, and the following results were obtained:

Arterial Blood		Venous Blood		A. F. Δ		Blood O ₂ Cap.	
CO ₂	O ₂	CO ₂	O ₂	CO ₂	O ₂	R.Q.	
(64)*	(64)	(59)	(59)	(58)	(58)	(58)	(50)
50.42	17.72	57.05	11.39	6.71	6.46	1.072	19.01
49.14†	18.12	54.96	11.96	5.82	6.2	0.95	19.56

*Figures in parentheses represent number of subjects. Arterial and venous blood was withdrawn from the same subjects but in five cases one failed to enter the internal jugular; this accounts for the larger number of arterial samples.

†Figures in this line reported by Lennox¹ in non-schizophrenic subjects.

A complete report of these findings, together with those from the control group, will appear at a later date, and at that time a brief clinical summary will be given of each patient studied, thus eliminating some of the vagueness which necessarily accompanies such an indefinite and general term as 'schizophrenia'. Suffice it to say at present, that the group was a representative one in that some of the patients were of the active and paranoid type whereas others were of the catatonic variety; some were actively engaged in manual labour and others were confined in a demented state to their respective wards.

As the blood samples were being withdrawn, a spiograph was recorded on the Roth-Benedict apparatus in order to detect any temporary alterations in breathing which might affect the gaseous content of the blood examined. The marked regularity in rhythm, uniformity in depth of both inspiration and expiration, and small tidal air in the schizophrenic group before, during and after the puncture was noted in contrast to the relative irregularity of all of these features before the puncture and a marked irregularity which supervened at the time of the puncture in the control group.

Segregating the pneumographs by inspection of the tracing, the following distribution is found:

	Number of subjects	% of cases showing 'regular type' of breathing	% of cases in which spiograph was neither regular nor irregular	% of cases showing 'irregular type' of breathing
Normal	80	6.6	17.4	76
Schizophrenic	57	77.7	7.6	14.8

The cardiac output, determined by Grollman's method, has also been measured in a few of the patients and in the control group. The difficulties inherent in the technique and also entailed in obtaining the necessary co-operation of the patient have limited the number of such observations so that, as yet, they are not sufficiently extensive to be entirely representative. However, the figures at hand demonstrate a small stroke volume and cardiac index in the majority of those schizophrenics on whom cardiac determinations have been made. The catatonic individuals have a smaller stroke volume and cardiac index than the paranoid. In agreement with others, we have found the basal metabolic rate to be in general low.

All these observations have been repeated a number of times on some of the subjects from both groups. Extremely consistent findings are obtained from the schizophrenics, whereas those from the control group show a greater variability on separate occasions. It is generally more difficult to establish a strictly basal

state in a mental patient than in a normal individual, and yet, in spite of this, there is more likelihood of finding the figures for blood gases, cardiac output and respiration more nearly the same in a schizophrenic than in a member of the control group. It would seem that the schizophrenic physiology is less susceptible to change. On one occasion when a schizophrenic individual was breathing into the Roth-Benedict apparatus, he began to hyperventilate both forcefully and rapidly, keeping this up for 3½ minutes before he could be persuaded to desist. Following the period of hyperpnea, his respirations continued with exactly the same rhythm and uniform depth as before the onset of his voluntary hyperventilation; there was no period of apnea and no semblance of Cheyne-Stokes' type of breathing. This set or fixed type of physiology is one which cannot readily adapt to the ever-changing internal and environmental demands; it is one which would allow greater fluctuations in the *milieu intérieur*.

It would appear that there is no one single physiological characteristic found in schizophrenic patients which cannot also be found in the normal population. We have found members of the control group with a very regular type of respiration, others with a small tidal air, and still others with a small cardiac output; some with a high arterial carbon dioxide or a low oxygen saturation. Still others may have a low basal metabolic rate or else a large difference in the gaseous content of arterial and internal jugular blood, or else a low blood pressure. Fewer still show the fixity of physiological processes and none, so far as we have observed, presents the combination of these phenomena to such a degree as does the schizophrenic.

It would be extremely interesting to know whether this pattern of physiological responses be present before the onset of frank psychotic manifestations, and we are at present gathering material which will decide this point. On the basis of the results obtained in a limited number of instances, one would say that this type of physiological activity is more characteristic of the individual than of his illness, and therefore precedes its appearance.

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¹ Lennox, *Arch. Neurol. and Psychiat.*, 23, 719 (1931).

Alleged Specific Effects of High-Frequency Fields on Biological Substances

VARIOUS claims for the demonstration of specific electric actions of high-frequency fields on biological substrates, that is, non-thermal effects dependent on wave-length, have already been refuted¹. Attenuation of some bacterial toxins exposed to 1.9–3.7 m. fields, under conditions which appeared to eliminate the influence of the heat developed, seemed nevertheless to indicate the existence of such an athermal action (Szymanowski and Hicks²). Subsequent negative results with different bacteria, etc., led these authors³

to suspect that their previous results might have been due to an undetected local rise of temperature, although a selective heating of small dispersed particles (bacteria, micelles, macromolecules) is improbable because of the rapid heat exchange with the medium⁴.

In these circumstances it was deemed essential to check the positive observations of Szymanowski and Hicks by exposing solutions of bacterial toxins to high-frequency fields of considerable strength under conditions which would strictly limit the rise of temperature. (Szymanowski and Hicks usually allowed a rise of average temperature to about 30° C. Since one surface only of the liquid was cooled, a steep temperature gradient was probably set up across the toxin layer.) The necessary conditions can be defined with some exactitude, and they have been embodied in two experimental arrangements: (a) the 'static' one, in which a film of liquid is enclosed between cooled condenser plates 1 mm. apart, and (b) the 'dynamic' one, in which a column of liquid of diameter 4 mm. is passed through a condenser field (each element being exposed for 0.15 sec.) and cooled during its return to the field⁵.

For the static method we can calculate the maximum rise of temperature in the centre of the film when the voltage across the plates and their temperature are kept constant⁶. With the tetanus toxin solution used in our experiments (conductivity 0.8×10^{-4} ohm⁻¹ cm.⁻¹ at 3° C.) this maximum temperature would, in the absence of convection effects, exceed the plate temperature by 0.17° C. with a potential gradient of 1000 v./cm. and by 2.54° C. with 3000 v./cm. With some simplification, the rate of heating can also be computed for the dynamic method⁷: with conductivities of 0.54×10^{-4} ohm⁻¹ cm.⁻¹ (0.1 per cent solution of tetanus toxin in distilled water) and 1.63×10^{-4} ohm⁻¹ cm.⁻¹ (1 per cent sodium chloride solution) at 20° C. the maximum rise of temperature during one passage through the field of any element of the fluid should be 0.013° and 3.8° C., respectively, for 2500 v./cm. and a wave-length of 3 m.

The value calculated for 1 per cent sodium chloride solution was confirmed experimentally by recording the resistance changes in the exposed region with an a.c. bridge and oscillograph during motion of the fluid: the average rise of temperature was 2–3° C., with a maximum variation of 0.5° C. during the slow phase of the rhythmic movement of the pump. Since the initial temperature was below 3° C., the maximum temperature of the toxin solutions in either method is far below that at which the rate of destruction of the toxin would be significantly increased.

Movement of 16 cm.³ of 0.1 per cent tetanus toxin solution for 4.5 hours at 3° C. in absence of the high-frequency field caused some attenuation, while exposure to a field of 2500 v./cm. at wave-lengths 3.1–3.4 m. produced only a slight additional effect (that is, a slight increase in the minimum lethal dose for mice). In these experiments, however, the toxin was actually exposed to the field for only 17.5 min. A 1 per cent aqueous solution of tetanus toxin kept for some hours in a thin layer between varnished metal plates or walls of Monax glass lost most of its toxicity. This destruction was just prevented by addition of 0.2 per cent of rabbit serum. After exposure of such a film (0.8 c.c.) to the field (1000 or 3000 v./cm., $\lambda = 3.1$ –3.4 m.) for 3 hours, the toxicity was exactly the same as that of the control film. A distinct specific effect, therefore, was absent. A generalization of this result would be premature

before investigations on other toxins of different properties were completed.

It may be added that, contrary to Schliephake's brief statement¹, the viscosity of serum from defibrinated ox blood, protected from undue heating, was not altered after exposure to a 3.6 m. field. The frequency-independent effect predicted by Krasny-Ergen can be expected to occur only during exposure.

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Nov. 24.

¹ See, for example, Curtis, W. M., Dickens, F., and Evans, S. F., *NATURE*, 138, 63 (1936).

² Brymanowski, W. T., and Hicks, R. A., *J. Infect. Dis.*, 50, 1 (1932).

³ Hicks, R. A., and Brymanowski, W. T., *J. Infect. Dis.*, 50, 466 (1932).

⁴ Krasny-Ergen, W., *Radio-logia*, 1, 136 (1937).

⁵ Bathman, J. B., and Rosenberg, H., Report of the Intern. Congr. for Short Waves, Vienna, 1937, p. 129. There are some misprints in the numerical values.

⁶ Schliephake, H., "Kurzwellentherapie", p. 52 (2 Ed., Jena, 1934).

Classification of Taxes and Kineses

IN recent years, the study of animal reactions to elementary physical stimuli has extended greatly, both in the laboratory and in the field. During this process, it has been necessary to modify somewhat Kühn's¹ classification based on the externally observable characteristics of locomotory reactions of this kind. Recent work by Ulliyott² indicates a way in which the classification and terminology can be considerably simplified and improved.

Working on the light reactions of a planarian, *Dendrocoelum lacteum*, Ulliyott showed that the classical avoiding reaction³ can be regarded as a special case of a more generalized reaction. If *Dendrocoelum* is tested in a smooth gradient of light which has no horizontal component, as it moves towards the brighter end it makes increasingly frequent turning movements; if the animal is kept in constant stronger light, the initial higher frequency of turning falls off owing to sensory adaptation. This combination of differential frequency of turning and adaptation leads to aggregation in regions of lower light intensity, provided that the gradient is of suitable steepness. This behaviour can scarcely be described as an avoiding reaction (cf. *Paramecium*, Jennings⁴). Nevertheless, the same mechanism is probably involved when the animal shows an avoiding reaction at the edge of a shadow. The terms *avoiding reaction* and *trial and error* are thus objectionable, not only because they describe a particular form of the reaction and not its general form, but also because they are not sufficiently objective. The term *phobo-taxis* is objectionable too, because the prefix *phobo-* is in common use in English, with an anthropomorphic implication, and because the reaction given this name is the only undirected one which is called a *taxis*.

We therefore propose the following modifications of the nomenclature. Variations in generalized, undirected, random locomotory activity due to variations in intensity of stimulation are *kineses*. Such variations can be of two kinds, namely, changes in linear velocity, and changes in rate of change of direction (Ulliyott's *R.C.D.*) or angular velocity. We

propose to divide kineses into (a) ortho-kineses (*ὀρθός*—direct, forward)—variations in linear velocity (previously called simply *kineses*); and (b) klino-kineses (*κλίνω*—to deviate)—variations in angular velocity. The prefix *kli-no-* is free from anthropomorphic implication. The whole word *kli-no-kinesis* can be used to describe the kind of reaction discussed by Ulliyott, as well as other 'avoiding reactions' and 'phobo-taxes' which have not yet been demonstrated to be either like or unlike it in their details.

If this change is made, the word *phobo-taxis* can disappear, and the word *taxis* can be reserved for directed reactions, formerly called *topo-taxes*. This last word, therefore, also becomes unnecessary, and it is the more desirable to drop it because it is so similar to *topo-taxis* in appearance and sound. We thus propose to add two prefixes to the nomenclature, in *ortho-kinesis* and *kli-no-kinesis*, and to remove two, in *phobo-taxis* and *topo-taxis*, so that the classification is clarified without becoming more cumbersome.

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Nov. 19.

¹ Kühn, A., "Die Orientierung der Tiere im Raum" (Jena, 1919).

² Fraenkel, G., *Biol. Rev.*, 6, 36 (1931).

³ Ulliyott, P., *J. Exp. Biol.*, 12, 265 (1935).

⁴ Jennings, H. S., "Behaviour of the Lower Organisms" (London, 1906).

Variations in Copepod Development

AN interesting phenomenon has just been brought to my notice on reading a paper by Martin W. Johnson on the development stages of *Eucalanus elongatus*¹.

In a paper which I published last year², I described the early stages of this copepod from material taken off the west coast of Scotland. The two descriptions correspond very closely except in one particular, for whereas I found only five stages in the nauplius life (the earliest corresponding to other calanoid nauplii at Stage II), Johnson finds all the six stages represented. Since Gurney in the Discovery Report No. 9 (1924) finds a similar state of affairs in *Rhinocalanus* (that is, only five nauplius stages), I am led to the conclusion that with *Eucalanus* there is a difference in the development between California, where Johnson's material was obtained, and the west coast of Scotland.

In searching for an explanation of these differences, it is natural to turn to the hydrographical conditions of the areas concerned. The Eucalanids are warm-water forms and exist in the colder regions only by virtue of the warm-water currents which bring them there. In both Gurney's material and mine the specimens were taken from water of which the temperature was some 10° lower than that of the area supplying Johnson's material. It seems, therefore, not impossible that the suppression of stages in development might be correlated with temperature, and further observations in this direction should prove of interest, especially as the incubation period of the eggs of *Calanus* appears to be lengthened by

the lowering of temperature. Can it be that in the case of a warm-water copepod species breeding in unusually cool surroundings the incubation period may be so prolonged that the animal emerges from the egg in the second nauplius stage?

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¹ *Trans. Amer. Mic. Soc.*, 58, Jan. 1937.

² *Ann. Mag. Nat. Hist.*, Sept. 1936.

Effect of Spraying Solutions of Growth Substances on the Inflorescences of the Florists' Chrysanthemum

THE florists' chrysanthemum exists in many forms, two of the commonest being normal 'double' and 'incurved'. In both, the inflorescence consists entirely, or almost entirely, of ligulate flowers, but the 'incurved' type is distinguished from the normal 'double' type by the fact that in the former the corollas of the flowers constituting the mature inflorescence remain incurved. Experiments carried out here in which inflorescences of the double chrysanthemum (var. 'Gold Standard') were sprayed with solutions of two growth substances indicate that the difference between these two types of chrysanthemum may be a simple physiological one. The two growth substances used were β -indoleacetic acid (heteroauxin) and α -naphthalene acetic acid. Aqueous solutions of these growth substances of a concentration of 0.05 per cent were sprayed on to partially opened inflorescences by means of an atomiser.

In the unopened bud of the inflorescence the corolla of each flower is rolled longitudinally and folded laterally, and during opening there is a longitudinal unrolling and a lateral unfolding of the corolla of each flower. When partially opened inflorescences are sprayed in the manner described above, corollas which at the time of spraying are mature are unaffected by the treatment. Corollas which at the time of spraying are unrolling exhibit some reversal of movement and become incurved. Corollas which at the time of spraying are still rolled have their normal unrolling inhibited whilst the lateral unfolding proceeds normally and the flower becomes a typical 'incurved' one. The results are the same whether the treatment is applied to inflorescences attached to, or detached from, the parent plant.

Although these experiments have been carried out with synthetic growth substances, the resemblance between the effect of natural auxin and synthetic growth substances in other directions is so striking, that it appears possible that one of the fundamental differences between normal 'double' and 'incurved' chrysanthemums may be a difference of growth substance metabolism.

With single chrysanthemums (vars. 'Single Bronze' and 'Cleopatra') a similar inhibition of corolla unrolling has been obtained, whilst in the latter variety some 'outcurving' of apparently mature corollas was noticed.

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Nov. 7.

Force Constants and Molecular Structure

IN previous papers¹ we have described measurements on the ultra-violet absorption spectrum of carbon suboxide, and have attempted to calculate the force constants of the linkages in this molecule from the measured normal vibration frequencies. A potential function was employed involving four constants, two of these representing 'cross-term interactions'. Unfortunately, at the time only the two symmetrical frequencies ($\nu_1 = 843$, $\nu_2 = 2,200$) were known accurately from the Raman data, and it was necessary to assume plausible values for the cross-term constants in order to obtain values for the main constants. Lord and Wright² have now published infra-red data from which the two unsymmetrical frequencies may be deduced ($\nu_3 = 2,280$, $\nu_4 = 1,570$). We thus have four frequencies and four undetermined constants. Insertion of the values gives $k_{00} = 12.89 \times 10^5$, $k_{02} = 15.0 \times 10^5$, $k_{22} = 5.10 \times 10^5$, $k_{12} = 2.43 \times 10^5$. k_{22} and k_{12} represent C—C—C and O—C—C interactions of the type previously suggested.

The new values of the main constants differ slightly from those previously found, but strengthen the hypothesis then suggested, that the bonds are intermediate between double and triple and that the molecule appears as a resonance hybrid. Moreover, the relatively high value of the interaction term k_{22} in such a molecule is in accordance with other related results, for which a reason was previously suggested. When applied to the relations of Badger and Clark connecting force constant and bond length³, the new values of the force constants give good agreement and much better than the old. We find for the C—C bond, with Badger's formula $r = 1.18$ Å., with that of Clark $r = 1.165$ Å., the electron diffraction value being 1.20 ± 0.02 Å.; for the C—O bond $r = 1.21$ Å. (Badger), 1.265 Å. (Clark) and 1.29 ± 0.03 Å. (observed).

We should like here also to refer to a recent note in NATURE by Bailey and Hale⁴ which seems to misinterpret calculations we have recently made of the force constants of linkages in ethylene and tetrachloroethylene⁵, and to raise objections which are invalid. Bailey and Hale point out the necessity of removing uncertainty as to what any particular force constant implies, and also the necessity of considering as far as possible molecules of the same symmetry type. They also refer to the difficulties involved in using a too artificial force field and point out that the calculations only refer to infinitesimally small amplitude. These matters, with others, are fully discussed by us in our detailed papers, and some of the arguments of Bailey and Hale are precisely those which are used by us. So far as the subsequent calculation for the case of ethylene and tetrachloroethylene is concerned, its merits and demerits are fully discussed by us in the paper referred to.

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¹ *Proc. Roy. Soc., A*, 157, 331 (1936); *J. Chem. Soc.*, 1301, 1384 (1937).

² *J. Chem. Phys.*, 5, 642 (1937).

³ *J. Chem. Soc.*, 1306 (1937).

⁴ NATURE, 130, 112 (1937).

⁵ *J. Chem. Soc.*, 1376, 1384, 1393 (1937).

Races with a High Proportion of Blood Group AB

In a "Research Item" in *NATURE* of October 2, the failure of Miss Macfarlane to confirm the high percentage of Group AB previously found in Tibetans is reported. May I quote another race with a high proportion of Group AB?

In an investigation of 1,000 Soussoux in French Guinea, J. S. de Goldflem¹ obtained the following results.

BLOOD GROUPS OF SOUSSOUX				
	No.	O	A	B
Adults	500	1%	1%	9%
Children	500	1%	1%	9%

This race is of interest in that the percentage of AB exceeds 50 per cent which is the theoretical maximum in a stable race, for, where p , q and r are the frequencies of genes A, B and R respectively, then $p + q + r = 1$ and $2pq = AB = \text{a maximum} = 0.50$, where $p = 0.50$ and $q = 0.50$.

A race having this group distribution could arise as the result of the mating between a race having more than 90 per cent A on one hand and a race having more than 90 per cent B on the other, but this group distribution would only appear in the first generation—and stability would be reached in the second. For example, in the race in question, the A and B children arising from the matings between AB and AB only would form nearly 40 per cent of the total children, using the formula:

$$A \text{ children from } AB \times AB \text{ matings} = 100 \frac{(AB)^2}{4}$$

per cent of total children.

A mutation occurring in this race at the present time could not, I think, give rise to this phenomenon.

It must be pointed out that Beth Vincent's technique was used for this observation.

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Nov. 11.

de Goldflem, J. S., *O.R. Soc. Biol.*, 123, 391 (1936).

Anomalous Dielectric Constant of Artificial Ionosphere

APPROPOS our letter in *NATURE* of October 2, p. 586, it has been pointed out to us by Prof. E. V. Appleton and Dr. F. W. Chapman that though the curves delineating the variations of μ^2 with N and $1/f^2$ are quite correct, they cannot, however, be regarded as showing the relation between K and N , or $1/f^2$. In fact μ^2 can be identified with K only when $v = 0$. In the general case, for a conducting medium, $\mu^2 = K + \frac{c^2 k^2}{p^2}$. Thus, though μ^2 can take up values both greater and less than unity, as depicted in Figs. 1 and 2 of our letter, K cannot do so because $\mu^2 - \frac{c^2 k^2}{p^2}$ can only have values equal to or less than unity.

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Points from Foregoing Letters

A TABLE showing the amounts of radioactive phosphorus (relative to the total phosphorus) in the yolk of eggs, the liver and the blood of a hen, 28 hours after it had been administered by subcutaneous injection, is submitted by L. Hahn and Prof. G. Hevesy. From the present and previous experiments the authors infer that the liver of the hen (and not the blood corpuscles) is responsible for the formation of the phosphatides. These are then carried by the plasma to the ovaries.

A curve showing the usual form of the phase variation of the abnormal component of low-frequency radio waves near sunset is given by K. G. Budden and J. A. Ratcliffe; also an example of a type of disturbance of the curve which, the authors find, is connected with 'fade-outs' or with magnetic anomalies. They conclude that a 'catastrophic' ionospheric disturbance decreases the reflection height of the low-frequency waves.

By applying a magnetic field (16 gauss) to a low-pressure bulb containing 'gas' ionized by short radio waves (6 m.), E. W. B. Gill has been able to reduce considerably (to 1/10th) the ionizing potential needed for producing an electrodeless discharge. The author states that his experiments confirm Prof. V. A. Bailey's theory on what happens to wireless waves in the upper atmosphere.

J. W. Thompson, Wm. Corwin and J. H. Aste-Salazar find that, as compared with normal persons, the mentally unbalanced (schizophrenic) individuals show less physiological susceptibility to changed

external conditions. Generally speaking, they have regular respiration, small tidal air and cardiac output, low blood pressure, low basal metabolic rate, high arterial carbon dioxide and low oxygen saturation.

The activity of tetanus toxin is found by Drs. J. B. Bateman, H. Loewenthal and H. Rosenberg to be unaffected by a high-frequency field (radio waves of 3 m. length and potential gradient of 2,500 v./cm.) when conditions were such as to prevent heating.

Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou propose alterations in Kuhn's classification of animal reactions. The new terms make clearer the relations between the various reactions, they are not anthropomorphic like some of those discarded, and confusion between them no longer arises from their similarity of pronunciation.

Dr. S. G. Gibbons directs attention to observed differences in the development of the copepod *Eucalanus elongatus* in Californian as compared with Scottish waters. He asks if it is possible that the colder temperature of the water off the west of Scotland may prolong the incubation period so that the animal emerges from the egg in the second nauplius stage.

Using recent additional information on the infra-red spectrum of carbon suboxide, Dr. H. W. Thompson and J. W. Linnett have recalculated the force-constants of the linkage in the molecule of that compound. The new values, they state, strengthen the hypothesis that the bonds are intermediate between the double and the triple types.

Research Items

Sinanthropus VI

SOME important inferences are drawn by Prof. Franz Weidenreich (*Bull. Geol. Soc. China*, 16; 1936-37) from fragments of a skull of Peking man designated as *Sinanthropus* VI, which have been brought together in the laboratory from material collected in the Choukoutien cave from 1934 onward. These consist of a fragment of a right temporal bone, comprising the ear aperture and adjacent parts (belonging apparently to the same skull as the left temporal bone and adjacent parts found in 1934 and already described), three teeth, two molars and a premolar, as well as two fragments of a skull, of which one is the greater part of a left parietal, while in material from the same level as the three teeth were the right side of a frontal bone and the anterior part of the squama of a right temporal bone. It is considered certain that all these pieces belong to one and the same skull—an adult (old) female. From these fragments it has been possible to form a general idea of the contour of the frontal portion of the skull, which on comparison with *Sinanthropus* I and *Pithecanthropus*, shows much less curvature than Skull I in the sagittal planes and approaches very closely to the frontal bone of *Pithecanthropus*. In a frontal direction between the inferior temporal lines of both sides, it is less curved than Skull I and indeed is even flatter than *Pithecanthropus*. On a profile view, Skull VI coincides practically in all its lines with those of *Pithecanthropus*. A further discovery is a very small fragment, in certain respects, however, of very great importance. This is the right moiety of the posterior arch of an atlas. There cannot be any doubt that this is a human first cervical vertebra, and that it belongs to *Sinanthropus*. It does not display any distinct fundamental difference when compared with that of recent man. Its interest lies in the fact that it adds support to the view put forward on the evidence of the absence of long bones from the cave, that the skulls were brought into the cave by man and were there broken at the base or split open in order to get at the brains.

Bull Culti of Ancient Egypt

A DISCOVERY which should be of considerable interest for the study of the bull cult in ancient Egypt, when fuller details are available, is reported from Cairo. Dr. Drioton, director-general of antiquities, it is reported by the correspondent of *The Times* in the issue of December 13, has announced the discovery near Zagazig of twelve large granite sarcophagi, which had formerly contained the mummies of sacred bulls, dating from the fourth century B.C. Although these tombs had suffered, presumably from the activities of grave robbers, the internal decoration of three of the sarcophagi is said to have been sufficiently well preserved for it to be possible to make out that they dealt with the future destinies of the sacred bulls, an aspect of the bull cult which thus becomes known for the first time. According to Dr. Drioton's report, it would appear that the sacred bulls were introduced by their patron divinities into the assembly of all the gods. Further, that the outstanding feature of the posthumous destinies of the sacred bulls was their reunion with

the moon. This is new to Egyptology. Near the sarcophagi of the sacred bulls were found small chambers, in which were mummies of sacred falcons, with their eggs buried beside them in jars. Further excavations are to be carried out on the site.

Temperature and the Growth of *Drosophila* and of *Lymnaea*

THE influence of temperature on the dimensional characteristics of *Drosophila melanogaster* has been investigated by several biologists. These studies concern only the final growth stage, while growth and development of this insect in the larva and pupa form the subject of a recent paper by Mr. Takeo Imai (*Sci. Rep. Tohoku Imp. Univ.*, 4th Series (Biology), 11, 403-417; 1937). It is shown that temperature influences the larval length, length of mouth armature and pupal length, in that high temperature causes a diminution of their dimensions. Two diverse hypotheses are held in regard to the explanation of thermal effect on size. In one case, it is considered to be dependent on the nutritional condition; diminution of size at high temperature is the result of a deficiency of food. In the other, it is maintained that the thermal effects result in modification of the chemical equilibrium. This latter view is held by the author, who suggests that high temperature produces effects that are connected with modification of the metabolic balance of the growing system; or, in other words, the balance between anabolism and katabolism is suggested as the cause of the morphological differences described. In a second paper in the same journal (pp. 418-432) the author formulates the same explanation with regard to the effects of temperature on larval shell size in the mollusc *Lymnaea*. It appears that growth of the larval shell occurs in two cycles, but while higher temperatures cause acceleration of development, the final shell size is diminished at both growth-cycles.

Associated Growth of Herbage Plants

A SERIES of three very interesting papers upon the physiology of pasture grasses when grown in association with legumes has been received from Australia (*Bull. Council for Sci. Ind. Research*, No. 105. Pp. 40+10 plates. Melbourne, 1937). A first paper by Messrs. H. C. Trumble and T. H. Strong indicates that no evidence has been obtained for the view that grasses are able to derive nitrogen from associated legumes during the vegetative stages of the latter, though the subsequent decay of nodules releases nitrogen to the soil. The other papers are written by Messrs. H. C. Trumble and R. E. Shapter, and discuss the physiology of specific associations of grasses and legumes. Yield of Wimmera rye-grass is increased by manuring with both phosphorus and nitrogen, whilst the yield of subterranean clover is raised by phosphorus only. The mixture gives increased yield with phosphorus at all levels of nitrogen. Many other results are given in detail, and the practical conclusion is that the greatest increase in production from the podsolized soils of southern Australia is to be obtained from liberal dressings of soluble phosphate to an associated crop of grass and suitably inoculated legume. The third paper shows that a perennial grass, namely, *Phalaris tuberosa*, may obtain considerable

nitrogen from an associated annual legume such as *Medicago denticulata*, which grows rapidly, and presumably begins to decay at an early stage. The grass obtains approximately 30 per cent of the nitrogen present in the root system of the legume in this particular combination.

Genetics of Rice

THE genetics of rice is receiving considerable attention in India. Mr. B. S. Kadam crossed a wild Bombay rice, which sheds its grains completely, with a non-shedding Burmese variety (*Proc. Indian Acad. Sci.*, 14, No. 3). He found the shedding character completely dominant and caused by two duplicate genes. Ramiah and Rao, in a similar cross in south India, found the F_1 intermediate, and evidence of more than one gene. Mr. Kadam also found (*J. Indian Bot. Soc.*, 14, No. 2) that in a Burmese variety which develops anthocyanin in its roots when exposed to sunlight, the condition was determined by two complementary genes, A , without which no colour can appear in the plant, and R , a specific gene for root colour. By crossing two Indian varieties (*J. Heredity*, 27, No. 10) he found that one possessed a gene which produces red pigment throughout the plant, while the other contained an inhibitor which prevented anthocyanin developing in the leaf blades. Messrs. Kadam, Patil and Patankar (*Indian J. Agric. Sci.*, 7, No. 1) found from various crosses of rice varieties no hybrid vigour in respect of height, tillering, panicle-length or weight of the plant, but an increased yield in some crosses.

Atomic Weight of Carbon

THE atomic weight of carbon has been changed in the current report of the Committee of Atomic Weights of the International Union of Chemistry from 12.00 to 12.01, largely on the basis of gas density and mass-spectrograph measurements, which were confirmed by Baxter and Hale (1936-37), who obtained the value 12.010 from the combustion of hydrocarbons. A. F. Scott and F. H. Hurley (*J. Amer. Chem. Soc.*, 59, 1937) have now determined the ratio of benzoyl chloride to silver, the chloride being hydrolysed and precipitated as silver chloride. With the current international values for hydrogen, chlorine and silver, the value $C = 12.0102$ was found. With the value $H = 1.0081$, the value becomes $C = 12.0100$, and the same figure is obtained if 107.879 is used for silver. The same authors (*ibid.*, 2078) have used the value $C = 12.010$ to recalculate the atomic weight of sodium from the ratios involving sodium carbonate. With the current international values for silver, bromine and iodine, three values of 22.993, 22.993 and 22.994 are obtained, about 0.003 lower than the international value for sodium of 22.997, but in agreement with the value 22.994 found by Johnson in 1933 from the ratio $NaCl : Ag$. No mass-spectrograph value is available.

Magnetostriction

WHEN magnetic material is placed in a magnetic field, small changes in its physical dimensions take place. This phenomenon is known as magnetostriction, and although studied by Kelvin and Bidwell about seventy years ago, it is only recently that it has attained both theoretical and practical importance. It is applied usefully in practice in connexion with the magnetostriction oscillator and the magneto-

striction echo-depth recorder. There are other physical phenomena connected with it, such as the changes it brings about in the magnetic properties of the material, known as the Villari effect. In soft iron, for example, the permeability is increased in weak fields but in strong fields it is weakened. This is usually referred to as the 'Villari reversal'. In the *Beama Journal* of October, W. Alexander and J. Swaffield describe some of the practical applications of magnetostriction. An important application due to Pierce is to use it for starting and controlling electrical oscillations. A special valve oscillator works on this principle. The magnetostriction echo-depth recorder is used for taking soundings at sea and has now reached the commercial stage. The principle is to transmit through the hull of the vessel a high-frequency sound impulse generated in a special type of magnetostriction oscillator. This is reflected from the sea-bed and recorded by apparatus similar to the transmitter but acting in the inverse way, the sound impulse being converted into an electrical one. After amplification and rectification, the voltage produced is applied to a chemical recorder and produces a mark on paper. The time which elapses between the transmission of the impulse and the marking of the paper is a measure of the depth at any instant. Thus the chain of dots forms a continuous trace giving the configuration of the sea-bed. In the United States a magnetostriction oscillator has been developed which produces intense audible vibrations of frequencies of 8000 cycles per second, capable of fracturing glass and of producing useful bactericidal effects.

An Annual Change in Longitude

IN *Mon. Not. Roy. Astro. Soc.*, 97, 9, October 1937, Dr. Frank Schlesinger has a paper with the above title, in which he disputes the conclusions of Loomis and Stearns that longitude changes between Washington and Greenwich as well as Paris are correlated with the hour-angle of the moon. Kawasaki showed quite recently that these changes in longitude could be equally well represented by an annual term which is completely independent of the position of the moon, and Schlesinger now treats the whole material as a unit. His results show that the evidence is in favour of the annual hypothesis as against the lunar, and he seeks for some causes for the annual change in longitude. Consideration is given to the wanderings of the earth's pole of rotation with respect to a fixed axis in the earth, and this would give rise to variations in latitude, longitude and also in azimuth. The latitude variations have been well observed at the Cape Observatory, Washington and at other places, and a simple expression is given which connects longitude and latitude changes. Using this for Washington, differences of longitude are computed between this station and Greenwich as well as Paris. On comparing these with the observed differences, the agreement is as close as might be expected between Washington and Paris, but is not so good between Washington and Greenwich. It is suggested that the polar motion is at least a partial explanation, and may be a complete explanation of the longitude changes which have been found to exist between Paris and Washington. Large differences between Paris and Greenwich still exist, and if these could be cleared up the polar motion could practically be accepted as an explanation of the Greenwich-Washington changes in longitude also.

British Institute of Radiology

ANNUAL CONGRESS AND EXHIBITION

THE eleventh Annual Congress and Exhibition of the British Institute of Radiology was held, as usual, at the Central Hall, Westminster. The Congress was opened on December 8 by the president, Dr. R. J. Reynolds, in the presence of Her Majesty Queen Mary, who, before the opening ceremony, made a tour of the Exhibition and took a great interest in the various items shown.

The papers read at the Congress dealt with X-rays in industry, the medical ones treating the use of X-rays in industrial diseases, and the physical papers dealing with X-rays in industrial research. The latter symposium, held on December 9, was opened by Dr. G. Shearer, who pointed out that technical advances in materials followed largely on advances in the detail with which the materials could be studied. Great progress had followed improvements in the microscope, while the development of the 'X-ray microscope', which revealed the inner structure of materials, had resulted in further striking developments. Among the main properties of solids revealed by X-ray methods were their compositions, grain sizes, the orientations of the constituent crystals and their states of perfection. As examples, he quoted the importance of grain size in paints and electrolytic deposits, and stated that imperfectly formed crystals were desirable in steels intended for permanent magnets and perfectly formed crystals for transformer steels.

Dr. H. J. Gough and Mr. W. Wood read a paper on the use of X-ray methods in the investigation of failure in service, which dealt with one phase of the problem of fatigue. Stressing the importance in design of an accurate knowledge of the strengths of materials, the authors pointed out that apparent strengths depended markedly on whether the stresses were continuous or cyclic. From a knowledge of atomic constitution it was possible to deduce values for the strengths of materials, but these were usually found to be far greater than those obtained in practice. It had been thought that the discrepancy was possibly due to flaws, but in that case it was difficult to understand how relatively consistent values of the strengths could be found. Even before X-ray studies were undertaken, it had been found that the failure might be due to some change in the micro-structure of materials, particularly of metals. X-ray studies of stressed metals had shown that the sizes of the crystal grains remained constant over the region in which Hooke's law was obeyed, but at the yield-point there was a break-down in the crystal grains, which continued until a more or less homogeneous 'crystallite' structure was obtained. This breaking-down of grains seemed to give a power of accommodation to the material, and fracture only occurred when all the grains had broken down and the accommodatory power ceased. With cyclic stresses similar phenomena were observed, with the important difference, at present not understood, that deterioration of the material in this case is local, whereas with continuous stresses it is general. The authors stated that many problems remained unsolved, one of the most important being the reason for the

crystallite structure, which implies a kind of 'crystal molecule'.

Dr. W. T. Astbury discussed X-rays and wool fibre, pointing out that wool, in common with other organic materials such as hair, horn, muscle, etc., consists of bundles of long polypeptide chains somewhat like a 'sliver' of wool on a minute scale. Wool, he said, is characterized by great elasticity and in favourable circumstances can be stretched to twice its natural length, and will recover when the stress is removed. Study of the material by X-rays and by other methods showed that wool has a kind of 'step-ladder' structure consisting of long chains of molecules, cross-linked by side chains. The chains were normally folded, but in the presence of water the chains could be straightened and would recover. This accounted for the power of recovery of shape by woollen garments after stretching when wet. At higher temperatures (steam) the side-chains were hydrolysed, and the material largely lost its power of recovery. This fact was made use of in various industrial processes including the 'permanent' waving of hair. X-ray studies had revealed clearly two definite states, normal and hydrolysed, and had shown the underlying nature of the change.

Dr. A. J. Bradley and Mr. H. Lipson read a paper on a 'Rapid Survey of Ternary Alloy Systems by X-rays', pointing out that at present it is not known why the various alloys of three metals, for example, copper, nickel and iron, have such varied properties. The crystalline form of the alloys is usually cubic and most commonly consists of face- or body-centred cubes, and often a mixture of both. Although microscopic examination will show the main features of the systems, careful X-ray examinations are necessary to find the complete diagram, as in many cases the various zones are very narrow. The authors stressed the particular necessity of studying the alloys in great detail so that the finer points should not be missed.

The twentieth Silvanus Thompson Memorial lecture was given by Prof. J. A. Crowther, his subject being 'The Biological Action of X-rays: a Theoretical Review'. Pointing out that, on account of simplicity of experiment, most recent research had been carried out with single-celled materials, Prof. Crowther said that the cells showed marked variations in radio-sensitivity during their life-history, young cells being more sensitive than older ones and cells about to divide being particularly sensitive. Lethal doses of X-rays ranged from 40 röntgens for the most sensitive states to 35,000 röntgens in the insensitive states. Intermediate doses, insufficient to cause the death of the cell, may prevent normal cell-division and may produce mutations. It appears that the sensitive unit is not the complete cell or its nucleus, but some smaller structure, possibly sub-microscopic in size. This might account for the insensitivity of normal cells, which are virtually homogeneous structures.

Considerations of the energetics show that such effects can only reasonably be expected on the basis of a localized quantum action. Two theories of the mechanism of radiation-action had been put forward,

one based on the possibility of a poison being formed, and one suggesting a direct or 'bullet' action, which may be due to the direct action of the quantum of radiation energy, to the production of an ion-pair or to the passage of an electron track through the sensitive part of a cell. Consideration of wave-length effects should ultimately show which is the true explanation.

Dealing with the two theories as to the mechanism, Prof. Crowther pointed out several objections to the poison theory: the objection that the amount of poison was small (100 r. producing a concentration of the order of 1 poison molecule in 10^6 normal molecules) was not considered valid, but other evidence concerning temperature effects, variations of effects with dosage rates and times seemed to point against the theory. Further, the known survival and mortality curves could only be considered consistent with the poison theory on the basis of certain unlikely

assumptions. On the other hand, the 'bullet theory' rationally explained most of the observed facts, including the insensitiveness of the reactions to temperature variations. In due course it might be hoped that the mechanism would be understood, and at present Prof. Crowther thought that possibly the root cause of radio-biological action might be found in the variations of the electric charges on colloidal particles when irradiated.

The Research Section of the Exhibition contained exhibits from fourteen individuals and institutions, illustrating research in technical, biological and physical problems, and included examples of early apparatus and radiographs. In the Industrial Exhibition was shown a commercial X-ray tube for operation at 1,000 kilovolts. In this tube the electrons are excited in three stages, each of 400 kilovolts, and the tube may be operated either with one pole earthed or in the balanced arrangement.

Nicotinic Acid and the Pellagra-Preventing Vitamin

IN an address to the Birmingham University Biochemical Society, on December 9, Dr. Leslie Harris, of the Cambridge Nutritional Laboratory, referred to the findings in some current work on the chemical nature of the pellagra-preventing factor.

Dr. Harris said that the suggestion of a connexion between nicotinic acid and 'vitamin B' is not a new one. About twenty-four years ago, Funk in England and Suzuki in Japan succeeded in isolating nicotinic acid from active 'anti-neuritic' concentrates, and it was once supposed that nicotinic acid might in some way be related to vitamin B₁. But later investigations proved conclusively that pure nicotinic acid itself had no anti-neuritic action, and there the matter was left for some years, although the possible physiological importance of nicotinic acid was emphasized by the discovery of Euler that the acid amide of nicotinic acid is a component of cozymase. Recently, however, it has been found that nicotinic acid or its amide has a growth-promoting action for certain micro-organisms (Knight, Mueller, Holiday), and for pigeons or rats kept on various diets deficient in some portion of the B₁ complex (Funk and Funk; Frost and Elvehjem). Special importance attached to the statement of Elvehjem and his co-workers that nicotinic acid or its amide was curative of 'blacktongue' in dogs; and work has now been done to link these new results with observations made at the Cambridge Nutritional Laboratory a year or so back. Here experiments by Birch, Gyorgy and Harris showed that what had hitherto been called 'vitamin B₁' consisted in reality of three distinct factors, namely, lactoflavin, vitamin B₁ (the 'rat dermatitis factor') and the pellagra-preventing (P.P.) factor proper. The latter appeared to be identical with the 'anti-blacktongue' factor for dogs. More recently, Harris confirmed these results as to the tripartite nature of the 'vitamin B₁' complex and showed furthermore that monkeys also developed a disease ('monkey pellagra') analogous with human pellagra when restricted to a diet deficient in the P.P. factor but containing the other known constituents of the B₁ complex.

A trial of nicotinic acid on monkeys which were developing symptoms of nutritive failure on a diet deficient in the P.P. factor has now indicated that this substance has in fact a curative action: further work is needed, however, to ascertain whether nicotinic acid is the sole deficiency in such a diet. Nevertheless, these results and the findings of other workers seemed sufficiently encouraging to warrant a trial on human beings suffering from pellagra.

Through the collaboration of Dr. A. Hassan of the Faculty of Medicine, Cairo, tests under controlled conditions have been made on pellagrins in Egypt. In preliminary trials, two cases of spontaneously occurring pellagra at the Khanka Asylum and three at Abuzaabal Prison were examined, together with three controls. All variables, such as the composition of the basal diet, the amount of work done daily, and the extent of exposure to sunlight were kept unaltered for all subjects. Nicotinic acid given by mouth up to a maximum level of $\frac{1}{2}$ gm. daily was found to hasten the subsidence of the erythema in all the cases. At the asylum, the general condition of the pellagrins was likewise improved, but at the prison the beneficial effect seemed largely limited to the specific action on the erythematous lesions. It may safely be concluded therefore that the nicotinic acid duly rectified a deficiency in these pellagra-producing diets. The results make it seem likely that the prison diets were deficient in some additional factor, and in fact the asylum diet did contain more meat, more greens, was better prepared and included some wheaten bread—the bread at the prison consisting of one quarter of maize. The possibility has therefore still to be borne in mind that nicotinic acid is not the sole major deficiency in some pellagra-producing diets—in other words, that pellagra as sometimes seen may be accompanied by more than one dietary error. Apart from this, it seems probable that nicotinic acid (or amide) is the less active form, or 'precursor' of a more active variation of the P.P. vitamin, which can be formed from it within the animal body.

Cellulose, Starch and Glycogen

A VALUABLE article on recent work on cellulose, starch and glycogen, by Prof. H. Staudinger, has appeared in a recent issue of *Die Naturwissenschaften* (25, 673; 1937). The fact that cellulose, starch and glycogen can be converted into esters without altering the degree of polymerization, and can be reconverted into the original substances, as shown by molecular weight determinations, optical rotation and other properties, shows that the glucose residues in the colloidal particles of these substances are linked by principal valences. The colloidal particles are therefore macro-molecules. The determination of the molecular weights of these substances is discussed. The ebullioscopic and cryoscopic methods are difficult to apply owing to the smallness of the effect, and other anomalies; but molecular weights can be satisfactorily determined from osmotic pressure data using the equation of Schultz, or by Svedberg's method using the ultra-centrifuge. It is also possible to determine them from viscosity data by an equation due to Staudinger. All these methods agree in giving a value about 200,000 for the molecular weight.

X-ray analysis shows the molecule of solid cellulose to be extended, and there is reason for believing that this is also the case in solution. Viscosity determinations show, however, that in starch there is a bending back of the molecules. Starch molecules are only about one eighth as long as they should be if extended. With glycogen,

solutions of the same concentration have the same viscosity, no matter what the degree of polymerization. This points to the existence of spherical macromolecules in this case. The linking of the glucose residues in these three compounds is discussed, and the connexion between physical properties and the shape of the molecule is emphasized.

Colloidal particles can be classified into two groups, linear and spherical colloids, according to the shape of the particles. The latter are powders in the solid state, and dissolve in water without swelling to give solutions of low viscosity. Linear colloids, on the other hand, are tough, fibrous substances, which dissolve with considerable swelling, and form viscous solutions. Glycogen is a typical spherical colloid, and its physical properties are not greatly altered by change in the size of the molecule. Cellulose is a typical linear colloid, and the physical properties depend a good deal on the size of the molecule. Starch occupies a position intermediate between cellulose and glycogen. A similar difference in structure of the macro-molecules is found in the case of the albumens.

The form of the macro-molecule of polysaccharides and albumens decides the different functions of these substances in the living organism. Cellulose forms the solid portions, whereas substances which have to be transported through the organism are spherical colloids.

Twenty-one Years of Glass Technology

THE subject of the presidential address delivered to the Society of Glass Technology at its twenty-first anniversary meeting at Sheffield by Prof. W. E. S. Turner was "Twenty-one Years. A Professor Looks Out on the Glass Industry". This address has now been published (Society of Glass Technology, Sheffield. Pp. 70+46 tables. 10s.; postage 3d.). Whilst its introductory and short concluding chapters are concerned mainly with the growth and development of the Society of Glass Technology and its international relationships, the major portion is occupied with an account of the great advances, mechanical, chemical and physical, which have revolutionized the ancient craft of glass-making throughout the world. The volume is one for the student of social history and of commerce as well as for those interested in the advances of applied science.

That the development of the completely automatic machine has been the dominant factor in influencing conditions in the industry during the period under review is brought out clearly by means of a carefully collected mass of evidence. The tendency to mechanization was already evident before 1910, as, for example, in the Owens' bottle machine which was brought to a commercial stage in the early years of the century, and by 1914 was in operation in ten European countries as well as in the United States. But its use was limited to a small number of licensees, and similar conditions

prevailed with the few machines available in other sections of the industry.

During the intervening years, mechanical progress has been very rapid, and there are now in wide use seven or eight different types of bottle machine, as well as automatic machines for the manufacture of tumblers and other domestic ware, plate and sheet glass, electric lamp bulbs and tubing. The change has led to an enormous increase of productive power, as is evidenced, for example, by a growth of the annual output of containers in Great Britain between the years 1924 and 1935 by sixty-two per cent, or to take a still more striking example, of an increase of machine-made electric lamp-bulbs in Europe from $2\frac{1}{2}$ millions in 1919 to 127 millions in 1932.

Concurrently with the advance of the machine has been the steady disappearance of the skilled glass-blower, for a single bottle machine may equal the output of more than fifty men, and, to take an extreme case, the most modern lamp-bulb machine, the Corning 399, has produced more than 500,000 bulbs daily, equivalent to the production of 500 glass-blowers. The same tendency has not been at work in other branches of labour, for there is evidence even of a slight improvement in total employment in the industry, due to the great increase of sales of glassware, largely induced by the cheapening of production, for which the machine has been primarily responsible.

Two other consequences have issued from the increased use of machinery. The first is the ousting of the small works and the concentration of production to an increasing degree in fewer but larger factories (the number of window glass works, for example, in the United States fell from 79 in 1919 to 18 in 1933). A second result has been a rapid world-wide spread of the industry, for the recent growth in many additional countries, of which Japan is an outstanding example, would not have been possible if it had depended on a supply of skilled glass-blowers.

With the development of machine production, and indeed rendered necessary by it, there has been a corresponding improvement in furnaces and refractory materials, in feeding devices for molten glass, and in lehrs for annealing the finished product.

In the striking advance here so admirably illustrated, the chemist and physicist, in addition to the engineer, have played a decisive part. To them has fallen such tasks as providing purer and more varied supplies of raw materials in ever-increasing quantities, and exploring the relationships between the chemical composition and chemical and physical properties of glasses so that a material most suitable for each type of production might be obtained. But the attention of the technologist has been by no means confined to the field of mass production, and a number of fresh developments in various fields during recent years testify to his industry. Among them may be cited 'Vita' glass, Safety glasses, Pyrex glass, Vitrolite, glass building bricks and modern glass wool or silk.

These and other advances in the art and science of glass-making have been reflected in the marked growth of technical training and research institutions and in the copious output of valuable literature, of which the *Journal of the Society of Glass Technology* is a striking example.

Science News a Century Ago

Debate on Civil List Pensions

In the House of Commons on December 19, 1837, Mr. Rice, the Chancellor of the Exchequer, moved that the Civil List Bill be read a third time. To this, Mr. Grote, the historian, then M.P. for the City of London, replied by moving an amendment that the clause empowering Her Majesty to grant a certain sum [£1,200] annually should be struck out. He maintained that pensions ought no longer to be assigned at the mere arbitrary and irresponsible will of the Sovereign. The proper distribution of these involved a great public duty, and the House should take them under its control.

Sir Robert Peel, speaking against the amendment, said that the sum of £1,200 as a provision for the United Kingdom was too limited. The honorable gentleman [Mr. Grote] would do away with pensions altogether, but cases would arise—cases where it would be proved that men of science had devoted the energies of their minds and fortunes for the benefit of society, and then the country would revolt against the niggardly conduct of Parliament. A pension and an honorary dignity were on the same principle awarded by the Crown. Literary and scientific men should, in his opinion, receive pensions if they stood in need of them; if not, they should receive those conventional distinctions, which the Crown alone should have the power of conferring. Mr. Buller, the member for Liskeard, who agreed in

the main with Sir Robert Peel, said it was almost impossible to point out one instance of a person who had benefited his posterity either by his writings or his advancement of science, from the time of Chaucer to the present day, who had not been supported by either the bounty of the Crown or the charity of some individual.

In the course of the debate, references were made to Locke, Johnson, Southey, Wordsworth, Coleridge, Dalton, Wollaston, Airy and Mrs. Somerville. Mr. Buller also referred to the case of 'Mr. Wallace, who had been for many years Professor of mathematics at Edinburgh, and who was second only to Ivory in his talents or attainments, and yet when he applied for a pension he was refused: he considered this a cruel case.' Mr. Grote's amendment was lost by 23 votes to 125.

Faraday's Experimental Researches

At a meeting of the Royal Society on December 21, 1837, Faraday continued the reading of his 'Experimental Researches in Electricity', Eleventh Series. The reading of the paper had been begun on December 14 and its concluding portion was read on January 11, 1838. The official abstract said: "The object of this paper is to establish two general principles relating to the theory of electricity, which appear to be of great importance: first, that induction is in all cases the result of the actions of contiguous particles; and secondly, that different insulators have different inductive capacities. . . . In conclusion, the author remarks, that induction appears to be essentially an action of contiguous particles, through the intermediation of which the electric force originating or appearing at a certain place, is propagated to or sustained at a distance, appearing there as a force of the same kind and exactly equal in amount, but opposite in its direction and tendencies. Induction requires no sensible thickness in the conductors which may be used to limit its extent. . . . But with regard to dielectric or insulating media, the results are very different; for their thickness has an immediate and important influence in the degree of induction. As to their quality, though all gases and vapours are alike, whatever be their state, amongst solid bodies, and between them and gases, there are differences which prove the existence of specific inductive capacity."

Naturalists in Abyssinia

"FRENCH and German naturalists," said the *Athenaeum* of December 23, 1837, "are overrunning Abyssinia in all directions. Letters have just been received from Schimper, who was sent by the Württemberg Naturalists' Society, to Africa. After sending home a collection of plants from the Hedjas and Mount Sinai, he arrived at Massawa in January, where great obstacles were raised to his prosecuting his journey, by the recent circumstance of two French travellers having been killed in Abyssinia. However, he succeeded in reaching Arkiko and Haley, and thence sent on to the Abyssinian King Wabeah, who was encamped at Harabo, between Adowa and Axum, for permission and safe conduct. This was granted, and he was soon welcomed at Adowa, the king's capital, by the German missionaries, sent from England; Blunhardt and Isenberg. From thence he intends to prosecute his scientific tour to the Abyssinian Alps." Wilhelm Schimper was born in Mannheim in 1804 and died at Adowa in 1878.

Societies and Academies

London

Royal Society, December 9.

R. W. GURNEY and N. F. MOTT: Theory of the photolysis of silver bromide and the photographic latent image. An attempt is made to explain the photolysis of silver halides in terms of the concepts of atomic physics. The mechanism by which the silver atoms formed by the light coagulate to form specks of metallic silver is discussed. The ideas used in this discussion are then turned to the photographic latent image, and are shown to account qualitatively for the variation of developed density with temperature, and, for given exposure, with intensity of light. A brief discussion is given of the Herschel effect, and of sensitization by dyes.

A. L. RHIMANN: The temperature variation of the work functions of clean and of thoriated tungsten. Measurements were made of the contact potential difference between a constant source of electrons and a neighbouring tungsten filament collecting space-charge-limited electron current, the condition of which was varied. This filament was either clean or covered with a layer of thorium atoms, and, in addition, it was held at various temperatures. In this way direct information was obtained concerning the rates at which the work functions of clean and fully activated thoriated tungsten (W-Th) vary with temperature. Within the limits of experimental uncertainty there is no difference between the temperature coefficients of the two work functions. The temperature coefficient found is about that which would be required to account for the observed value of the thermionic constant A of clean tungsten on the assumption of practically perfect transmission. It must be concluded that the factor (of the order of 10-20) by which the A of W-Th is less than that of clean tungsten is due to internal reflection of electrons at the W-Th surface.

Paris

Academy of Sciences, November 3 (C.R., 205, 761-824).

GEORGES CLAUDE: The search for aeroplanes lost at sea. Remarks on the use of fluorescein.

ROBERT ESNAULT-PELTERIE: The coefficient of self-inductance of a solenoid. Two approximate formulae are suggested, one giving an accuracy of 3 per cent and the other of 0.1 per cent.

GEORGES GIBAUD: A new category of equations where the principal values of integrals are represented.

JEAN CABANNES and CHARLES BOUHET: An attempt at the classification of the Raman lines of a quartz crystal.

MARC KRAEMER: The definition of certain non-commutative rings. The classification of the primitive extensions of bodies with discrete valuation.

E. J. GUMBEL: The generalization of Boole's inequality.

HENRI CARTAN: Filters and ultra-filters.

ERNEST VESSIOT: The equations $F(x, y, z, p, q, r, s, t) = 0$ which have a general explicit integral.

MICHEL GUERMANDESCOU: A new class of nuclei of Fredholm.

JEAN LERAY: The solution of the problem of Dirichlet.

JEAN DUFAY and SSU PIN LIAU: The colour indices of the O and B stars and the selective absorption of light in space.

GEORGES REBOUL and JEAN REBOUL: The ionizing radiations of low quantum emitted spontaneously by the ordinary metals. Ordinary metals, like the true radioactive metals, constantly emit radiations. These appear to belong to the bands situated in the region of the soft X-rays.

VITOMIR H. PAVLOVIĆ: An improved apparatus for the subjective study of colour mixing.

RENÉ BERNARD: Stimulation potentials of the B^*H and C^*H levels of the nitrogen molecule.

TOM KIU: Remarks on photographic plates sensitized with salicylate.

ALEXANDRE TRAVERS and ROBERT DIEBOLD: The isolation of pure cementite by acid attack of ferrous materials and on some physical properties of this body. The product isolated contained 6.6 per cent of carbon, the theoretical figure being 6.67 per cent. The Curie point, electrolytic potential and X-ray spectrum were determined.

PAUL COUTURIER: The action of mixed organo-magnesium derivatives on some hydroxy or alkoxy aromatic amides.

PIERRE MASTAGLI: The reducing action of the alkaline benzylates on hydratropic and α -alkyl-cinnamic aldehydes.

GEORGES DUPONT and CHARLES PAQUOT: Some reactions of isoprene and of dimethylbutadiene.

GEORGES BRUHAT and ANDRÉ BLANC-LAPIERRE: The double refraction of quartz by compression and its dispersion in the ultra-violet.

GEORGES DÉJARDIN, ALBERT ARNULF and DÉMETRE CAVASSILAS: The absorption coefficients and average temperature of atmospheric ozone.

DAVID MALAN: Stormy discharges in the upper atmosphere.

RENÉ SOUBÈGES: The embryogeny of the Convolvulaceae. The development of the embryo in *Convolvulus arvensis*.

MARCEL GOMPEL: Researches on the oxygen consumption of some coastal aquatic animals.

PAUL WINTERBERRY: Morphogenesis and epigenetic induction.

AUGUSTE and RENÉ SARTORY and JACQUES MEYER: The infection of cultures with a fungus by *Rhizoglyphus echinopus*, a parasite of the potato.

GEORGES MOUIRQUAND and HENRY TÊTE: Chronic food deficiency (partial C avitaminosis). Reversible and irreversible processes.

Moscow

Academy of Sciences (C.R., 16, No. 4, 1937).

N. M. ERMOLAJEV: The expansion of an infinite integral into a semi-convergent series.

G. A. TEKHOV: The deviation of light rays in the gravitation field of stars.

A. A. ULJANOV: Radiations accompanying the corrosion of metals (1).

V. I. NIKOLAJEV and A. K. SENJUTA: Dehydration of mirabilite *in vacuo*.

A. IMÄENEN: The morphology of large bacterial cells.

P. A. POVOLOČKO: (1) Chromosome morphology in *Punica granatum* L. (2) Causes of sterility in winter-grown plants of *Nicotiana tabacum*.

M. CH. ČAJLAČJAN: Concerning the hormonal nature of the plant development process.

B. A. ZENKOVIČ: Food of the Far Eastern whale.
A. A. VOENKOV: Morphogenetic activity of different parts of the hypophysis (6). Experiments with the implantation of the posterior part of the hypophysis to tadpoles.

V. V. POPOV and V. S. POPOV: Is the cornea of metamorphosed anurans determined?

V. V. POPOV, S. P. EVDOKIMOVA and A. G. KRYMOVA: The lens-forming activity of the epidermis in larval and adult Amphibia.

V. V. POPOV, M. N. KISLOV, M. F. NIKITENKO and P. S. ČANTURŠVILI: The lens-forming activity of epithelium in embryos of *Polobates fuscus*, *Bufo viridis*, *Bombina bombina* and *Triton cristatus*.

Vienna

Academy of Sciences, October 14.

W. OBERHUMMER: Possibility of dissolving chromic oxide and chrome iron ore at room temperature. Silver nitrate catalyses the solution of chrome iron ore by dilute sulphuric acid.

GERTRUD WILD: Spectroscopic analysis of fluorites. The presence of rare earths in natural fluorites is confirmed.

E. EPSTEIN: Electrical precipitation of the disperse phase of organic and inorganic dispersoids by radium emanation. α -Particles cause a reduction of the charge and an increase in the size of the particles in phosphatide and gold sols, leading in the former case to flocculation and in the latter case to colour changes.

K. SCHWARZ and F. EBSTER: Apparatus for the production of electrons of very high energy.

F. SCHLOSSBERGER: (1) Use of the fine structure of X-ray absorption edges for the determination of crystal structure. (2) Precision X-ray camera for obtaining powder diagrams at high temperatures, and an apparatus for measuring X-ray diagrams.

O. NEUBERG and C. H. SCHWITZER: Agar-agar.

D. BALABEW: Application of the phase rule to crystal systems.

H. MACHE and O. MOSEKOWICZ: Ionization of air at low pressures by γ -rays: parabolic law for the ionization current. It is shown that if, for pressures greater than 100 mm., current-potential curves be plotted for various amounts of ionization, then points corresponding to the same degree of saturation all lie on a parabola.

H. PREIBRAM, LEONORE BRUCHER and MARTHA GEMRING: Colamin, the physiologically active component of choline.

F. MAUSER: Synchronous metamorphosis of the legs of *Dixippus morosus* Br. et Redt.

GERTRA SCHMID: Conditions for the development of the imaginal red coloration on the fore legs of *Dixippus morosus* Br. et Redt.

O. HRABEK: Local transformation of solid and hollow bones of *Molge cristata* Laur. It is possible to interchange a hollow bone from one limb with a solid bone from another. In certain cases these bones become transformed so as to become appropriate to their new position.

A. W. RUTZ and R. SABATHY: Studies of the Raman effect (78). Nitrogenous substances (8). Nitriles.

A. WARSBERG: Influence of morphine on the excretion of salt in the urine.

K. FEDERHOFER: Normal vibrations of spherical shells (2).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICERS (chemist and engineer) at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (December 30).

SENIOR LECTURER IN HIGHWAY ENGINEERING in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 7).

LECTURERS IN CIVIL, MECHANICAL AND MECHANICAL ENGINEERING in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 19).

PROFESSOR OF MINERALOGY AND GEOLOGY in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 31).

ASSISTANT for research on various diseases of small fruits at the East Malling Research Station, East Malling, Kent—The Secretary.

Official Publications Received

Great Britain and Ireland

Royal College of Surgeons of England. Scientific Report for the Year 1936-1937. Pp. 40. (London: Royal College of Surgeons of England.) [1511]

Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1927 to 1936 (Trade and Commerce Section). (No. 66.) (Omd. 5582.) Pp. xv+229. (London: H.M. Stationery Office.) 2s. 6d. net. [1511]

ULAW'S Monographs and Reports, No. 2a: Report of a Discussion on the Destruction of Sea-Birds by Oil Waste, held at University College, University of London, on May 10, 1937. Pp. 16. (London: University of London Animal Welfare Society.) [1511]

Twenty-one Years: a Professor looks out on the Glass Industry. Being the Presidential Address delivered on the occasion of the Twenty-first Anniversary Meeting of the Society of Glass Technology, at Sheffield, November 6th, 1937. By Prof. W. R. S. Turner. Pp. 70. (Sheffield: Society of Glass Technology.) 10s. [1511]

Science Museum. Board of Education. Catalogue of the Atom Tracks Exhibition (November 1937—February 1938). The Results of 25 Years of Research by Prof. C. T. R. Wilson's Expansion Chamber Method, in which the Tracks of Individual Atoms and Electrons are rendered Visible and Photographed. Compiled by Dr. F. A. B. Ward. Pp. 28. (London: H.M. Stationery Office.) 6d. net. [1511]

Other Countries

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ended June 30, 1936. (Publication 3406.) Pp. xiv+446+122 plates. (Washington, D.C.: Government Printing Office.) 1.50 dollars. [1511]

Indian Forest Records (New Series). Vol. 3, No. 4. Entomological Investigations on the Spike Disease of Sandal (32) Lygaeidae (Hemipt.). By K. C. Chatterjee. Pp. 105-123. 8 annas. 10s. Vol. 3, No. 5: On *Leis* et *Anobides* nouveaux des Indes (Coleoptères). Par M. Pic. Pp. 123-126. 3 annas; 4s. Vol. 3, No. 6. Immature Stages of Indian Coleoptera (23). By J. O. M. Gardner. Pp. 127-140. 12 annas, 1s. 3d. (Delhi: Manager of Publications.) [1511]

Indian Central Cotton Committee. Technological Laboratory. Technological Bulletin, Series A, No. 28: Technological Reports on Trade Varieties of Indian Cottons, 1937. By Dr. NAWAZ AHMAD. Pp. v+145. (Bombay: Indian Central Cotton Committee.) 1.8 rupees. [1511]

Queen Victoria Memorial, Salisbury. Annual Report for the Year ended 31st March 1937. Pp. 8. (Salisbury, S. Rhodesia: Queen Victoria Memorial.) [1511]

South African Institute for Medical Research. Annual Report for the Year ended 31st December 1936. Pp. 68+2 plates. (Johannesburg: South African Institute for Medical Research.) [1511]

Proceedings of the United States National Museum. Vol. 84, No. 3023: On the Detailed Skull Structure of a Crested Hadrosaurian Dinosaur. By Charles W. Gilmore. Pp. 481-492. Vol. 84, No. 3022: Annotated List of West Virginia Mammals. By Remington Kellogg. Pp. 443-450. (Washington, D.C.: Government Printing Office.) [1511]

Catalogues, etc.

Moll Recording Microphotometers. (MF 37.) Pp. 12. (Delft: P. J. Kipp and Zonen.)

Calendar for 1938. Pp. 32+32+32 maps+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

Books for Presentation (Catalogue No. 543.) Pp. 60. (London: Bernard Quaritch, Ltd.)

Kodak X-Ray Materials and Accessories. Pp. 40. Kodak X-Ray Reduction Camera. Pp. 8. (London: Kodak, Ltd.)

Zeits Nachrichten Sonderheft 2, August 1937. Pp. 48. Folge 2, Heft 3, August 1937. Pp. 81-112. (Jena: Gustav Fischer.)

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Vol. 140

Location of Industry in Great Britain

THE astonishment and uneasiness with which the evidence given by the Board of Trade to the Royal Commission on the Geographical Distribution of the Industrial Population at its fourth meeting has been received is an indication of how far the old ideas of *laissez-faire* have been left behind. The policy of do-nothing which the Board apparently follows is as unsuited to the present day as it is inconsistent with the general tenor of the Government's active intervention for the promotion of industrial and social well-being. Already Government policy is influencing the location of industry in many indirect as well as direct ways. The making of the Great West Road out of London, the electricity 'grid', the transference of workers, and the housing subsidy are some of the means already used to direct the location of industry away from old to new industrial areas, and are sufficient in themselves to invalidate the complacent view put forward by the Board of Trade.

The whole problem is one to which scientific workers may well give their attention; and welcome evidence that they are doing so is afforded by the meeting recently devoted by the Institution of Chemical Engineers to the Special Areas of England and Wales, at which Mr. O. H. Boyd gave an account of some technical and economic aspects of the Commissioner's work.

Mr. Boyd's survey showed clearly the great progress which has been made in the Special Areas in improving the local services in co-operation with the local authorities and other similar bodies. Arrangements have been made in all the areas whereby the industrialist can be provided, by the trading estates companies in the north-east and in South Wales and by the Industrial Development

Company in West Cumberland, with up-to-date factories of standard type either on the trading estates themselves or by arrangement with the Commissioner in other parts of the areas. The new policy of industrial development is already showing encouraging results, and is assisted by the fact that the areas are now in a position to provide a much more attractive market for the new and lighter industries than they have been for some years.

If there is a defect in Mr. Boyd's paper, it is that, before a technical audience, he made no reference in an otherwise comprehensive bibliography to the admirable report on Science and Industry of the Joint Committee of the Local Sections of the Society of Chemical Industry, the Institute of Chemistry and the Chemical Society submitted to the District Commissioner in May 1935. This is the more regrettable because the preliminary step to the development of new industries must be research of this kind, and of the type undertaken by Prof. Marquand and his colleagues in South Wales—the application of scientific principles of industrial location to the facts of the distressed areas. We must know precisely what industries can be located profitably in the areas, and what industries can, in general, be located with equal success anywhere.

The improvement which has already taken place in the areas, and the fact that the manufacturer need no longer hesitate to try his fortune in them, should not lead us to overlook the fact that essentially recovery has revealed the bare bones of the problem. It is serious enough that more than 1,300,000 persons should be out of work at the height of prosperity. It is even more disturbing that the burden of unemployment should still

be heavily localized in the distressed areas. The major social problem persists in all the Special Areas. Their industries have in part been scaled down and rationalized, but their labour forces, amenities and facilities are still those designed for the old order when the markets of the world were open.

It is to this aspect of the question that Mr. Donald Tyerman directs attention in a trenchant article in *Lloyd's Bank Monthly Review*. Current conditions of recovery and rearmament have, for the time being, largely solved the cyclical problem. The special and more fundamental problems remain, intensified by the accumulation of derelict people and places, although the liquidation of the areas by scaling down and labour transference has commenced. Recovery in the Special Areas has in fact shown us that we must be prepared for distress at least as severe as ever in the next depression, or we must very considerably accelerate the development in them of new industries.

This is not to invalidate the solutions which are already being attempted: the maintenance of the maximum volume of staple exports by a liberal trade policy, and, if need be, by special aid, to reduce the difficulties of adjustment and liquidation to a minimum; the scaling down of equipment, capacity and labour forces to the maximum which can be employed in the staple industries, involving further extensive reorganization of the coal, cotton and iron and steel industries; and the mitigation of distress by curing, cleaning up and caring for human wastage, by special treat-

ment for aged unemployables and young untrained unemployed. These remain as essential, but the establishment of new industries requires much closer investigation than it has yet received.

It is natural to expect that the Royal Commission on industrial distribution will become acquainted with much of the data and proposals available. Armed with this knowledge, the Government, with the assistance of business men, industrialists and technicians, will be in a position to act. It will at least continue its policy of fixing a magnet in the Special Areas which will overcome such attractions of London and the south as are not based upon their essential requirements or on well-founded economic considerations. If, however, it is to go further by increasing the inducements to new industries in the distressed areas, by multiplying trading estates and increasing the moneys available to the Special Commissioners and the Special Areas Reconstruction Association and by guiding or controlling much more vigorously than hitherto the location of industry, it will need in increasing measure the co-operation of scientific workers. They must accept the responsibility for some measure of the basic work required. The position which many men of science now take in industrial leadership and development places upon them, individually and through their professional associations, the further responsibility for that informed, impartial and creative criticism which is of vital importance to a democratic Government.

A Chemical Encyclopædia

Thorpe's Dictionary of Applied Chemistry. By Prof. Jocelyn Field Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol. 1: A—Bi. Pp. xxvii + 703. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937). 63s. net.

THE appearance of a new edition of "Thorpe" arouses mixed feelings. Chemists will welcome what they know will be a lucid exposition of the latest information regarding a host of chemical subjects, compiled by experts, but this welcome must be tempered by the fact that the authors state it will be nine years before the last volume

is to appear, and, since it is, unfortunately, impracticable to draw up an index in advance, it will be nine years before it is possible to ascertain with any facility what are the contents of the nine volumes. By that time, the present volume will be out of date and, presumably, steps will be taken to issue another edition; in other words, the "Dictionary of Applied Chemistry" is to become a periodical. This method of issue, no doubt, simplifies the work of the publishers, and, possibly, appeals to librarians who prefer to spread their slender monetary resources over a period of years, but it does not yield the best type of book from the user's point of view.

The authors attempt to overcome the difficulty of obsolescence by stating that each substance will be dealt with twice over, once under its own initial letter and again in a general article, the later of the two being the more up to date. Apart from the undesirability of dealing with the same compound twice, all materials are not as accommodating as those mentioned in the preface. For example, in the present volume, "aconitine" has the misfortune to begin with the same letter as "alkaloid" and thus escapes revision.

In spite of the editors' assurance that a new edition is a necessity, some doubt may be felt on the matter. Great as has been the progress of science in the last ten years, the chemistry of 1927 is not obsolete; the old edition of the present work was and still is a most valuable book and a mine of information, but, apparently, it is to be regarded as non-existent, for, among the many hundreds of references, one that never seems to appear is "Dictionary of Applied Chemistry, 1927". Nearly every owner of the new edition is in possession of the old, and there are many subjects of no great general interest—for example, the alcoholometer readings used in different countries—for which a reference to the earlier edition should suffice. Then, as regards newness, a random selection of "anthracene" reveals the fact that about one-eighth of the article contains information obtained after 1927. The proportion for the whole volume is difficult to ascertain, but it would seem to be of this order. If this estimate is not far from the truth, a 'super-supplement' should be sufficient to include all new matter and this could be brought out in one or, perhaps, two years.

With regard to the contents, the first impression is that of a text-book of organic chemistry rather than of a dictionary of applied chemistry. This is, perhaps, due to the lavish provision of structural formulae, the comparative scarcity of diagrams of plant and the almost complete absence of flow sheets. No one will deny the undesirability, and, indeed, the impossibility, of divorcing technical chemistry from its underlying fundamental principles, but it is manifestly impossible to cover the whole of modern chemistry, even in nine volumes, which implies that something must be left out. There is a great need for a really good reference book on applied chemistry in the English language, and little harm would be done if much of the purely theoretical matter in the present volume were omitted and more technical details were included. The former matter is readily found in journals; the latter is much more difficult of access, although, fortunately, not so difficult as in years gone by, when every process was regarded as secret. As an example, the space occupied by "ajlantonine" is almost exactly equal to that

devoted to the manufacture of absolute alcohol. Much of the organic matter may be criticized for its text-book style of presentation. It is an exception for yields to be mentioned, although it must be recognized by now that the yield obtained by a given process is not only of vital importance to the manufacturer, but is also of the utmost value in determining the mechanism of the reaction.

The article on "analysis" has disappeared, but there is a hint that this is to be replaced by one on "chemical analysis". It is questionable whether too much space has not been devoted to this subject. With the exception of certain valuable tables, the information given is usually insufficient to enable an analysis to be conducted and could be curtailed. An example of how this may be done is to be found under "Aluminium, detection and determination of"—a most admirable summary.

The general articles are of interest, but the desirability of including them is doubtful; bound together in a separate volume, they might appeal to many, but in their present association they are apt to be overlooked, particularly without an index. How many people requiring information on the weathering of paints would look for the word "ageing", and who would turn to a dictionary of applied chemistry for details of precision weighing? It is suggested that future volumes should give a list of these special articles with a brief indication of their contents. Incidentally, the author of the article "balance" mentions Aston's microbalance for gas densities, but does not refer to the far superior type of Whytlaw-Gray.

It is difficult to discuss individual articles. Of these, the most outstanding are "aluminium", "autoclave", "acetylene", "absorption" and "adsorption". A few omissions and errors have been noticed. The methods given for preparing esters of acetic acid are certainly not those of 1937, the azeotropic process not being mentioned. Austenite is dismissed in thirteen lines. The yield of acetic acid obtained by the distillation of wood is said not to vary greatly with the species of tree, a statement incorrect even for hard woods. The erroneous combination *carum ajowan* is given for the ajowan plant and ascribed to Benthham and Hooker, the correct name being *Trachyspermum Ammi* (Link) Sprague. Finally, the process of manufacture of the important pigment, antimony oxide, is not mentioned, while the conditions of interconversion of the two oxides are not made clear.

Minor defects such as these are unimportant when compared with the value of the book as a whole. If the subsequent volumes contain less of the laboratory and more of the works, their value will be still greater.

H. E. W.

Academic Spiritualism

(1) Some Cases of Prediction:

a Study. By Dame Edith Lyttelton. Pp. 160. (London: G. Bell and Sons, Ltd., 1937.) 2s. 6d. net.

(2) Personality Survives Death

Messages from Sir William Barrett. Edited by his Wife. Pp. xlv + 204. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

(3) The Superphysical:

a Review of the Evidence for Continued Existence, Reincarnation, and Mystical States of Consciousness. By Arthur W. Osborn. Pp. xvi + 350. (London: Ivor Nicholson and Watson, Ltd., 1937.) 12s. 6d. net.

WITHIN recent years, a distinct change in the character of spiritualistic propaganda has become discernible. A division is becoming apparent and, if we may be pardoned for using a current political expression, its exponents are becoming somewhat 'class-conscious'. The extent and crudity of the fraud now being practised both in Great Britain and in the United States have almost forced the more educated classes to eschew what is presented for the edification of their weaker brethren, and to build up something more in accordance with their own intellectual standards. Propaganda is to-day of a much more sophisticated type; and the language of modern psychology and statistical method is supplanting the naïve descriptions of earlier years.

(1) Dame Edith Lyttelton, in her study of some cases of prediction, has written a disarming introduction to her collection, since she shows herself fully aware of the objections which are naturally aroused by her narrative. Passing from cases which she admits might be due to coincidence, she proceeds to more detailed instances which can, she thinks, only be understood if we assume what she calls "precognition". Yet on a careful reading of her records the student cannot fail to be assailed by the feeling that, even in the most detailed cases, a normal explanation would suffice were the facts more fully known and reported in a more strictly scientific spirit. Sometimes the central point of the story seems awry, as when a soldier was seen as in a vision with a scar over his left eye. The seer, in a letter to Dame Lyttelton, actually states that his friend did return from the Great War with a scar over his

left eye, whereas the fact was that the scar in question was under the right eye.

(2) From cases of prediction, premonition and extended telepathy, it is easy to consider messages from the dead, and Lady Barrett has thrown down the challenge boldly when she entitles her collection of communications purporting to come from the late Sir William Barrett, "Personality Survives Death". These messages, mainly delivered through the mediumship of Mrs. Osborne Leonard, are strikingly illustrative of the theory which regards the building up of the characters of the deceased personalities as due to the dramatic powers of the medium, who adopts histrionic poses the material for which may be derived either from normal sources or in some other and unknown way. Mingled with this material we find much more which is probably derived from the medium's own mental content, thus suggesting that the effort of sustaining a prolonged dramatization may be severe. However that may be, Lady Barrett appears satisfied that the communicator is really the person he purports to be; and some of the trivialities and intimate details brought out at the sittings are certainly reminiscent of the late Sir William.

As a serious contribution to spiritualistic literature the book is clearly one which shows how much work remains to be done before we can hope to obtain any clear idea of the nature of the mental processes occurring with a reliable trance medium. Indeed such a task becomes more important when we turn to (3), Mr. A. W. Osborn's study on the "Superphysical", for it is here that we can discern the direction in which modern academic spiritualism is drifting.

In the introductory section to his book, Mr. Osborn discusses and analyses current scientific and psychological ideas, laying stress upon whatever, in his opinion, counteracts the influence of materialism. He then proceeds to pass in review the so-called supernormal phenomena of spiritualism and psychical research, in this part of his book displaying a singular lack of critical appreciation of the material with which he deals. Finally, he attempts to show that an acceptance of the facts alleged in the preceding sections, together with an understanding of the implications involved in the philosophic ideas advanced by certain modern physicists, necessarily lead the student to a fuller realization of mystical states of consciousness and thence to a new order of living.

It is here that we can see the link which is tending more and more to unite those who previously had but little interest in spiritualism regarded as a religion. The phenomena of prediction, the supernormal aspect of which is so sincerely sponsored by Dame Lyttelton, suggests the necessity for radical changes in our psychological approach to problems of human personality which, Lady Barrett assures us, survives death; whilst Mr. Osborn, accepting both

these claims, continues the work by pointing out how such facts lead to a new conception of life and death. Were the alleged facts, however, to be substantiated, it is doubtful whether their interpretation would tend in the direction indicated by Mr. Osborn; and it can scarcely be admitted that the fresh evidence now advanced by Dame Edith Lyttelton and Lady Barrett is more striking than much already printed elsewhere.

Conservation of Wild Animal Life

The Animal Year Book:

Vol. 4. Edited by Dr. H. E. Bargmann. Pp. vi + 174 + 10 plates. (University of London Animal Welfare Society, 1937.) 2s. 6d.

ALL, surely, will agree with the contention, made in the preface to this review of the work accomplished by the University of London Animal Welfare Society during 1937, that "The progress of the movement for animal welfare, both at home and abroad, depends very largely on arousing the interest of the rising generation in its problems".

Two such problems of the very first importance are placed in the forefront of this review. The first, under the title, "The Tragedy of the Possum", reveals the appalling slaughter that has taken place of the common opossum (*Trichosurus vulpecula*) to supply the insatiable demands of the fur-trade. Mr. David Stead, a well-known Australian naturalist, takes his evidence mainly from Government reports, hence he may be acquitted of bias, or of speaking without authority. Legislation for the protection of this animal now exists in all the States of Australia, but it has been of slow growth, though quickened by the statistics for the year 1919-20 when no less than 7,500,000 were sent to the markets. The attempt to curb this waste of life, made by the Governments in the form of 'close seasons', has proved ineffective, since animals killed during the close season in one area are sent into a neighbouring State to be passed out as the harvest of its open season!

Various subterfuges are resorted to for the purpose of justifying 'open seasons'. But it seems clear that unless the slaughter of this animal for trade purposes is prohibited altogether, its extinction in the very near future is assured. Mr. Stead points out that "Australia has a unique heritage for which it must accept responsibility", and continues, "Is it too much to hope that public opinion which urges that trusteeship of this fauna

shall become active and real, can supply the force to set the machine in effective and permanent motion?"

The second of these problems is ably set out by Mr. A. H. Kirkman. In concerns "Africa's Vanishing Fauna", and the alarming rate of the disappearance of the 'game animals' of Africa. The blaauwbok (*Hippotragus*) and the quagga have already vanished. Only a few skins in museums are left to tell us what they were like. Of the mountain zebra only two herds of twenty or twenty-five are known to exist, on farms, and these are being zealously guarded. The same is true of the bontebok, of which species two herds only, of forty-four and twenty-five respectively, now exist, and under private ownership. Of that extraordinarily interesting antelope the white-tailed gnu, it is estimated that no more than about three hundred remain of the hordes that existed before the advent of the Dutch settlers. The survival of the Cape hartebeest is now precarious, and the sable antelope is in danger of extinction. But we should like to know on what authority the statement is made that the elephant "still exists in several tens of thousands".

The difficulties which confront the game-wardens, where they exist, in the preservation of the animals of Africa in their respective areas of control are great. This is largely due to the fact that the natives now possess fire-arms. A further factor in this alarming progress of extermination is the slaughter carried on for the avowed purpose of exterminating the tsetse-fly and the carriers of sleeping-sickness. The annual report of the Southern Rhodesian Government for 1931 shows that during the year a grand total of 15,067 animals were slain in this effort to achieve the impossible. If, and when, the last of the 'big game' animals in the haunts of this fly is wiped out, sleeping-sickness will still remain, since the trypanosomes, which cause the disease are carried

in the blood of numerous species of small mammals the extinction of which would be impossible. Those who wish to read the full story of this rapidly increasing march of destruction would do well to read Mr. Kirkman's admirable summary.

With the issue of the fourth volume of "The Animal Year Book", the editorship passes into

the efficient hands of Dr. Helene E. Bargmann. As is inevitable with a change of editorship of such a publication, this issue is largely occupied by the effort to clear up arrears of accepted matter. The new editor is to be congratulated upon having executed this difficult task with patience and discretion.
W. P. P.

Polynesia through Many Eyes

Religion and Social Organization in Central Polynesia

By Robert W. Williamson. Edited by Dr. Ralph Piddington. Pp. xxx + 340. (Cambridge: At the University Press, 1937.) 25s. net.

THE curiosity which Polynesia excited in the eighteenth and nineteenth centuries was not of the scientific kind which searches for facts on which to base generalizations; it was the curiosity of dilettantes. Explorers, sailors and missionaries did not pursue their inquiries to the point at which they would begin to demonstrate but cease to amuse, nor were they prepared to subject the blossoms of imagination to the icy blasts of scientific criticism. To entertain they had to be intelligible, and to be intelligible they had to transpose Polynesian customs into a European mode. The European mind was imbued from childhood with Greek mythology, so Williams arranged the Fijian gods into a pantheon on the Greek model, an arrangement more convenient than true.

Deification was familiar from the history of Rome, so Polynesian theology was reduced to deification. The Polynesian gods were supposed to be deified chiefs, and they were stated to be so as a fact. Now deification is a ceremony, and no such ceremony has ever been recorded in Polynesia, nor is there any word in the language which could by stretching its meaning be translated deification. The facts are that every deceased has power and so may become the object of a cult, which may or may not persist according as he proves effective or not. A dead chief has more power than a dead commoner, and so has a better chance of surviving in the memory of the people.

The distortion of the facts was still further increased when the naturalism of Greek mythologists was combined with misunderstandings of Roman religion. The French missionaries believed that in Mangareva "all the principal phenomena of nature were deified as good or evil spirits, according as they inspired hope or fear" (p. 26). That statement contains at least four theories: of deification, of emotion as the cause of deification,

of a theological dualism, of a hierarchy of phenomena. Every one of these theories requires to be supported with the evidence of facts, the facts being the actions and words of the Mangarevans; but the good missionaries were there to convert heathens, not to prove theories; and they cannot be blamed for not even distinguishing between facts and theories. The anthropologist should know better, because it is his business to make a distinction, without which science is impossible.

Mr. Williamson, however, was far too modest to distinguish when his masters had not done so. He was far too diffident and too kind to reject any of his witnesses. Equal weight is given to all, and if X asserts the opposite of Y, the contradiction does not seem to impair his faith (for example, p. 123). Mr. Williamson is more than impartial; he is neutral. The only witnesses that do not benefit by this neutrality are the natives. Wilkes, a passer-by, is allowed to depone as to the meaning of the Samoan word *atua*, but not the Samoans, though their evidence was recorded verbatim in *Man* in 1915 (p. 12).

This neutrality had been a tradition too long for Mr. Williamson to break away from it. He had patience, honesty, thoroughness and industry, and a preference for safety. It was not safe to introduce into anthropology the distinction between the observed facts and the interpretation of those facts. It would have meant scrapping ruthlessly, as unfit for scientific consumption, masses of travellers' tales, amateurish speculations, careless observations, misunderstandings and mistranslations and faults of memory which had been passed by generations of anthropologists. Mr. Williamson is not the only one who quailed at this sacrilege. Rivers is almost the only one who did not.

What Mr. Williamson had not the courage to do the reader will have to do for himself; he will have to sift the material. To do so he will probably find himself compelled to go to the originals. Mr. Williamson has provided him with an exhaustive catalogue and a conscientious guide.

A. M. HOGART.

Handbuch der Anorganischen Chemie
Herausgegeben von Prof. Dr. R. Abegg, Dr. Fr. Auerbach und Dr. I. Koppel. In 4 Bänden. Band 4, Abteilung 3: Die Elemente der achten Gruppe des periodischen Systems. Teil 4: Nickel und seine Verbindungen. Lief. 1. Herausgegeben von Dr. I. Koppel. Pp. xviii+827. (Leipzig: S. Hirzel, 1937.) 78 gold marks.

THE literature relating to any one of the chemical elements is now so great that scientific workers in general should be grateful for comprehensive works such as the volume under review, which save them much labour in their search through numerous and scattered original publications. In the English language we now have the recently completed "Comprehensive Treatise on Inorganic and Theoretical Chemistry" by J. W. Mellor which fulfils this need, whereas in German there is not only "Gmelin-Kraut's Handbuch der Anorganischen Chemie" and the handy "Lexikon der Anorganischen Verbindungen" of M. K. Hoffmann but also "Abegg's Handbuch der Anorganischen Chemie", of which the present volume constitutes a part.

The Abegg series of handbooks enjoys a well-deserved popularity as works of reference. This appreciation is due not only to the comprehensive nature of these volumes but also to the clarity and logical order of their subject matter. The present monograph on nickel maintains fully the high standard of the foregoing volumes, and is to be warmly recommended to all inquirers interested in this element, which is important for both technical and scientific reasons. Nearly one third of the 827 pages of this treatise is devoted to the preparation and properties of the metal, and about an equal amount of space is allotted to nickel compounds, including univalent, bivalent and trivalent derivatives, simple and complex salts, amminated derivatives and complex compounds with organic addenda. Other sections include data on the atomic weight of nickel, the physics of the nickel atom and the colloidal properties of the metal and certain of its derivatives. These topics are surveyed with all the thoroughness usually displayed in this series of treatises.

This volume, which is fully documented up to 1936 and printed clearly on durable paper, is largely free from errors. There are, however, two criticisms which the reviewer wishes to make. The first is the absence of an index. This omission is offset to some extent by a good table of contents at the beginning of the volume and by the orderly arrangement of the text, which follows closely the periodic arrangement of the elements. The second criticism relates to the high cost of the treatise, which at the existing rate of exchange places it beyond the reach of many chemists.

F. H. B.

Wide Horizons:

Wanderings in Central Australia. By Robert Henderson Croll. Pp. xiv+168+27 plates. (Sydney and London: Angus and Robertson, Ltd., 1937.) 9s. 6d. net.

MR. CROLL records impressions of Central Australia, which were gathered on four expeditions between

1929 and 1934. He witnessed both the effects of a seven years drought and the rejuvenation of the country and its animal and vegetable life after the rains. The contrast is strikingly portrayed, though, not unnaturally, the narrative stresses the aridity of the dry period. The author conveys to his readers the charm and beauty of the landscape as effectually as he impresses upon them the vastness of its spaces. He is an enthusiast on the economic possibilities of the country, given a water supply and a market such as a newly discovered gold-field might afford.

The concluding chapters deal with the problem of the aboriginal and the half-caste. Here the indictment of the Australian people is mainly in the form of a statement of fact, and is temperate in language. It is all the more telling for that. While recognizing the beneficent work of the missionaries, he holds that humanitarian measures have been no less a failure in the long run than neglect; and that what is needed is a drastic change in method, liberal expenditure in money, and Federal control (see NATURE, Dec. 18, p. 1029).

Duše Rostlin (The Soul of Plants)

By Prof. B. Němec. Pp. 234+16 plates. (Prague: Nakladatelství Prácké Akciové Tiskárny, 1937.) 29 crowns.

PROF. NĚMEC, the distinguished Czechoslovak plant physiologist, has written an absorbing survey of the plant kingdom under the title "The Soul of Plants". Writing for men of science in general, he describes plant-life, the evolution of higher forms, the struggle for existence and the purposefulness of their life-cycles. There is a particularly striking chapter, "Death rules the Living", which gives a vivid idea of the contributory causes for the 600,000 plant species and of the genetics of the 'miracle of inheritance', the sources of variation, genes and the ways in which plant posterity is ensured.

It is to be hoped that an English edition of this work will appear, so that Prof. Němec's views may reach a wider circle of readers.

Biological Laboratory Technique:

an Introduction to Research in Embryology, Cytology and Histology. By Prof. J. Brontë Gatenby. Pp. vii+130. (London: J. and A. Churchill, Ltd., 1937.) 7s. 6d.

THIS book gives a short introduction to recent methods in microtomy, many of the methods being adapted for the smear technique which does not require section cutting. It is a useful and compact summary for amateurs who do not have an elaborate equipment and for university students and teachers desiring an introduction to the most recent practices. In addition to a statement about apparatus, the treatment of living cells and vital staining, there are sections on smear methods, fixation, embedding in paraffin, dioxan, *n*-butyl alcohol and celloidin. A chapter on staining is followed by notes on methods in histology and embryology.

Apparent Enlargement of the Sun at the time of Rising and Setting

By Dr. Vaughan Cornish

IT is a matter of common observation that when the sun is nearly on a level with the eye and is in the vicinity of the horizon its apparent size

ment, or any intention of subsequent measurement, but from known view-points, so that the angular magnitudes of terrestrial features were afterwards ascertained from the map.

The sun seen from Bern rising above the Bernese Alps forty miles away, measured 0.16 inch on a 7-inch page. As seen from Grindelwald the sun rising above the Wetterhorn four miles away measured only 0.9 inch on a 7-inch page. These measurements seem at first to confirm the expectation that the sun would be apparently enlarged in proportion to the diminution of terrestrial features by greater distance. When, however, I measured the mountains in the two drawings and compared

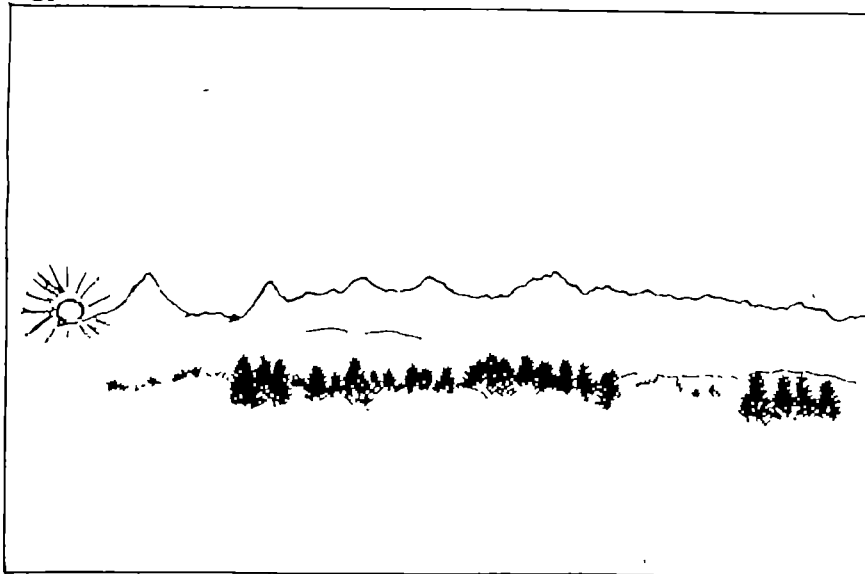


Fig. 1.

THE RISING SUN FROM BERN

is greater than when high up in the sky. It is generally assumed that this is due to the circumstance that the features of the skyline provide a true standard of instinctive comparison which enables the eye to appreciate the angle subtended by the sun's disk. It is true that the linear magnitude of the terrestrial features is fairly well known and that the tone and other qualities of the horizon give an instinctive impression of its distance. The current explanation breaks down, however, under the test of actual measurement of the apparent magnitudes. These measurements are trustworthy only if made by an indirect method which side-tracks the critical faculty, for as soon as thought comes into play, the spontaneous impression of magnitude is impaired. The measurements in question have been made from a number of sketches which I have made during the last forty years, all drawn originally without measure-

ment, or any intention of subsequent measurement, but from known view-points, so that the angular magnitudes of terrestrial features were afterwards ascertained from the map. I found that the apparent magnitude in the more

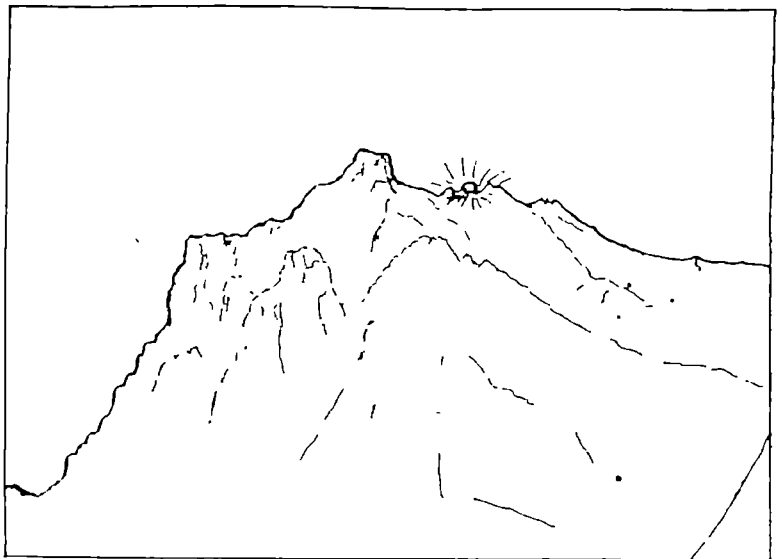


Fig. 2.

THE RISING SUN FROM GRINDELWALD

distant view was not reduced proportionately to the distance, but on the contrary was subjectively

magnified. The arc of horizon comprised in the sketch made at Grindelwald was 34° ; that from Bern, 21° . Thus the subjective enlargement of the mountains seen from Bern was 1.6, that of the sun being 1.7, which for this class of observation is practically identical.

Following up this clue, I measured drawings of the arc of the horizon included in a page of my sketch-book when drawing the long line of comparatively low hills on the west of Bournemouth Bay, and the lofty mountains enclosing the valley of Lauterbrunnen. I found that whereas the impression of lateral extent received in the former case was the greater, the arc of the horizon comprised in the panoramic sketch was much less, that is, the eye was sooner satisfied when it had to deal mainly with one dimension.

Referring again to the small apparent size of the sun when rising above a crest-line something like 20° above the line of sight, that is, above the Wetterhorn seen from Grindelwald, it will be noted that the features of the view are not strung out in a narrow horizontal band as when the range of which the Wetterhorn is a member is

viewed from Bern forty miles away. It seems, therefore, that the more the eye takes in vertically the more it takes in horizontally and the less imposing are both dimensions.

These indications led to an interesting result on measuring drawings which comprised the peaks of Eiger and Mönch seen from Gurten-Kulm and from Kleine Scheidegg, distant respectively about 37 and $2\frac{1}{2}$ miles. From the former position, the arc of the horizon in the page of the sketch-book was $18\frac{1}{2}^\circ$; in the latter $60\frac{1}{2}^\circ$. The peaks seen from Kleine Scheidegg stood about 26° – 27° above the line of sight. These measurements explain the familiar sense of disappointment experienced on near approach to mountain peaks the great magnitude of which has impressed the mind when viewed from a distance. As we approach the mountain the field of attention steadily expands without, however, any warning sensation in the eye. Our field of attention varies according to circumstances and the mind transfers the change of magnitude to the objects in the field, but in the reversed sense, an actual restriction of the field being accompanied by apparent enlargement of the objects viewed.

Expedition to Baffin Bay, 1937

AN expedition, led by J. M. Wordie of St. John's College, Cambridge, has returned from a three months voyage to Davis Strait and Baffin Bay. The party, ten in number, had as its main objectives the geology and archaeology of Ellesmere Land and the investigation of the upper atmosphere by free balloons. The Norwegian motor-sealing vessel *Isbjørn*, of Tromsø, 172 tons, carrying a crew of twelve, was specially chartered for the expedition, and sailed from Leith on June 27, returning on October 1. H. Carmichael and E. G. Dymond, who was assisted by I. M. Hunter, made cosmic ray investigations with high-altitude balloons near the magnetic pole. Eskimo anthropology and archaeology were studied by T. C. Lethbridge and T. T. Paterson, assisted by R. W. Feachem and D. Leaf; geology, petrology and physiography by Paterson, H. I. Drever and A. H. Robin; and botany by Feachem.

The year was exceptional in that no ice was met with in Melville Bay, and the ship was able to proceed as far north as Bache Peninsula in Ellesmere Land without ice hindrance; the Middle Pack, which usually occupies the west side of Baffin Bay, and is fed from Smith Sound and

Lancaster Sound, was nowhere seen. This lack of ice, though it gave unusual opportunities for archaeological work and geographical exploration, had the disadvantage that no large floes were available out at sea as launching grounds for balloon flights, and cosmic ray work was therefore confined to the West Greenland coast.

The cosmic ray experiments involved the measurement of the intensity of the radiation at great altitudes in the polar atmosphere, and instruments were conveyed to heights of more than 25 km. by free balloons, utilizing the methods of Prof. E. Regener of Stuttgart. Two types of apparatus were used, one designed and constructed by Carmichael in the Cavendish Laboratory, Cambridge, consisting of a pressure ionization chamber and electrometer with photographic recording of the ionization, pressure and temperature, and the other, by Dymond in Edinburgh and J. A. Ratcliffe in Cambridge, a triple-coincidence counting set with wireless transmission of the counts and the barometric pressure. In addition, the intensity of the cosmic rays at sea-level was recorded by two ionization instruments, one lent to the expedition by Regener and Hoerlin,

the other by Millikan and Neher. Two flights with Carmichael apparatus were made and four with Dymond apparatus. Both the Carmichael instruments were recovered with their photographic records, and coincidences were counted to considerable altitudes on three of the Dymond flights. One Dymond apparatus to which a recording Bosch meteorograph had been attached was also recovered.

To test wind conditions, pilot balloons were released on every possible occasion, balloons of larger type than usual being used so as to obtain a rapid ascent to great heights. The rate of ascent, about 21 km. per hour, was reliably determined

particular attention being given to work at Turnstone Beach, Buchanan Bay, Ellesmere Land and at Cape Hardy (Cape Sparbo), North Devon. They have brought back a very fine collection which far exceeds any previously made in this part of Arctic Canada, and which it is hoped will determine the early material culture of the Eskimo who crossed Smith Sound into Greenland about twelve hundred years ago.

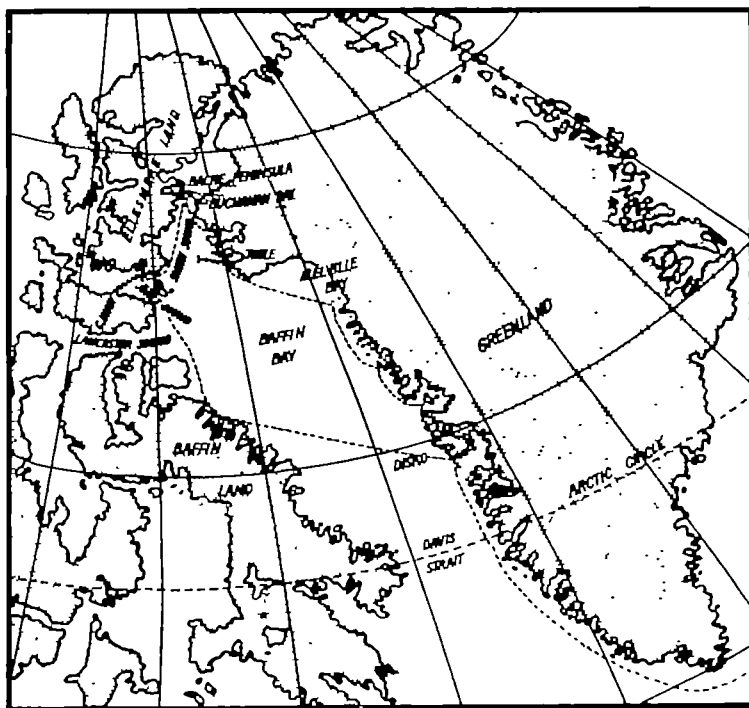
The geological results were also very satisfactory. In West Greenland, north of Disko Island, sills and dykes were discovered, traversing the Tertiary basalt lavas and showing a differentiated series with banded gabbros and allied rocks,

recalling the Tertiary material found by Wager and Deer at Kangerdluak, East Greenland, in 1935-36. The Thule sediments of North-west Greenland were traced into Ellesmere Land and found to pass conformably upwards into Lower Cambrian rocks with a trilobite and brachiopod fauna. This series was also found as far south as Jones Sound, proving a greater extension into Canada than was hitherto suspected.

On the return voyage, unexpected geographical discoveries were made in North-east Baffin Land, which was found to be a region of long fjords penetrating a glaciated mountain area south-westwards into hill country of low relief. This region was probably familiar in part to Dundee whalers last century, but its extent and variety were quite unexpected. New fjords and islands were discovered, and of the fjords six are 40-60 miles in length, while there are

many others of shorter extent. The fjords themselves are steep, with mountain walls 2,000-2,500 feet in height. By contrast, the land beyond is open and not unlike Scottish moorland country, and at one time must have carried a plentiful reindeer stock.

A running survey was made of the new land, using sextant and range-finder methods with the ship's course as base, and in this way more than 600 miles of new coast-line were successfully mapped. The work had to be done quickly late in the season, and was carried out by the entire party led by Paterson, who selected this method as being the best in view of the limited time available, the persistent low clouds on the mountains, and the sluggishness of the compass near the magnetic pole.



BAFFIN BAY EXPEDITION, 1937. ROUTE SHOWN BY DOTTED LINE.

by synchronized observations with Watts 3½ in. theodolites from the ends of bases of about one mile. In all, twenty-eight pilot balloons were flown, and nineteen were followed to their bursting points, reached from one to one and a half hours after release. The still larger balloons, with apparatus, ascended more slowly and were in the air for three to four hours. The balloon work showed that, in general, during this particular summer, the air near Greenland was remarkably still above 20 km. and that, even up to that height, high-velocity winds were rare. On occasions, balloons ascended almost vertically to their greatest heights. The whole personnel of the expedition assisted in launching and observing the balloons.

The archaeologists excavated numerous Eskimo ruins in Ellesmere land and North Devon,

The Standard of Anglo-Saxon Silver Pennies

By Ernest A. Smith

THE Department of Coins of the British Museum was considerably enriched some time ago by the valuable collection of Early English coins, bequeathed by the late Mr. T. G. Barnett, of Birmingham, which includes some five hundred silver pennies of various Anglo-Saxon kingdoms. These begin with a series of Mercia, including fine portrait coins of Offa (A.D. 758-796) of workmanship unrivalled until the reign of Henry VII, and the still rarer portrait coin of his queen Cynethryth, the only queen to appear on coins until Mary Tudor. In describing this collection, Mr. J. Allen, keeper of the Coin Department, points out that "the historical value of the Anglo-Saxon coinage lies in the fact that it records rulers otherwise unknown, illustrates by its mints the rise and fall of Kingdoms, and particularly well illustrates the struggle with the Vikings and Danes".

Apart, however, from their undoubted historical value, the large number of Anglo-Saxon pennies included in the collection is of special interest as, incidentally, it raises afresh the question of the fineness of the silver coinage used at that period, as Anglo-Saxon and Anglo-Norman coins are believed to have been made of the same alloy as that now known as sterling silver. This contains 92.5 per cent of silver, and has been the legalized standard for the silver coinage and the manufacture of silver wares in Great Britain for a period now extending well over six hundred years.

This being so, it will not be without interest to consider briefly the available evidence in support of this belief, especially as there appears to be no lack of suitable material with which to confirm it.

During the past fifty or more years, very considerable numbers of Anglo-Saxon silver pennies have been brought to light by the spade. This is perhaps not surprising when we recall that "the increase of mints inaugurated by Aethelred II (866-871) was continued to the end of the Anglo-Saxon period, during all of which time there was a great output of coins, and throughout a general uniformity of style and fabric" (Gueber). A wonderful find was made as early as 1840, at Preston, when a leaden chest was discovered containing no less than 10,000 silver coins, and nearly 1,000 ounces of silver ingots. It is thought to have been the treasure chest of the Danes who were defeated there in 911. Two years earlier, in 1838, some 550 coins were dug up at Gravesend, Kent; and in more recent years smaller lots have been brought to light from time to time. Doubtless

some of these eventually found their way into the melting pot, but in spite of this, many excellent specimens of Anglo-Saxon coins and silver wares are to be found in the British Museum and other museums of the country. It would appear, however, that up to the present, very few of these coins have been subjected to chemical analysis in order to determine their composition, a method of investigation that is now taking such a prominent place in all modern archaeological research. Such few analyses as have been published seem to indicate that the composition aimed at by the Anglo-Saxon coiners was of the nature of a definite standard, which corresponded more or less to the sterling silver of more modern times. Thus, a few coins issued before the Norman Conquest, assayed by the late Sir W. C. Roberts-Austen, chemist of the Royal Mint, gave the following results in regard to silver content. A coin of Burgred, King of Mercia (A.D. 852-874) contained only 33.2 per cent of silver, whilst one of Ethelred (A.D. 978-1016) was found to contain 91.84 per cent of silver, and was probably intended to represent the old standard of England, 92.5 per cent. A coin of Canute (A.D. 1016-1035) proved to be of the standard 93.1 per cent silver, and Roberts-Austen considered was clearly intended to represent the old standard. A coin of William the Conqueror was found to contain 92.3 per cent of silver, and was therefore of sterling quality. Unfortunately, no analyses of Anglo-Saxon silver wares appear to have been made, or if made, have not been published.

At first sight there may not appear to be very much agreement between the figures quoted, but in considering these compositions, it must not be overlooked that the early silver melters were not conversant with the scientific casting technique adopted at the present time to ensure uniformity of composition. Also they had no knowledge of the segregation that invariably takes place when silver-copper alloys solidify, and gives rise to irregularities of composition.

In regard to the adoption of this somewhat peculiar silver standard, Roberts-Austen has pointed out that, in the case of both the gold and silver currency of Great Britain, the adjustment of the relative proportions of the precious and the base metals was undoubtedly guided by the particular system of weights used. In the case of the silver coinage, the fineness of alloys of this metal has from very early times been computed by divisions of the troy pound, which is said to have

been derived from the Roman weight of 5759.2 grains, the 125th part of the large Alexandrian talent, this weight, like the troy pound, having been divided by the Romans into twelve ounces.

There seems to be little doubt, therefore, that there is a distinct connexion between Roman and modern coins and plate, which suggests that the sterling silver was most probably introduced by the Roman coiners. Both Roman and Anglo-Saxon coins and silver wares were undoubtedly made from silver obtained from argentiferous lead by the cupellation process, to which more or less copper was intentionally added to give greater hardness to the metal to enable it better to withstand wear. That the Romans were skilful in conducting the cupellation process is proved by the high percentage of silver contained in many of their earlier issues of coins for which this silver was employed. Gowland¹ has shown that the coins of the Romans, especially during the periods of the Republic, and the Empire up to the time of Nero, and again, with a few exceptions from Constantine to Justinian, frequently contained 98-99 per cent of silver. Much lower percentages, as for example 95 and less, indicate the intentional addition of copper. Some Roman silver coins of the first three centuries, found at Baden-Baden in 1825, when analysed showed a silver content varying from 91.3 down to as low as 50.5 per cent silver. Some of the higher quality coins had the following percentages of silver:

Tragan	(A.D. 98-117)	89	per cent silver
Hadrian	(A.D. 117-138)	88.25	"
Antoninus Pius	(A.D. 138-161)	91.3	"

A coin of the Triumvir Antoninus (31 B.C.) had almost the same composition as British silver coins, as it contained 92.5 per cent of silver, and 7.1 per cent of copper, the remainder being gold and lead.

The differences shown in these figures are no doubt partly accounted for by the fact that the Romans adopted the method of casting their coins for the sake of cheapness and speed, and in consequence greater irregularities in composition are to be expected than in coins cut from sheet metal.

In this connexion also the assays of Roman silver objects in the British Museum, made by Gowland², are of considerable interest. They gave the following percentages of silver: Spoon, 95.64; dish, 94.30; dish, 92.50; rim of vessel, 95.52; bottom of another vessel, 94.90; patera, 95.15; large dish, 95.09.

As Gowland remarks, "in these assays the proportion of silver present ranges from 92.5 to 95.6 per cent, which would almost seem to indicate that this composition was aimed at by the Romans for what may be termed silver plate, and was of the nature of a definite standard."

The above data are of extreme interest, and although few in number, and not conclusive, they are sufficient to indicate without much doubt that the origin of sterling silver belongs to a much more remote date than is generally supposed. It is a common belief that the introduction of sterling silver dates only from 1300, when it was first legalized as the quality of silver to be used for silversmiths' work. But in the earliest known accounts in which the standard of fineness is mentioned, it is always spoken of as the 'old standard of England', or as 'Easterling silver', thus showing that it had been in use for a considerable time prior to the passing of the Act. As already stated, the coinage of William the Conqueror was of this standard, which may therefore be said to have been in existence, without much interruption, from that time until the present day. Here it may be stated that opinions differ as to the origin of the term sterling, but the explanation found in the oldest records, and now very generally accepted, is that it is derived from the Germans, who were termed Easterlings by the English, from the fact that they lived 'eastward'. The money made by the German coiners was famous throughout Europe for its good quality, and it is said that German melters were fetched over in the twelfth century to improve the British coinage, which at that time had become somewhat debased. The coins made by these melters was termed Easterlings money by the English, but in the course of years, with the propensity for clipping long words, the first two letters were eventually dropped, and thus the alloy became known as sterling silver.

There is little doubt that silver of sterling standard was also used at a very early date for the production of silver wares, and it was only when fraudulent practices increased in their production that it was legalized to protect the honest craftsman and public alike.

The question of its origin is one of more than passing interest, as it concerns an alloy which is produced in considerable quantities annually, and has long been accepted as the most suitable standard for silversmiths' work not only in this country but also in America and elsewhere.

Now that the importance and value of chemical analysis as an indispensable aid to archaeological research is being more generally recognized, it is to be hoped that further analyses of Anglo-Saxon coins and silver objects will be made, so that fresh light may be thrown on this interesting question.

¹ *Brit. Mus. Quart.*, 10, 124 (March, 1936).

² *Quarter Lectures on "Alloys used for Coinage"*, Roberts-Austen, *J. Roy. Soc. Arts* (1884).

³ *"The Metals in Antiquity"*, W. Gowland. Royal Anthropological Institute of Great Britain and Ireland. 1912.

Obituary Notices

Prof. Arthur Hutchinson, O.B.E., F.R.S.

IN the death of Arthur Hutchinson, emeritus professor of mineralogy in the University of Cambridge, and lately master of Pembroke, the science of mineralogy has lost an able exponent and investigator. His distinguished services to his Department, first as demonstrator and lecturer and finally as professor, extended over a period of thirty-six years. His loss is a heavy blow to his profession, his University, and his friends.

That which Hutchinson accomplished during his scientific life divides naturally into two parts, the results of his investigations and his work as a teacher of mineralogy. His first piece of crystallographic research was carried out while he was still a scholar at Christ's College. Afterwards he studied under Emil Fischer at Würzburg. His accomplishments in the field of analytical chemistry are seen in his early work on the mineral stokesite, which he discovered and described. His analysis of this unique and only known tin silicate and the derivation of its formula was performed upon a minute fragment of the only single crystal that has yet been found.

Hutchinson established the chemical formula of the mineral lengenbachite and with A. M. Macgregor he gave a complete account of the composition and optical constants of another new mineral—cornetite. Hutchinsonite, a rare thallium mineral from the Binnenthal, was named in his honour.

Much time and thought was given by Hutchinson to the graphical treatment of problems in crystallography and crystal optics, and we owe to him the stereographic protractor and a crystallographic slide rule, instruments by means of which laborious calculations may be checked or avoided and the problems accurately solved by graphical methods. Later he showed how his stereographic protractor could be adapted to the rapid indexing of the spots of a Laue crystal photograph. In the field of crystal optics Hutchinson's memoirs on the diathermancy of antimonite are pioneer investigations. Introducing a new method of attack on crystallographic problems, he made an accurate determination of the refractive indices and dispersion of this opaque rhombic mineral for wave-lengths at the extreme red end of the visible spectrum. In these investigations Hutchinson's skill and resource as an experimenter are seen at their height.

Hutchinson excelled as a teacher and he gave unrelenting thought and attention to improving the material equipment for his lectures. He constructed with great skill and ingenuity many large crystal models and other apparatus for use in elementary instruction. During the latter part of his career, he devoted much time and energy in the vacations to the care of the large mineral collection, which now became of increasing service in teaching and research.

His genial personality and great capacity for friendship endeared Hutchinson to his colleagues and old

students alike, and the expression of their devotion was signally evoked in the large and representative gathering which assembled to honour him by the presentation of his portrait on the occasion of his retirement from the chair in 1931. He was elected a fellow of the Royal Society in 1922; he also served as president of the Mineralogical Society (1921–24), of which at the time of his death he was foreign secretary.

The period of Hutchinson's professorship (1926–31) coincided with a time of intense activity in research in X-ray crystallography, and he devoted much of his energies towards the organization of his Department to meet the needs both in teaching and research of this rapidly developing branch of his subject. To this time of his tenure belongs the creation of a special lectureship at Cambridge in structural crystallography, and the establishment of a laboratory of crystal physics. These developments foreshadowed the ultimate reorganization of the subject of mineralogy in the Natural Sciences Tripos. The well-equipped new building for mineralogy erected in 1933, and the crystallographic research laboratory, stand as memorials of his life and work.

We regret to record the death at Warsaw of Dr. Pawal Łada, a young Polish geneticist, who was working in the School of Agronomy of the University of Crakow, in July last, aged forty years. He had made intensive studies of rye and was seeking to produce a variety having six rows of seeds instead of the usual four. He had also studied a disease known as 'brittleness' in rye and showed that it is really a genetic character unaffected by environmental conditions; in his breeding experiments it behaved as a simple Mendelian recessive. He discovered no character of the seed correlated with brittleness, so was unable to find a way of discarding seeds subject to this trouble. As part of his technique he carried out his experiments in special nurseries located in an area of woodland remote from cultivation, so that his plants could be shielded from cross-fertilization from outside sources. Łada was a native of the Ukraine, but he settled in Poland as a refugee, and in his researches he was assisted by his wife, who had been also a fellow student. There was a freshness of outlook and ingenuity in his methods of experiment that promised well for his future had he lived.

We regret to announce the following deaths:

Dr. N. Gustaf Dalén, inventor of automatic regulators for use in conjunction with gas accumulators for lighting lighthouses and light buoys, for which he received the Nobel Prize in Physics in 1912, on December 10, aged sixty-eight years.

Prof. G. H. F. Nuttall, F.R.S., emeritus professor of biology in the University of Cambridge, on December 10, aged seventy-four years.

News and Views

The National Institute of Industrial Psychology

In his speech at the annual general meeting of the National Institute of Industrial Psychology held on December 16, Lord Dudley, president of the Institute, referred to the ever-widening field of its work. This was particularly shown in the investigations of environmental conditions in schools. The vocational guidance department has had more demands for assistance in the choice of a career than ever before, the figures for the year being 1278, an increase of 17.5 per cent on those of the previous year. In its industrial investigations, the Institute offers a service to industry which it endeavours to make as complete as possible. While all the Institute's work is approached from a psychological point of view, the part which pure psychology plays varies from branch to branch. Devising selection tests, for example, and finding and ameliorating staff grievances depend almost entirely on psychological considerations. On the other hand, problems of heating and ventilation, of lighting and of movement study, involve largely physiological considerations. Sir John Keane, chairman of the Institute, said that alterations and additions have been made to the Institute's premises, but that there is an urgent need of new accommodation. In speaking of new developments, Sir John referred particularly to the promising start that has been made in the north-western area by the Institute's new branch office in Manchester. It is hoped, he said, to develop in other areas regional sections for membership which might lead to the formation of further branch offices. It is also hoped that in the future the Institute's advisory service on the heating, lighting, and ventilation of schools will be extended to hospitals.

Science and Social Service

In his address on "Science and Social Service" given to members of the National Institute of Industrial Psychology at the annual general meeting, Sir Richard Gregory stressed the urgent need of the application of scientific method to social and international problems. Although scientific discoveries may be prostituted in the cause of war, it must be acknowledged that the advance of science has on the whole led to an enormous alleviation of human suffering and an increase in the capacity and facilities for happiness. As science is responsible for the industrial developments and economic changes which have caused violent disturbances in our social structure and provided also the means by which civilization may commit suicide, it has a duty to guide the human race in the wise use of the powers it has created. The personal and group loyalties of men, their fears, ideals, passions and ambitions all

lend themselves to scientific study with the view of providing a basis for effective social action. It is fashionable at the present time to blame the machine for the mechanization of life. To do this is to make the fundamental mistake of regarding the machine as the master and not the servant of society, and to forget that the most regrettable results of industrialization are not for the most part the direct fault of technological progress, but of lack of consideration for human needs. One of the prime needs of the present time is the development of research in the social and biological sciences on a scale commensurate with that of the physical sciences. The principal aim of any such studies should be to increase the comfort and promote the intelligence of the worker in order to combat the evils due to conditions arising out of mechanization in industry. Most of the work of the National Institute of Industrial Psychology is designed to this end, and is thus assisting in the adjustment of society to the changes caused by technical development.

New Buildings for the University of London

An important modification of the building plans of the University of London on the Bloomsbury site is announced. Mr. Charles Holden's original model published in 1932 proposed a building nearly a quarter of a mile long with two towers and long façades on Malet Street and Woburn Square. This was afterwards modified by the introduction of two bays on the Malet Street frontage. The design received almost complete commendation from the lay and professional Press. *NATURE* in an article by "T. Ll. H." published in the issue of July 9, 1932, was the first journal to express misgiving. "Questions of style apart," it was suggested, "air, sunlight, and accessibility are crucial in considering the design. Is it wise, from these viewpoints, to build a single huge building, possibly the largest in London, a break-air, if the word may be coined?" Attention was directed to the difficulty of ventilating a large building and the plea put forward "that the idea of a single great building should be abandoned and an alternative design adopted treating the problem in a more free and characteristic way". This policy has now been officially adopted and a group of buildings surrounding the garden of Torrington Square will be substituted for the northern part of the site. Sites have been offered to Birkbeck College and the School of Oriental Studies. Birkbeck College has in recent years greatly developed its work in scientific teaching and research, particularly for evening students, and will presumably require large laboratories, lecture theatres and other accommodation.

The Metric System and British Export Trade

PRESIDING at a lecture by the Rev. A. J. Stubbs, vice-chairman of the Decimal Association, at the Institute of Export on December 14, Sir Isidore Salmon, M.P., declared that British industry could save large sums of money internally, and increase international trade by millions of pounds a year, if Britain cared to adopt the metric system. "It is unbelievable," he said, "that our own Government has virtually ignored the decimal and metric systems, which are employed by every one of our foreign competitors and many of our Colonies and Dominions. We should in our own interest do all we can to bring before the Government the urgent necessity of appointing a committee to inquire into the whole question." Mr. Stubbs, who before he was ordained, was an electrical and civil engineer, said that of our overseas trade, 84 per cent went to decimalized coinage countries, including about one third of our British overseas markets. The importance of the metric system was also plain, he said, when it was realized that for export purposes we had to manufacture different sizes of machined products, other goods or cartons, and effect intricate internal calculations. It might be said that, to improve export trade, our first duty was to adopt the metric system with its internationally agreed and unalterable values. Mr. Stubbs mentioned that among the influential supporters of a British metric system and decimal coinage were the British Chamber of Commerce, the International Chamber of Commerce, the Federation of British Industries, the Trade Union Congress General Council and the National Association of Head Teachers.

History of Science

THE October number of the *Annals of Science*, a quarterly journal dealing with the history of science, published by Messrs. Taylor and Francis, contains some papers of unusual interest. Prof. J. R. Partington and Dr. D. McKie contribute the first part of their historical studies on the phlogiston theory, dealing with the levity of phlogiston. This theory had a most important influence on the development of chemistry, yet its history is in many ways defective. Prof. Partington and Dr. McKie have made a very detailed and thorough study of the original sources, and show how the idea of the levity of phlogiston developed and what forms it took during the second half of the eighteenth century. Particular attention is given to the views of Guyton de Morveau, a portrait of whom is prefixed to the issue of the *Annals*. Prof. Marjorie Nicolson and Prof. Nora M. Mohler contribute a very interesting study of Swift's "Voyage to Laputa", in which they show how carefully Swift read the contemporary scientific literature and how skilfully he was able to make use of it in his own writings. There are also interesting papers on views concerning the nature of heat and cold, on aqueous vapour and evaporation, on the teaching of the history of science in a women's college in America, and on the Chemical Society of Glasgow.

Early Astronomical Instruments at Oxford

ALTHOUGH a manuscript of 1697 in the Bodleian Library has provided an inventory of the instruments belonging to the early Savilian professors, it is only quite recently that certain of these instruments were discovered to be still in existence and within the walls of the University Observatory itself. In the *Observatory* of July, p. 190, Dr. R. T. Gunther describes four instruments which have been re-assembled from "certain old metal bars and plates" found behind some cases in the University Observatory and brought to the notice of Dr. Gunther by Prof. H. H. Plaskett. These newly discovered instruments are: (1) a 14-in. astrolabe made by Thomas Gemini in 1559 for Queen Elizabeth; (2) a mural quadrant of 6 ft. 9 in. radius made in 1637 by Elias Allen; (3) a 6-ft. iron sextant with brass limb, to be attributed possibly to Elias Allen; and (4) an equatorial quadrant of 2-ft. radius of which the maker is uncertain. In describing these interesting instruments, Dr. Gunther directs attention to the high excellence of Allen's work as instanced by the mural quadrant of 1637, which he divided to give direct readings to 2' and, by means of a diagonal scale, to 12". It is suggested that these instruments were installed by Bainbridge, the first Savilian professor, on whose death they passed as his private property to his successor, John Greeves; in 1659, seven years after the death of John Greeves, the instruments appear to have been given to Oxford by his brother, Nicolas Greeves, in memory of the first two Savilian professors.

Grass Drying

THE development of grass drying since 1927 was discussed by Dr. R. E. Slade in a lecture given to the Institution of Chemical Engineers on December 17. Progress has been remarkable and further advance depends on reducing capital and running costs, designing a plant suitable for small farmers, and improving management so as to ensure a continuous and reasonably steady supply of grass during the growing season. The best plants to-day, said Dr. Slade, can produce high-protein dried grass at an overall cost of £5 a ton, including obsolescence, and this cost compares favourably with that of feeding cakes at the present time. Dr. Slade has recently been experimenting with a simple, inexpensive dryer, workable by one man and suitable for a farm with 50-100 acres of grassland. A single fixed tray, 15 ft. long, 7 ft. wide, with a deep bed of 2½ ft., is charged with grass to a depth of 2 ft. The grass is held down with a hurdle, covered with Hessian, and heated by furnace gases at 120° C. for 1½ hours; it shrinks 10-12 inches, more grass is added, and the heating is repeated for a like time. The grass, now nearly dry, is tedded and then heated again for 45 minutes. The average air-cycle efficiency during the 4 hours' heating is 76 per cent, and the weight of water evaporated, in a two-day test, was 7.6 cwt. for each cwt. of coke burned. This simple and inexpensive dryer is to be tested further during the coming year.

Artificial Wool Production in Italy

THE manufacture of artificial wool from milk has been successfully started in Italy, and the product known as Lanital has been shown to possess properties suitable for the textile industry. Ninety-four tons of Lanital were produced in 1936 and 760 tons in the first seven months of 1937. The process is based on a patent taken out in 1935 by Comm. Antonio Ferretti, and the plant as installed at the factory of Snia Viscosa at Milan is described in an illustrated article in *Engineering* of December 17. In the process, milk is first deprived of most of its cream, and then chemically treated to coagulate the casein. From vats the casein is transferred to tanks in which are placed water and certain solvents, the result being a viscous substance which can be made into fibres by squirting through fine holes in a spinning nozzle. After passing through an alkaline bath, the fibres in bundles are cut into 'flocks' which after further treatment are dried in steam-heated drying machines, the material then being ready for spinning and weaving into fabrics. It is stated that 'Lanital' has higher heat retaining properties than natural wool and that it can be boiled without loss of weight. Though established to render Italy free from the necessity of relying on outside supplies of raw material, purchases of casein are already being made from Holland and Denmark. It is, however, estimated that the country can supply 20-25 per cent of its wool requirements. At a recently opened exhibition in Rome, a whole pavilion is devoted to the Lanital industry.

Scandinavian Influence in Northumbrian Art

SCANDINAVIAN influence, owing to the Norse occupation, left a deep-seated and long-persistent mark on the life and culture of northern England, which is especially to be noted in art motifs and decorative design at the close of the first and beginning of the second millennia of our era. An interesting and instructive example of this influence is to be seen in the crozier of Bishop Ranulf Flambard, who died in 1128, and whose tomb on the site of the Chapter House of Durham Cathedral was opened in 1878. With his body were found the remains of a pewter chalice, his sapphire ring and his pastoral staff. The ring and staff were exhibited by Mr. T. D. Kendrick at the Society of Antiquaries on December 16. The wood of the staff has perished, but there remains the crook and ferrule of iron. The crook was silver-plated, and had been cleverly and delicately chased with an interlace of slender serpents, the design being inlaid in niello. As Mr. Kendrick pointed out, Flambard had so far identified himself with northern England as to adopt for his crozier the hard and economical ecclesiastical art of Northumbria in preference to the richer style of southern England. Mr. Kendrick went on to show that this ornament was in the characteristic eleventh century Viking style, and must have been made by a smith well practised in making the silver-plated spearheads with niello design of serpents and scrolls, which come chiefly from the Baltic lands. Some of such spearheads had been found in England, and there was

little doubt that Flambard's staff had been made by a Northumberland smith. Though the design was Scandinavian in style and feeling, in detail it showed certain marked peculiarities, which must be regarded as northern English, since they could be explained only as due to a long-established English manuscript style. They were not found in purely Scandinavian art. There was additional evidence for this Anglo-Scandinavian style, as for example in architectural detail at Kirkburn in Yorkshire, which helped to prove its general diffusion.

Health Legislation in Industry

DR. LEONARD P. LOCKHART opened a discussion on the "Wider Issues of Health Legislation in Industry" in the Section of Medical Sociology at the recent annual meeting of the British Medical Association held at Belfast (*Brit. Med. J.*, September 25, 1937). He said that the new Factories Act, in spite of omissions and shortcomings, represents a very considerable advance in social legislation. While certain provisions will act automatically to improve health and safety, there are others that will depend on a high level of co-operation and of common consent to make the result effective. He pointed out the important part played by voluntary effort preceding the consolidation by law. For example, individual employers have done a considerable amount of experimental work in industrial health, and much of what is known as industrial welfare has proved so valuable that it has now ceased to be voluntary and is to become an obligation. The voluntary activity of progressive employers, aided by the trade unions, has provided the necessary data to form a basis of the new industrial law.

THE Act as it is pegs industrial health and welfare at a higher level than ever before, but it should not be assumed that nothing remains to be done. The long fight to obtain recognition of society's duty to its members is all but won; the next task will be more laborious, and it will lack the spectacular victories of the earlier political struggles. Nor must it be thought that the responsibilities of the employer are ended when he has fulfilled the letter of the law. Many of the wider issues of industrial health, such as the psychoneuroses and emotional disturbance, with their physical sequelae, arise not out of unhealthy conditions as commonly understood; but out of methods of work, methods of selection of staff, systems of supervision, payment and incentives, and Dr. Lockhart suggests that some form of statutory advisory board might be desirable, since it would be free to raise and discuss these matters before they became political questions. He also advocates an industrial training for doctors as a post-graduate course. The paper raises many important issues, and is worthy of very careful consideration.

Control of Public Lighting

ON December 10, Mr. J. M. Kennedy, Electricity Commissioner, inaugurated the 'Actadis' system for the ripple control of the public lighting of Maidstone. This is the latest development of a method which

began with the lamplighter going his rounds with his pole. The method is the distribution of high-frequency A.C. ripples over the electric supply network from a central transmitting apparatus. The high-frequency machine which generates the current injected at various points into the network is rated at 30 kilowatts, and its frequency can be varied between 300 and 900. They are injected directly on to the 6,600 volt A.C. system and actuate relays on the low-tension side. As condensers are placed in the high-frequency circuits, the power consumption is small. At present there are about 500 relays installed for the control of the lamps. The great advantage of the system is that the whole street lighting of a city can be switched on or off by actuating push buttons at a central point. If this system were adopted in a city, every street lamp could be extinguished within a few seconds of warning of an emergency being received. The system can also be used to control part of a load, for example the load required for the 'water heaters', for a short time so as to prevent the maximum load, as shown by the 'maximum indicator' being exceeded. The system was installed in Maidstone by Actadis Ltd., Vincent House, Vincent Square, S.W.1. The bulk of the apparatus is manufactured in Great Britain.

Coloured Roads

IN *Roads and Road Construction* of October 1 Mr. C. W. Manlove considers the question of whether it would not sometimes be advisable, instead of having a mass of signs at the side of the road, to colour the traffic lanes with various colours. A good driver looks at the road surface ahead, and should not be distracted by having to decipher road signs, a necessity which is sometimes contributory to accidents. If the road surface had a tinted colour when the speed limit changed, the driver would automatically notice that he was entering or leaving a controlled area. The coloured road has for several years been a common feature in the United States. This is probably due to the fact that in America many of the roads are made of concrete; in Great Britain concrete roads are only beginning to be made. Recent official tests on the main Bath Road prove that a concrete road has a very long life. It has been computed that if the load does not exceed 15,000 tons of traffic a day, to wear the surface down one inch would take 200 years. The Cement Marketing Board estimates that the cost of tinting the top of a cement carriage road to the depth of two inches, supposing the road to be 30 feet broad, would be about £250 per mile. As international colours are used for colouring electrical engineering diagrams, the day may come when international colours will be used on the surfaces of the roads for warning and directing chauffeurs when danger is ahead and a change of speed is necessary.

The Cross-Channel Ferry Service

THE cross-channel ferry service between Dover and Dunkerque has now been in operation since October 1936. The three ferry steamers engaged in the service carry passengers between Great Britain and

Europe in through sleeping cars. Recently a special ramp has been built which enables motorists to drive straight into the special garage on board the ship, which has accommodation for twenty-five cars. It is not necessary to empty the petrol tanks of the cars before boarding the ship as special fireproof construction has been adopted. The new ramp is a reinforced concrete structure at the side of the ferry dock and there is a portcullis type of transfer bridge which is lowered on to the deck of the ship. The length of each of the ferry steamers is 360 feet and the beam is 63 feet. It is provided with twin screws each driven by a Parsons steam turbine through single reduction gearing. The normal speed is 16½ knots and the total horse-power is 4,900. It takes 500 passengers, 12 sleeping cars (or forty goods wagons) and 25 cars in the garage. The *British Engineers' Export Journal* of August states that the traffic carried by the train ferry is very varied. To the engineering exporter this ferry service is of great value, since heavy and awkward pieces of machinery can be loaded on a truck at Victoria and need suffer no transshipment until they arrive at a destination on the Continent. Up to May 31 of this year, the ferry service conveyed 9,577 loaded wagons, and during the same period 12,277 tons of merchandise were conveyed in through trucks from Dover to Dunkerque, and 23,288 tons were carried in the reverse direction.

Forestry Research in Malaya

THE Research Institute of the Forestry Department of the Federated Malay States has now been in existence for some years and is carrying out investigations of varying types which should have considerable importance for the improvement of the forests of the country. The Institute is organized on the lines of the Imperial Forest Institute at Dehra Dun in India, the branches consisting of silviculture, botanical, wood technology, timber mechanics, seasoning, preservation and durability of timbers and entomology. Chemical investigations affecting forestry are undertaken by the Chemical Division of the Department of Agriculture, a grant being made by the Forest Department for this purpose. The Institute works in collaboration with Princes Risborough and also with the Malayan Railway Department and with the Civil Engineer, H.M. Naval Base, Singapore. The Forest Botanist, whilst on leave, spent some time working on a collection of Malayan specimens at Kew, where, by the courtesy of the director, he was accorded assistance by the Kew Herbarium staff. An item of botanical interest is mentioned in the annual report for 1936 (Forest Research Institute, Kepong, 1936) referring to the Gunong Tahan Expedition. The collection made includes 144 numbers, mainly from the open *padang* of the mountain tops. Although this collection has not yet been completely worked through, it is said that "it is evident that, though it contains very little that is new, it includes some nice material of rare species known only from this locality, e.g. *Agathis florescens*, Ridl. and *Gentiana malayana*, Ridl."

Forest Bibliography

Two parts of the "Forest Bibliography to 1933" have now been issued from the Department of Forestry of the University of Oxford. This work has been compiled by Prof. R. S. Troup and his staff. The systematic referencing of current forest literature was commenced at Oxford in 1920, and continued jointly by the Forestry Department and the Imperial Forestry Institute after 1924. The object at first was to provide staff and students with facilities for keeping in touch with forestry literature. Recently, in response to requests, publication was decided upon. The Bibliography comprises literature published to the end of 1933, and contained in the library of the Oxford Department of Forestry. Forest literature published on and after January 1, 1934, is being dealt with under the decimal system of classification prepared by Dr. Flury and recently adopted by the International Union of Forest Research Organizations. The Oxford Bibliography is said to comprise a fairly complete list of material published in English and a considerable amount of literature published in French and German. Material from other countries is mainly confined to literature where an English, French or German summary is appended. The first part opens with a list of abbreviated titles and then gives the subjects of classification as *A*, General Forestry; *B*, Sylviculture; *C*, Forest Protection; *D*, Forest Utilization; *E*, Forest Mensuration; *F*, Forest Valuation and Finance; *G*, Forest Management; *H*, Forest Policy and Economics; *I*, Meteorology; *J*, Geology; *K*, Education and Research; *L*, Terminology and Classification of Information; *M*, Engineering and Surveying; *N*, Botany; *O*, Invertebrate Zoology; *P*, Biography. Most of these branches are divided into sub-heads.

The Strangeways Research Laboratory

THE investigations described in the report of the Strangeways Research Laboratory, Cambridge, for 1936 fall into two main divisions: one is concerned with the growth and development of cells and tissues, or with their organization in the embryo; the other deals with the action of radiations on the living cell, with the object of analysing their destructive effect so that the different forms can be used to the best advantage in the treatment of cancer. The methods of cell culture have found many applications in the work of biological and medical laboratories. The Strangeways Laboratory continues to attract workers from other centres, who go to Cambridge to obtain instruction and practice in a difficult and still relatively unfamiliar technique. The Trustees point out that the income of the laboratory is chiefly made up of grants from public bodies and corporations and donations from individuals, which cannot be regarded as permanent. The great need is an endowment to provide an income not necessarily large but assured, so that plans may be laid for the future in reasonable security. Additional space is required for the visitors to the laboratory and for the development of the work on experimental embryology, which has now reached a stage when expert assistance from biochemists is urgently needed. The Trustees express

the hope that a capital sum sufficient to provide an extension to the present building may be forthcoming, as well as sufficient funds to provide the requisite additional annual income.

Training in Business Administration

ESTABLISHED seven years ago, the Department of Business Administration at the London School of Economics provides a post-graduate course extending normally over one year for men and women who intend to follow a business career. It has been found that such post-graduate students are of three main types. First, there are university graduates in economics, commerce or Modern Greats who require chiefly to learn the practical application of principles of which they are already familiar. Secondly, there are graduates in modern languages and technical subjects such as chemistry and engineering who already have technical qualifications which would often enable them to obtain immediate employment without difficulty. Later on, however, as they rise to positions of responsibility, they may find themselves obliged to exercise functions of management for which their technical training by itself provides little preparation. Training in business management should enable them to avoid many of the initial mistakes inevitable in a process of learning by trial and error. Thirdly, there are students who have already had considerable experience of business and who come or are sent by their employers to widen their outlook and increase their capabilities. At first sight it would seem difficult, if not impossible, to frame a course which would be equally suitable for these different groups, with their varying types of training and background. Experience has shown, however, that given appropriate methods of teaching, the lack of homogeneity in the class is a source of strength rather than of weakness. The work is carried on mainly in a series of discussion classes, to which each student can contribute from his own special knowledge.

Memorial to the late Viscount Grey of Fallodon

THE report of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, presented at the annual meeting on October 26, states that the North Country Memorial takes the form of a simple inscription engraved upon the masonry of the Hancock Museum in Newcastle, near the entrance. An essential part of the memorial was the creation of an endowment fund which would help to ensure the continuance of the Museum itself, and this Memorial Endowment Fund now amounts to £8,156. The sum is none too large for its purpose, but the fund is still open, and it is hoped that further donations will be received. The summary of accounts which is included in the report shows that the payments for the past year exceeded the receipts by £52 19s. 10d. The Museum itself is a valuable educational institution, and while the number of ordinary visitors is slightly down at 12,348, the increasing use made of the exhibits by classes of pupils from Newcastle Council Schools is encouraging. During the year, 1,337 scholars visited the Museum with their teachers, and arrangements have been

made whereby pupils of the schools under the Northumberland County Education Committee may share in the advantages hitherto restricted to town children.

Garden Plants from China

AN interesting account of the botanical pioneers who first made known the wonderful flora of China, appears in the *Journal of the Royal Horticultural Society* (62, Pt. 8, 347-351, August 1937). It is mainly a review of a "History of European Botanical Discoveries in China" by E. Bretschneider. The volume is one of the treasures of the Society's Lindley Library, and the article is from the pen of Mr. F. C. Stern. It was not until nearly 400 years after Marco Polo's celebrated journey that Europeans took an interest in the decorative plants of China. Domenico Parenin first mentioned *Wistaria chinensis* in 1698, but Father Pierre d'Incarville was probably the first botanical collector in China, about half a century later. It was not until the early part of last century, however, that Chinese plants began to find their way into European gardens; previous collections had been for herbarium material. The work of Dr. Abel, John Reeves, Robert Fortune, Dr. Hance, Father Armand David, Father Jean Marie Delavay, Nicolai Przewalski, Dr. Augustine Henry and other investigators of last century, is described. The account of their collections makes interesting reading, and the plants they introduced are among the greatest contributors to garden beauty.

Tokyo Earthquakes of 1936

THE last *Solismetric Report* issued by the Earthquake Research Institute completes the list of earthquakes felt in Tokyo in 1936. In addition to the central station, there are eleven others at various distances up to eighty-four miles from Tokyo, and the records obtained at these stations have enabled the position of the epicentre in all the earthquakes, and the focal depth in all but three, to be determined. The year 1936 is notable on two accounts. It is the year of fewest earthquakes in the district since the network of stations was formed, the number being only 31, or less than half the average number (64) in the preceding twelve years. Also, more than half the centres were submarine, 14 lying beneath the Pacific Ocean, 4 below Tokyo Bay, and only 13 under land. The depth of focus ranges from 15 km. to 80 km., the average being 45 km. None of the earthquakes was of destructive strength, but in one—that of November 3—the shock was of degree 7 of the Rossi-Forel scale or strong enough to throw down ornaments, vases, etc. Indeed, only four of the 797 earthquakes in the thirteen years were strong enough to cause slight damage to buildings.

The Rubber Research Institute, Malaya

THE year 1937 will stand out in the history of the Rubber Research Institute, Malaya, as it marks the beginning of a second decade of activity and was the occasion of the occupation of new premises. The purpose and recent work of the Institute are well

described in an illustrated booklet and the annual report for 1936, both of which have recently been published (Kuala Lumpur: The Institute). Research work is carried out in four main divisions, botanical, pathological, chemical and soils respectively. Many of the investigations are necessarily made in the field, both at the Institute's Experimental Station and also on, and in co-operation with, a large number of estates throughout Malaya. Retrenchment of staff during the slump and a disastrous fire in 1936 seriously curtailed the activities of the Institute, but a period of expansion is now coming into being, and the rapid development of the advisory work is good evidence that this service is appreciated by estate owners and small-holders alike.

Deep Well Drilling

At the Rumanian Branch of the Institution of Petroleum Technologists, on November 27, a discussion was held on problems of deep well drilling. (*J. Inst. Pet. Tech.*, 23; 1937). Mr. G. Elias opened by summarising the points he considered most influential in successful drilling to depth. Accidents must be avoided at all costs, and the only way to safeguard against them is by provision of suitable equipment, drillers and crews. Mud conditions must be good, as they are invariably reflected in the condition of the well itself. The ultimate cost of the well and drilling time are largely dependent on the selection of a suitable casing programme, and this should be drawn up in new areas immediately the necessary information is available from first wells. An adequate steam supply should be available on the site, not only to reduce the time factor, but also to ensure that a big volume of mud is circulated. Particular care should be taken to see that adequate derricks are employed and also that their foundations are such as to prohibit uneven settling.

Maternal Mortality

THE Ministry of Health has issued two reports upon this subject, namely, (a) "An Investigation into Maternal Mortality in England", and (b) "Maternal Mortality in Wales" (London: H.M. Stationery Office. 5s. 6d., and 2s. 6d., respectively). The national average for maternal mortality has remained for a number of years in the neighbourhood of 4 mothers per 1,000 live births, despite great expansions in maternity services and remarkable improvement in the general health of the community. The provisional figures for 1936 show a slight decline, the rate for that year being less than 4. In many districts in England and in Wales, however, the maternal mortality rate is higher than the average, being 5 or more, and the two reports survey the circumstances that may be responsible for this excessive mortality in England and Wales, and the measures that may be taken to reduce it. The rate is generally higher in industrial areas and lower in rural ones. The first report deals more fully with prevention, and a section is devoted to the subject of abortion. Attempted abortions appear to be frequent and on the increase, as well as to be responsible for a number of deaths from puerperal sepsis.

Safe Catgut for Surgical Use

REFERENCE has been made on two or three occasions in *NATURE* to the risk of tetanus arising from the use of imperfectly sterilized catgut for surgical ligatures. In order still further to reduce the risk of tetanus infection, the Minister of Health has issued new regulations which require all surgical ligatures and sutures, including catgut, that are not sold under the special licensing arrangements of the Therapeutic Substances Act, to bear a label stating in prescribed terms that efficient sterilization is necessary before use (Statutory Rules and Orders, 1937, No. 767, and Circular 1641. H.M. Stationery Office. 1d.). Catgut which is sold under licence under the Therapeutic Substances Act is free from any possible risk of infection, as its manufacture is strictly controlled and it is properly sterilized before being put on sale.

Bird Protection in Britain

DISSATISFACTION has often been expressed with the legislation by which birds are protected in Great Britain, although there can be little doubt that the law has had the effect of increasing the number of some desirable birds and of extending the survival period of others which were becoming too scarce. The present code of bird protection laws is, however, too complicated and cumbersome, and in several respects it lacks provisions which would much increase its efficiency, so that time and again attempts have been made to consolidate the position. For those who are interested in the present position, particularly in view of the possibility of future legislation, a brief but informative summary of the Acts under which birds are protected in Great Britain has been written by the editor of *Bird Notes and News*, and a first instalment appears in the autumn number (vol. 17, 167; 1937).

Bronze Bust of Sir Arthur Keith

It is proposed to present Sir Arthur Keith with an excellent bronze bust of himself in appreciation of his work in the fields of anatomy, embryology and anthropology. Sir Arthur wishes to hand over the bust to the keeping of the Royal College of Surgeons, should it be found possible to secure it. The sum of £150 is required to purchase the bust, and contributions are invited towards this amount. Cheques should be made payable, and be sent, to the secretary of the Royal College of Surgeons, Lincoln's Inn Fields, London, W.C.2 ("Arthur Keith Bust Fund"). Sir Arthur Keith has been invited by the College to give a lecture on the ancient types of man which were discovered in Palestine some years ago. This lecture will be given in the College Theatre on February 14, 1938, and it is proposed to present him with the bust on that occasion.

Announcements

THE following awards have recently been made by the Royal Aeronautical Society: *Sims Gold Medal*: to Dr. N. A. de Bruyne for his paper on "Plastic

Materials for Aircraft Construction"; *Taylor Gold Medal*: to G. Mead, for his paper on "Power Plant Trends"; *Wakefield Gold Medal*: to Dr. G. V. Lachman, for his paper on "Aerodynamic and Structural Features of Tapered Wings"; *Edward Bush Memorial Prize*: divided between Major B. O. Carter, for his paper on "Aircraft Blade Vibration", and A. G. Pugsley, for his paper on "Control Surface and Wing Stability Problems"; *Pilcher Memorial Prizes*: to A. J. Hanson, for his paper on "Critical Speeds of Monoplanes", and C. O. Vernon, for his paper on "Aircraft Performance Estimation".

At the ordinary meeting of the Institution of Electrical Engineers held on December 16, an oil painting of Mr. Sydney Evershed, by George Harcourt, R.A., was presented to the Institution. The painting was subscribed for by the many business associates and admirers of Mr. Evershed, to commemorate the fiftieth anniversary of his entry into the electrical industry, and it was formally presented, on their behalf, by Lieut.-Col. W. A. Vignoles.

At the annual general meeting of the London Mathematical Society on November 18, the following were elected officers and council for the session 1937-38: *President*: Prof. E. A. Milne; *Vice-Presidents*: Prof. G. B. Jeffery, Miss M. L. Cartwright, Mr. J. Hodgkinson; *Treasurer*: Dr. A. E. Western; *Librarian*: Prof. H. Hilton; *Editor*: Prof. G. N. Watson; *Secretaries*: Mr. F. P. White, Mr. W. L. Ferrar. At the December meeting, the Council received with great regret the resignation of Mr. W. L. Ferrar from the office of secretary, as from January 1, 1938; Mr. P. Hall, King's College, Cambridge, has been appointed to succeed him.

THE twenty-sixth annual Conference of Educational Associations will be held in University College, London, on January 3-10 under the presidency of the Right Hon. Sir Kingsley Wood, M.P. On January 4, Sir Kingsley Wood will deliver his presidential address entitled "Education and Health". A joint conference on "Health in the Schools" will be held on January 6. Further information can be obtained from the Conference Secretary, Gordon House, 29 Gordon Square, W.C.1.

THE Carnegie Institution of Washington has issued a catalogue of its publications, either issued or in press, consisting of a numerical list and a classified list arranged under subjects, with brief descriptive notes on the publications listed. A few copies of the publications still in print are reserved for sale at prices quoted, and those out of print can be consulted in certain libraries throughout the world in which they were deposited on publication. A list of these libraries is obtainable on request. Subjects covered by the catalogue include astronomy, botany, chemistry and physics, engineering, genetics, folk-lore, geology, mathematics, nutrition, philology, terrestrial magnetism and zoology.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1102.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Divided Aurora Rays with one Part in the Sunlit and another in the Dark Atmosphere

ON October 11 last a fine aurora was photographed from eight of my aurora stations in southern Norway. The stations Kongsberg, Tönte and Askim, forming a triangle with sides 105 km., 80 km. and 85 km., worked together with my station on the eastern roof of the Oslo Observatory; all four were connected

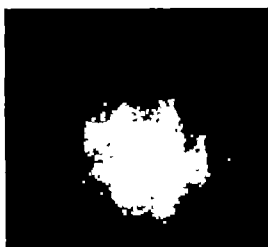


Fig. 1.

DIVIDED AURORA RAYS AT 19h 55m 7s, PHOTOGRAPHED FROM KONGSBERG, BY MR. BUSHINGDAL.

by telephone and took simultaneous pictures in continual succession as rapidly as possible. Three other stations, Tuddal, Lillehammer and Oscarsborg, forming a triangle with sides 178 km., 189 km. and 101 km., were in the same manner connected with my other station on the western roof of the same Observatory and worked independently of the first set.

Among the sixty-five successful sets of aurora pictures taken this night there are some of unusual

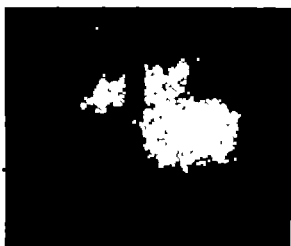


Fig. 2.

THE SAME RAYS PHOTOGRAPHED AS IN FIG. 1 PHOTOGRAPHED SIMULTANEOUSLY FROM TÖNTE, BY MR. ALBERT TÖNTE.

interest showing high aurora rays divided by a dark space where the rays are penetrating the boundary between sunlit and dark atmosphere. A similar case of this rather infrequent phenomenon, on March 15-16, 1929, has earlier been published in *NATURE*¹.

In Figs. 1 and 2 are seen two of the four simultaneous pictures taken on October 11, 1937, at

19h 55m 7s G.M.T. from my stations Kongsberg and Tönte, base-line 105 km. Fig. 3 is an explanatory sketch to the Kongsberg picture.

The two other simultaneous pictures from Oslo and Askim show the same features; there can therefore be no doubt that the lower rays are the continuation of the upper ones. Due to the long base-line, the parallaxes are good, about 5°, in spite of the great distance to the rays. In fact they were lying about 1,000 km. away, over a region at 68° latitude and 3°-9° longitude east of Greenwich, to the west of the Lofoten Islands.

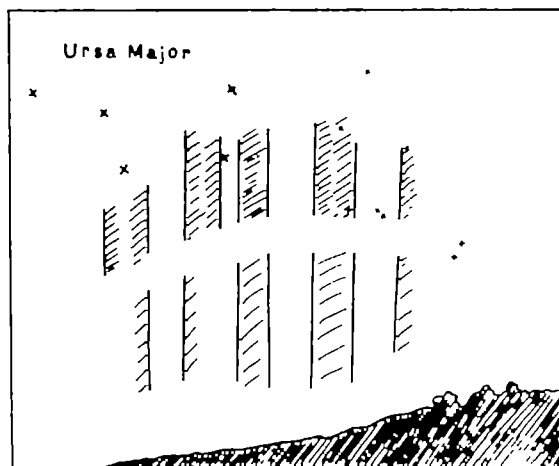


Fig. 3.

SKETCH OF THE KONGSBERG PICTURE.

The upper rays, which had a rather red tint compared with the lower ones, had their base points 415-480 km. above the earth, and their summits reached to about 625 km. These rays were situated in full sunshine. The continuation of the rays downwards went from about 350-400 km. down towards the horizon, where they can be followed to about 175 km. above the earth. They were all in shadow.

What is most remarkable, however, is the dark space between the upper and lower parts of the rays, comprising the boundary between sunlit and dark atmosphere. It seems as if the light of the rays is extinguished in the vicinity of this boundary and recovers again lower down.

This phenomenon is rather infrequent, and lasted only a few minutes. On a picture taken one minute later, the lower parts are much weaker. This last picture gives, however, a valuable check on the height measurements. In fact, by a pure chance, the rays happened to be photographed by all eight stations almost at the same time, and a calculation with the formidable base-line Tuddal-Lillehammer of

178 km. gave very nearly the same height as the calculation with base Kongsberg-Tömtö, namely, a height of 410–450 km. for the base points of the sunlit parts of the rays.

The last traces of sunlit aurora rays were photographed at 20^h 14^m G.M.T., four hours after sunset in Oslo. These were lying about 400 km. south-west of their former position and their base points were also near the earth's shadow, more than 400 km. above the earth. The lower parts did not appear this time.

A spectrum was taken of these sunlit rays on a panchromatic plate Agfa 188. The plate was first exposed from 19^h 55^m to 19^h 58^m on the rays just under β and γ Ursae majoris, and then from 19^h 58^m to 20^h 15^m on similar rays to the left of η and ξ of the same constellation. In this spectrum the line 6800 Å. is by far the strongest; next come the lines 5577 Å., 6550 Å., as in the spectrum obtained on October 18 last year².

These phenomena of sunlit aurora rays are very remarkable and their closer study may throw new light on the physical state of the upper atmosphere. It would be of interest to do experiments on the possible action of light, in particular ultra-violet, on the light phenomena of corpuscular rays in rarified gases, to solve the problems which these sunlit aurora rays present to us.

CARL STÖRMER.

Institute of Theoretical Astrophysics,
University, Blindern,
V. Aker, Norway.

¹ Störmer, C., "New Evidence of the Action of Sunlight on Aurora Rays", *NATURE*, June 8, 1926.

² *NATURE*, 139, 584 (April 3, 1937)

Mechanism of Optical Sensitizing of Silver Halides by Dyes

It has not been definitely settled whether optical sensitizing involves a chemical decomposition of the dye. The observation of Leszynski¹ that some twenty

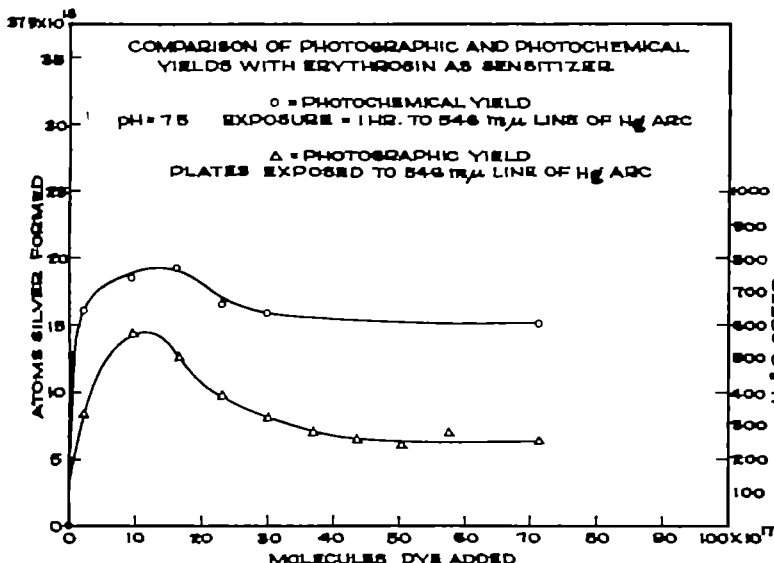
Bokinik and Iljina² have published results to somewhat the same effect as those of Leszynski. Working with silver bromide sols sensitized with erythrosin, they found a continued linear growth of silver atoms with number of erythrosin molecules added to the sol, and, according to the exposure, yields of four to fifteen atoms of silver per molecule of dye.

In repeating and extending the procedures of Leszynski and of Bokinik, we have obtained results which, while in agreement on some points, diverge widely on others. In our first experiments with a simple silver halide hydrocol (stabilized with slight bromide ion excess and sensitized with erythrosin) the dye was found to be destroyed progressively with exposure to light, and the number of silver atoms formed was between one and two per dye molecule disappearing. This was obtained in approximately monochromatic light 5460 Å., cutting out the blue-violet light. However, check observations showed that the dye also disappeared on exposure to the blue-violet light absorbed by silver bromide, eliminating the green light absorbed by the erythrosin-silver halide complex. This could only be due to the photolytically produced bromine attacking the dye. On repeating the experiments in green light (5460 Å.) with the blue-violet excluded, but with adequate halogen acceptors present (acetone semi-carbazide, phenol) the result obtained was: The adsorbed dye was not destroyed by the light absorbed, but bromide ions were converted to bromine, silver ions to metallic silver, progressively with exposure. (The reaction, at first linear with time, slows down as the surface is exhausted.)

In the case of erythrosin, the evidence is that by no means all the dye molecules adsorbed are active photolytically. The amount of silver produced by a given exposure increases rapidly at first, with increase of adsorbed dye, but reaches a limit long before adsorption saturation. In the case of basic (polymethine) dyes, the limit of the photolytic yield may

coincide approximately with adsorption saturation. A photochemical equivalent (silver atoms formed per quantum absorbed) of about 0.3 was found in the case of erythrosin. The photographic efficiency of erythrosin, in terms of photographic sensitivity as a function of dye adsorbed, closely parallels the photolytic yield, as shown in the accompanying curves.

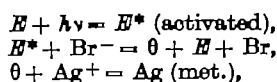
While our results confirm those of Leszynski, and of Bokinik and Iljina, in demonstrating that a single molecule of adsorbed dye can give rise to a large number of silver atoms (depending upon exposure, etc.) they differ widely from those of the latter authors in the observation of an early limit to the photochemical yield as a function of degree of adsorption. These authors make no mention of the addition of a halogen acceptor; in the absence



atoms of silver could be obtained (for a certain exposure) for one dye molecule indicated that either a 'physical' transfer of energy is effected, or else a chain reaction, with regeneration of the dye molecule.

thereof we get no such yields of silver atoms, and find the dye to be destroyed. Our principal result is that the optically sensitizing dye facilitates the transfer of an electron from a bromide ion to a silver ion, without undergoing decomposition itself. Formally,

this might be expressed as



the quantum $h\nu$ being absorbed by the erythrosin adsorbed to the silver halide, and being much smaller than that required to effect the transfer directly.

A fuller discussion of this process together with details of the experimental and analytical procedures will be published elsewhere.

Research Laboratories,
Eastman Kodak Company.
Rochester, N.Y.
Nov. 5.

S. E. SHEPPARD.
R. H. LAMBERT.
R. D. WALKER.

¹ Lescynski, W., *Z. wiss. Phot.*, **24**, 261 (1928-27).

² Bokunik, J. L., and Ilina, Z. A., *Acta physicochemica, U.R.S.S.*, **3**, 383 (1935).

Cozymase in Invertebrate Muscle

RECENT work from the institutes of Meyerhof¹ and von Euler² has demonstrated the important part played by cozymase in muscle glycolysis. Cozymase has now been quantitatively determined in, and isolated in a pure form from, mammalian muscle³. In muscle, as in other tissues, cozymase is present partly in the reduced, dihydro form in equilibrium with the oxidized form, 35-40 per cent of the total cozymase in mammalian muscle being in the reduced form^{3,4}.

An interesting feature in the physiology of cozymase is its rapid inactivation by tissue enzymes after the death of the organism⁴. Its distribution in living tissues has been reviewed by von Euler⁵.

We have now determined the cozymase in the fresh musculature of marine invertebrates from various phyla as well as its autolytic inactivation by the minced tissue. The technique has been described elsewhere^{3,6}. As standard, highly purified cozymase, kindly supplied by Dr. P. Ohmeyer, has been used. The accompanying table summarizes the results.

COZYMASE IN FRESH MUSCLE (mgm. per gm.).

Phylum	Species	Muscle	Structure	Oxidized form	Reduced form	Oxidized + reduced forms	Per cent reduced form
Cnidaria	<i>Metridium senile</i>	Dermomuscular coat	Mixed	0.023	0.008	0.030	27
Gephyrea	<i>Phaceloceros vulgaris</i>	Retractors of proboscis	Smooth	—	—	0.174	—
Arthropoda	<i>Homarus vulgaris</i>	Tail	Striated	0.280	0.170	0.450	38
Mollusca	<i>Pecten marcinus</i>	Adductor	Striated	0.140	0.099	0.239	41
"	<i>Ostrea edulis</i>	Adductor	Smooth	0.187	0.134	0.321	42
"	<i>Buccinum undatum</i>	Columnellar	Smooth	0.132	0.069	0.201	34
"	<i>Sepia officinalis</i>	Mantle	Smooth	0.220	0.170	0.390	44
Echinodermata	<i>Echinus esculentus</i>	Jaw	Striated	0.073	0.068	0.141	48
"	<i>Holothuria nigra</i>	Longitudinal bands	Smooth	0.026	0.006	0.032	23

Although its concentration varies widely, cozymase is present in all the muscles examined. In the powerful striated tail musculature of *Homarus* and in the smooth mantle muscle of *Sepia*, its concentration is as high as in mammalian muscle³. Not much difference in concentration is found between striated and smooth muscles. This is particularly exemplified in the adductors of *Pecten* and *Ostrea*. The smallest concentrations are found in the cnidarians *Metridium* and in the two representatives of the echinoderms examined. The higher concentrations are thus shown

by these muscles capable of swift or sustained vigorous activity.

In *Metridium*, *Echinus* and *Holothuria* the pyrophosphate P is also lowest, ranging from a trace to 0.2 mgm. P₂O₅ per gm. fresh muscle as against 0.5-1.0 in the other groups.

It seems interesting that the ratio of the oxidized to the reduced form is fairly uniform and within the limits of that in mammalian musculature. The amount of enzymic inactivation during 4 hours autolysis at 18° has also been found to be fairly uniform, ranging from 30 to 50 per cent of the cozymase originally present. This is definitely lower than in mammalian musculature, where it ranges from 80 to 95 per cent^{3,4}.

This work has been done while one of us (S. O.) was holding a Ray Lankester investigatorship.

S. OCHOA.
O. G. OCHOA.

Marine Biological Laboratory,
Plymouth.
Nov. 26.

- ¹ Meyerhof, O., and Ohmeyer, P., *Biochem. Z.*, **300**, 234 (1937).
² v. Euler, H., Adler, M., Günther, G., and Holström, H., *Z. physiol. Chem.*, **245**, 217 (1937).
³ Ochoa, S., *Biochem. Z.*, **303**, 68 (1937).
⁴ v. Euler, H., and Heitwink, H., *Naturwissenschaften*, **25**, 259 (1937).
⁵ v. Euler, H., *Ergebn. d. Physiol.*, **28**, 1 (1935).
⁶ Ohmeyer, P., *Biochem. Z.*, **297**, 212 (1936).
⁷ Ohmeyer, P., and Ochoa, S., *Biochem. Z.*, **303**, 338 (1937).

A New Oxidation Catalyst

COENZYMES I and II occupy pivotal positions in biological oxidations. The great majority of metabolites in animal tissues are oxidized through the intermediation of these coenzymes. But whereas the mechanism of the reduction of the coenzymes by dehydrogenase systems is well understood, the physiological mechanism of the oxidation of reduced coenzyme I or II has been obscure.

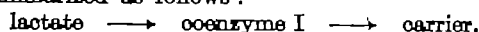
The reduced form of coenzyme I is oxidized extremely slowly by methylene blue, flavin, cytochrome c, etc. If a phosphate extract of washed and ground muscle tissue is added to a mixture of reduced coenzyme and one of these carriers, the rate of

oxidation of reduced coenzyme is increased some twenty-fold. We have fractionated this extract by centrifugation and have found that the insoluble sedi-

ment contains the factor which catalyses the oxidation of reduced coenzyme I. The insoluble particles with which the factor is associated can be washed exhaustively by repeated suspension in water and centrifugation without any loss in activity. The factor is destroyed by exposure to 52° for 15 min., by precipitation with acetone or by drying.

The lactic dehydrogenase system as prepared by Green and Brosteaux¹ rapidly catalyses the oxidation of lactate by means of flavin, methylene blue and

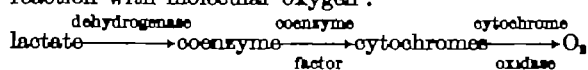
other carriers. The stages in these oxidations may be summarized as follows:



The arrows indicate the direction of transfer of hydrogen. The dehydrogenase is involved only in catalysing the oxidation of lactate by the coenzyme. The fact that the overall reaction is very rapid must therefore mean that the oxidation of reduced coenzyme by the carrier is not the slow spontaneous process referred to above, but that it is definitely catalysed. The lactic dehydrogenase preparation can be resolved by various methods into a water-clear solution containing the dehydrogenase and a suspension of insoluble particles containing the coenzyme factor. Neither solution alone can catalyse the oxidation of lactate by methylene blue whereas both together rapidly do so. This resolution of the two catalytic components has been accomplished with practically every coenzyme dehydrogenase system known in animal tissues; for example, lactic, malic, β -hydroxybutyric, alcohol, hexosemonophosphate, triosephosphate and triose.

Thus for the oxidation of metabolites, in coenzyme systems at least two catalytic agents are required; (1) the soluble dehydrogenase which catalyses the oxidation of the substrate by the coenzyme and (2) the insoluble coenzyme factor which catalyses the oxidation of reduced coenzyme by the carrier.

The studies of Keilin have demonstrated that the oxidation of practically all metabolites directly or indirectly proceeds via the cytochromes. Hitherto, no satisfactory link has been found between coenzyme systems on one hand and the cytochrome system on the other. Recently Dewan and Green described a coenzyme oxidase in animal tissues which catalysed the oxidation of reduced coenzyme by molecular oxygen¹. We have succeeded in resolving the so-called coenzyme oxidase into three insoluble components, (1) the coenzyme factor, (2) cytochrome *a* and *b* and (3) cytochrome oxidase. What we considered to be a direct oxidation of reduced coenzyme by molecular oxygen is really a two-stage process, namely, oxidation of reduced coenzyme by one of the cytochrome components (probably *a*) and oxidation of reduced cytochrome by molecular oxygen. The coenzyme factor catalyses the first oxidation, and the cytochrome oxidase catalyses the final reaction with molecular oxygen:



Since the cytochrome oxidase is poisoned by cyanide, the overall reaction does not take place in presence of dilute cyanide.

The coenzyme factor is not identical with flavo-protein or any known carrier. Strictly speaking, the coenzyme factor is a dehydrogenase which specifically catalyses the oxidation of reduced coenzyme by carriers. It is interesting to note that whereas flavoprotein, like the coenzyme factor, catalyses the oxidation of reduced coenzyme by carriers in pure solutions, it shows practically no activity as factor in any of the animal coenzyme I dehydrogenase systems we have studied. This paradox is difficult to explain.

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D. E. GREEN.

(Beit Memorial Research Fellow).

Institute of Biochemistry,
Cambridge.

¹ Green and Bronteaux, *Biochem. J.*, **30**, 1489 (1936).

² Dewan and Green, *Biochem. J.*, **30**, 1069 (1937).

* We are indebted to Professor D. Keilin for this information.

Influence of Hydrogen and Water Vapour upon the Combustion of Carbon Monoxide Mixtures

It is well known that the addition of hydrogen and water vapour to inflammable carbon monoxide mixtures speeds up the rate of flame travel. Experiments now in progress show that the flame temperatures determined by platinum thermometry also are increased.

The influence of hydrogen will be clear from an examination of Table I, in which are given the flame temperatures developed after the combustion of the mixtures (25 - *x*) per cent CO + *x* per cent H₂ + 75 per cent air when *x* is increased from 0 to 5.

TABLE I.

Percentage hydrogen	Flame temperature (°C.)	Latent energy (per cent)
0	1650	20.5
1	1706	17.5
2	1725	16.5
3	1735	15.5
4	1745	15.0
5	1750	14.5

It will be seen that there is a marked increase in flame temperature when hydrogen replaces a little of the carbon monoxide. A 1 per cent replacement increases the flame temperature by 55° C. A 5 per cent replacement increases the flame temperature by 100° C., in spite of the fact that there is a decrease of 25° C. in the ideal calculated flame temperature.

In a previous letter¹, it was stated that an addition of about 2 per cent water vapour to a carbon monoxide - air mixture had very little influence upon the flame temperature attained, but since the water vapour was added to the mixture the quantity of combustible gas was reduced. When the proportion of combustible gas is kept constant, and water vapour is added at the expense of the air alone, the flame temperature increases substantially. This may be seen from Table II, in which are given the flame temperatures after the combustion of the mixtures, 25 per cent CO + *y* per cent H₂O + (75 - *y*) per cent air, where *y* is increased from 0 to 2.14.

TABLE II.

Water vapour (per cent)	Flame temperature (°C.)	Latent energy (per cent)
0	1650	20.5
0.87	1675	19.5
1.50	1690	18.5
2.14	1700	17.5

In all the experiments, combustion took place at atmospheric pressure.

The latent energy, which is expressed as a percentage of the heat of combustion in the tables, resides, we believe, in the long-lived metastable molecules formed in the flame front. Small quantities of hydrogen and water vapour would appear to reduce the number of the metastable molecules formed during the combustion of dry carbon monoxide mixtures.

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Nov. 26.

¹ NATURE, **136**, 230 (Feb. 13, 1937).

Sound-Films as Diffraction Gratings for the Visual Fourier Analysis of Sound-Waves

It may be of interest to give a preliminary account of what I believe to be a new method of producing acoustic spectra. The method, which is to employ the striations on "variable-density" sound-film as a diffraction grating for monochromatic light, permits an instantaneous separation of sound into its components which is analogous to the directness with which a spectroscope analyses light. If sound-film is modulated by a pure tone, a visual appreciation of frequency is clearly possible, the diffraction angle increasing with frequency. It might be anticipated that in the case where numerous frequencies are present, the diffraction pattern might contain a confused series of combination frequencies, after the manner of the 'ghosts' which appear with imperfect diffraction gratings possessing extraneous periodicities. A further complication might be expected from the fact that the range of frequencies recorded on the film extends over at least seven octaves, producing a correspondingly great overlapping of orders of spectra.

Theoretical investigation, however, reveals a very interesting state of affairs, which is briefly outlined below. Some of the conclusions are not new, but they are re-expressed because of their present application, and because they represent a departure from the traditional view of optical gratings.

(a) The Fraunhofer diffraction effect achieves as a physical process the same integrations that furnish the amplitudes and phases of the terms of a Fourier series. The function which the series represents is the variation of the light-amplitude on traversing the grating, which may be called for brevity its transparency curve.

(b) The customary orders of spectra of an optical grating represent the harmonics present due to the abrupt discontinuities in the transparency curve.

(c) A sound-film with a purely sinusoidal variation in the amplitude of the light transmitted will give rise to a first-order diffracted beam only; a film with any number of such periodicities superposed will give one diffracted beam for each component and no others.

There is thus no question of orders overlapping, and furthermore, if ghosts appear, they are merely a proper indication that a component of one frequency has been modulated by another frequency, the ghosts arising in the same way as the upper and lower sidebands which occur in wireless. One of the possibilities suggested by the theory is the analysis of transient sounds. Taking as the simplest case a pure tone of short duration, the record on the film acts as a grating of limited resolving power, and the resulting spread of the diffracted beam is just such as corresponds to the frequency range required to form the original 'wave-packet'.

It is necessary to employ for the recording apparatus a light-shutter the response of which is proportional to the square of the amplified audio-frequency current (for example, a shutter operating on the dynamometer principle) in order that the amplitude and not the intensity of the transmitted light may follow the wave-form of the sound pressure.

A simple experiment illustrates the way in which a complex wave-form can be analysed by this method. If interference fringes are formed on a photographic plate with a mercury arc, each actinic wave-length

of the source impresses a different set of sinusoidal bands upon the plate. The developed plate used as a grating with a sodium lamp as source reproduces the lines of the mercury spectrum in yellow light, but in the first order only.

A fuller account of this work will be presented for publication elsewhere.

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Oct. 29.

Adiabatic and Isothermal Compressibilities of Heavy Water

ABOUT 50 grams of heavy water supplied by the Norak Hydro-Elektrisk Kvaestofaktieselskab as 99.2 per cent pure ($d_4^{20} = 1.1049$) has been used in the present investigation. The refractive index of the sample has been found to be 1.3278 for the D line at 30° C, which may be compared with 1.3276 given by Luten¹ under the same conditions. Using a piezometer made of soda glass and similar in construction to that employed by Tyrer² and recently by Dakshinamurti³, the adiabatic compressibilities of heavy and ordinary water are determined. Tyrer's value for ordinary water is also given below for comparison. The specific volume, its variation with temperature and the specific heat in each case are taken from the existing literature and used for calculating the isothermal compressibility with the help of the well-known thermodynamical equation. Small variations in these do not appreciably affect the result, and hence the degree of accuracy with which they have been determined is of little consequence.

		Temp.	Spec. vol.	dV/dT	C_p	$\beta_p \times 10^6$	$\beta_T \times 10^6$
Water	Tyrer	30.0	1.00434	0.000304	0.9979	44.5	45.2
	Authors	29.2	1.00434	0.000304	0.9979	45.9	46.6
Heavy water	Authors	29.5	0.9123	0.000277	1.003	42.0	42.6

The compressibility of heavy water is nearly the same as that of ordinary water, and the ratio of the isothermal to the adiabatic compressibility is very close to unity as in the case of water. The above figures also enable us to predict that the intensity of the Rayleigh scattering in heavy water will be of the same order as that in ordinary water.

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Oct. 28.

¹ *Phys. Rev.*, **45**, 161 (1934).

² *J. Chem. Soc.*, **106**, 2534 (1914).

³ *Proc. Ind. Acad. Sci.*, **5**, 385 (1937).

Drift of Net Assimilation Rate in Plants

In a recently published note¹, the effect of age on net assimilation and relative growth-rates in the cotton plant is discussed. Although details² of the experiments have not reached me, it is evident from the note that O. V. S. Heath's results conflict with data already published^{3,4} from this laboratory. In the experiments with cotton, no general rise or fall in the net assimilation rate (dry weight basis) was

found up to the time of flowering and, although it is admitted that the absence of such a drift with time is not proved, Heath claims that his data confirm the findings of Gregory⁵. The latter found the net assimilation rate (area basis) to be independent of time up to maximum leaf area in barley, and he accounts for 80 per cent of the variation of his data in terms of the variation in external factors.

In our own experiments with Sudan grass and oats^{6,7}, there are marked significant falls with time in the net assimilation rate or unit leaf rate (dry weight basis) before flowering. With the tobacco plant, too, unpublished data from this laboratory show very rapid falls in net assimilation rates with time on either dry weight or area bases. That the falls are not solely due to an effect of temperature is clear from the fact that the oats⁴ were grown under conditions of steadily rising mean daily maximum temperatures. With the Sudan grass⁸ also, temperature was rising during a portion of the period before flowering.

Where the dry weight basis is used, a progressive increase in the fibre content of the leaves would partly account for a fall in the net assimilation rate with age; this points to the inadequacy of the dry weight basis for comparative measurements. It is also possible that the use of leaf area as a basis for the expression of metabolic rates introduces time drifts of a complicated kind.

The data from this laboratory call for further interpretation, and to this end analytical work is already in progress.

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Nov. 8.

¹ Heath, O. V. S., *Ann. Bot.*, N.S. 1, 555 (1937).

² Heath, O. V. S., *J. Agric. Sci.* (in press).

³ Ballard, L. A. T., and Petrie, A. H. K., *Austral. J. Exp. Biol.* 14, 135 (1935).

⁴ Williams, R. F., *Austral. J. Exp. Biol.*, 14, 165 (1935).

⁵ Gregory, F. G., *Ann. Bot.*, 40, 1 (1926).

Series Effect on the Dipole Moments of Some Alkyl Halides

THE problem of induction along hydrocarbon chains has been the subject of some of our previous papers¹ on measurements of dipole moments in solution. The experiments now reported relate to the moments of alkyl bromides and iodides as determined in benzene solution at 20°, and the values may be compared with those determined with the vapours².

Although earlier values of these moments determined in solution have been published³, considerable divergencies exist among the results, and neither of the two series has been completely investigated in solution under the same conditions. The apparatus and the method of calculation used were those previously described⁴. The values of the polarizations and the dipole moments, expressed in Debye units, are given below.

Compound	$P_{\text{sol}}(\text{c.c.})$	$P_{\text{v}}(\text{c.c.})$	μ
CH_3I	61.5	19.3	1.41
$\text{C}_2\text{H}_5\text{I}$	90.8	24.2	1.78
$n\text{-C}_4\text{H}_9\text{I}$	101.0	28.0	1.84
$i\text{-C}_4\text{H}_9\text{I}$	100.5	29.3	1.95
$n\text{-C}_6\text{H}_{13}\text{I}$	108.0	33.5	1.88
$n\text{-C}_8\text{H}_{17}\text{I}$	109.7	33.2	1.88
$\text{C}_6\text{H}_5\text{Br}$	94.9	19.1	1.88(°)
$n\text{-C}_4\text{H}_9\text{Br}$	103.8	23.6	1.93
$i\text{-C}_4\text{H}_9\text{Br}$	112.2	23.9	2.04
$n\text{-C}_6\text{H}_{13}\text{Br}$	107.4	28.3	1.93
$n\text{-C}_8\text{H}_{17}\text{Br}$	113.7	33.0	1.95

The difference between the bromides and iodides is striking. The moments of the n -iodides increase as far as the butyl compound and then preserve a constant value, while those of the n -bromides show no increase beyond n -propyl bromide. Although the moments of the iodides are slightly lower than those of the corresponding bromides, the increase thus extends over a further carbon atom in the former. Both the i -propyl compounds possess larger moments than their isomeric n -compounds.

The increases in moment with extension of the carbon chain shown by the vapours are larger and apparently continue to higher members of the series. The measurements in solution are complicated by the effect of the principal dipole upon the surrounding solvent molecules, as well as by its influence upon other parts of the polar molecule. For compounds of the present type, the first effect should give rise to an induced moment which opposes the principal dipole of the molecule^{5,7}, whereas the moment induced in the second case should either increase or decrease the total moment according as additional polarizable matter is brought within or outside two cones of semi-angle 55° about the dipole axis⁶. Lengthening of the hydrocarbon chain would to some extent add OH_2 groups in this space, and the percentage increase in moment in homologous series should be uniform. That this conclusion is not confirmed by experiment is probably due to the necessary approximations in the theory.

The contributions to the resultant moment of the molecule of the moments induced by the primary dipole in the parts without and within the cones would differ with the polarizability and size of the halogen atom, and the secondary effects produced by addition of OH_2 groups would probably vary in the two cases. The polarizability and size of the iodine atom exceed those of the bromine atom, and it is in the iodides that the greater inductive effect is shown.

It seems that the polarizability of the polar group is a more important factor than the magnitude of the principal dipole in determining the change of moment in these series. This is also shown by the fact that the polarizability of the nitrile group is smaller than that of the iodo-group and, although it possesses a greater moment, the percentage variation of the moment in the nitriles is smaller and the moment attains its limit more quickly than in the iodides.

A fuller account of these results will shortly be published.

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J. R. PARTINGTON.

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Nov. 23.

Cowley and Partington, *J. Chem. Soc.*, 1252 (1933); 604 (1935).

² Groves and Sugden, *J. Chem. Soc.*, 158 (1937).

³ See *Trans. Faraday Soc.*, 30, Appendix p. 21 (1934).

⁴ Cowley and Partington, *J. Chem. Soc.*, 1184 (1935).

⁵ Cowley and Partington, *J. Chem. Soc.*, 135 (1937).

⁶ Frank, *Proc. Roy. Soc., A*, 153, 171 (1935).

⁷ Higasi, *Sci. Papers Inst. Phys. Chem. Res.*, Tokyo, 26, 284 (1936).

Potato Flowers and Dissemination of Potato Viruses

THE exact method of the spread of virus X in the field is not yet known. It has been suggested, however, that a species of thrips is the vector and that infection is conveyed by the insect feeding in the flowers¹.

In the returns issued by the Department of Agriculture for Scotland¹, there are fourteen potato varieties which flower sparingly or not at all. Four of these, Arran Crest, Epicure, Ninetyfold and King Edward, are necrotic to virus X when infected artificially through graft unions, and field crops are invariably free from infection. The remaining ten varieties, Duke of York, Eclipse, Sharpe's Express, Witchhill, Great Scot, Royal Kidney, Arran Banner, Arran Chief, Arran Consul and Rhoderick Dhu are non-necrotic, and analyses of samples drawn from commercial stocks have shown that virus X is of common occurrence within them. Of the free-flowering varieties in commerce, none is necrotic to virus X and none is X-free. It would seem, therefore, that the absence of virus X in commercial stocks is more closely related to the necrotic reaction than to the absence of flowers.

In support of this view, there is the observation that the necrotic disease is rarely, if ever, seen in the field, a fact which receives partial explanation on the grounds that as the necrosis is lethal, perpetuation of diseased plants vegetatively is eliminated. There is also experimental evidence derived from artificial methods of infection to suggest that entry of the virus into varieties to which it is lethal does not take place readily through means of infection other than a graft union.

The possibility of a species of thrips acting as a vector of virus is in no way invalidated by this criticism of the locus of entry.

The position with regard to virus A, of which *Myzus persicae* is the vector², is very similar to that of virus X. Of the forty-six varieties listed in the agricultural returns³, seventeen are necrotic to virus A and are free from the virus under natural conditions. Ten of these varieties seldom produce flowers and seven are free-flowering. Of the twenty-nine non-necrotic varieties, three non-flowering and five flowering varieties are usually found to be infected with virus A, whilst the virus is not uncommon, either alone or in combination with other viruses, in the remaining twenty-one varieties. It seems clear, therefore, that the factor determining the presence or absence of virus A is the reaction of the variety to the virus and not the presence or absence of flowers.

Evidence with regard to non-necrotic aphid-borne viruses has been obtained from a series of controlled field-trials in which free-flowering varieties were kept disbudded throughout their growing period. Twenty plants of each of eight varieties were interplanted with leaf-roll infector plants. After one season of exposure, 48 per cent of the flowering controls and 49 per cent of the disbudded plants had contracted infection. At the end of a second season the infected plants had increased to 68 per cent of the flowering controls and 75 per cent of the disbudded plants. It would seem, therefore, that the presence of flowers *per se* has little effect on dissemination of potato virus diseases.

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Nov. 24.

¹ Smith, K. M., "A Text-Book of Plant Viruses", p. 343 (1937).

² Scott, J. Agric., 30, 93-93 (1937).

³ Loughman, J. B., NATURE, 151, 833 (1933).

Mechanism of Polyploidy through Colchicine

THE action of colchicine on plant nuclei has been studied in stamen hairs of *Tradescantia reflexa*. Ovaries with attached filaments from which the pollen sacks had been removed were submerged in a salt sugar solution in which checks will survive more than 48 hours. Colchicine in concentrations ranging from 2×10^{-4} M. to 6×10^{-3} M. inhibits spindle formation and thus prevents anaphase. The drug slows down, but does not inhibit, the normal chromatin changes. Thus the split metaphase chromosomes commence to shorten and swell. Chromonemata become visible within them. Gradually they assume interphase structure. Meanwhile, chromosomes may have assumed various positions within the cell. Single chromosomes or groups of few chromosomes may have separated from the main group. The reconstruction of the amphidiploid colchicine nucleus thus at first leads to an irregular contour, which is gradually lost; micronuclei may be formed.

In summary, colchicine specifically inhibits anaphase, so that polyploid nuclei originate through reconstruction of an interphase nucleus from metaphase chromosomes, wherever plant cells divide under the influence of the drug.

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Nov. 22.

Rotational Analysis of the Visible O_2 Bands

THE visible O_2 bands obtained by a heavy discharge through helium containing a small amount of oxygen have been photographed in the second order of a 21-ft. grating.

Examination of the bands, λ 5632 (1, 0), λ 6026 (0, 0) and λ 6419 (0, 1), shows that each consists of four components containing in all thirty-nine branches. The alternate lines in each branch are missing and the structure agrees with the $\Sigma_g^- \rightarrow \Pi_u$ transition predicted for these bands by Mulliken¹. The missing lines at the origin show that the Π level is inverted. The A-type doubling is greater in the $\Pi_{1/2}$ than in the $\Pi_{3/2}$ state, increasing with J in each case, and is very small in the $\Pi_{1/2}$ and $\Pi_{3/2}$ states.

The fine structure of the Σ level agrees with Budd's² theory. The F_1 level is blended with F_2 and F_3 with F_4 , while F_1 and F_2 are separated by a constant interval from which $\epsilon = 0.148$ and $\gamma \sim 0$. The effect of this structure is to reduce the total number of branches to be expected for the transition from 48 to 40.

Preliminary values of the molecular constants obtained from the analysis are as follows:

$$\begin{aligned} A &= -46.0 \text{ cm.}^{-1}, B_0' = 1.292 \text{ cm.}^{-1}, \alpha_0' = 0.027 \text{ cm.}^{-1}, \\ D_0' &= -6 \times 10^{-8} \text{ cm.}^{-1}, r_0' = 1.274 \times 10^{-8} \text{ cm.}, B_0'' = \\ &= 1.108 \text{ cm.}^{-1}, \alpha_0'' = 0.018 \text{ cm.}^{-1}, D_0'' = -5 \times 10^{-8} \text{ cm.}^{-1}, \\ r_0'' &= 1.346 \times 10^{-8} \text{ cm.} \end{aligned}$$

A complete account of the analysis of these and of the (2, 0) band will be published shortly.

THOMAS E. NEVIN.

University College,
Dublin.
Nov. 18.

¹ Mulliken, *Rev. Mod. Phys.*, 4, 51 (1932).

² Budd, *Z. Phys.*, 106, 73 (1937).

Volume-Rectification of Crystals

It has been shown by Khastgir and Das-Gupta¹ that crystals like carborundum, silicon and zincite, which have no centres of symmetry, give volume-rectification when placed between mercury electrodes; whereas with symmetrical crystals, for example, galena and iron pyrites, they did not find this rectifying effect when the crystals were similarly placed with large area of contact between mercury electrodes. Experiments conducted in our laboratory have, however, shown the existence of the so-called volume-rectification in galena, iron pyrites and pyrolusite placed between mercury electrodes.

While it is further expected that all rectifying crystals should show the same effect, our investigation has also given indications which tend to show that either both surface-rectification and volume-rectification (if there be really any volume-rectification) must be co-existent in all rectifying crystals, or the whole phenomenon of rectification is only a surface effect.

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Bengal. Nov. 10.

¹ *Ind. J. Phys.*, 9, 258 (1935).

Bright Meteor of November 9

WITH reference to the note in NATURE of December 11, p. 1009, on the meteor observed on November 9, I observed this object at 21h. 26m. G.M.T. while engaged on meteorological work at Hastings. My attention was first directed to a reddish light in a direction west by south of my observation point; this suddenly burst into a brilliant metallic blue head which continued for one or two seconds before vanishing. The light was quite brilliant and resembled a magnesium flare. An interesting feature was that the meteor was of sufficient size to leave a very distinct streak; this was of an ashy grey colour and persisted for 7-10 seconds, growing gradually fainter.

The meteor became visible at an elevation of about 60° and vanished at about 30°. Its deviation from a vertical line from zenith to horizon was in the region of 10° towards the north.

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Dec. 13.

Points from Foregoing Letters

PHOTOGRAPHS showing a 'divided' aurora with the upper part of the rays in the sunlit and the lower part in the dark atmosphere, with a dark space occurring at the boundary, are sent by Prof. O. Störmer. The photographs were taken simultaneously in different localities. It appears that the aurora is extinguished at the boundary of the sunlit atmosphere but recovers farther down.

Graphs giving the number of silver atoms liberated from silver halides by the action of light, for each molecule of a 'sensitising' dye present, are submitted by Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker. The new results confirm those of previous investigators in showing that a single molecule of adsorbed dye gives rise to a large number of silver atoms, but differ in that they indicate that only a portion of the dye molecules are active.

A new oxidation catalyst is announced by J. G. Dewan and D. E. Green. Its presence was detected in the centrifuged insoluble sediment from a phosphate extract of washed and ground muscle, which increased the rate of oxidation of reduced coenzyme I (in the presence of methylene blue, flavin, etc.). The new 'coenzyme factor' is destroyed by heating for 15 min. at 52° C. It is not identical with flavoprotein or any known 'carrier'. Practically every dehydrogenase known in animal tissues can be resolved into two catalytic components, one soluble and the other insoluble. The insoluble 'coenzyme factor' may be considered as a dehydrogenase which specifically catalyses the oxidation of reduced coenzyme by 'carriers'.

Tables showing that the presence of hydrogen (1-5 per cent) or of water vapour (1-2 per cent) increases by several per cent the flame temperature of (25 per cent) carbon monoxide-air mixtures, are submitted by Prof. W. T. David and B. Pugh.

Dr. D. Brown points out that if sound-film is prepared under certain specified conditions, and the striations on the sound track used as a diffraction grating with monochromatic light, a Fourier analysis is achieved resulting in an acoustic spectrum of

the original sound. One of the applications which is suggested refers to the study of transient sounds.

The compressibility of heavy water is found by Prof. S. Bhagavantam and B. S. R. Rao to be very nearly the same as that of ordinary water, and the ratio of the isothermal to the adiabatic compressibility very close to unity, as in the case of water.

The time drift of net assimilation rate in plants is discussed by R. F. Williams. His results show a fall in the rate during vegetative growth; this fall is independent of the drift in mean maximum temperature. These results are not in agreement with recent findings of Heath and of Gregory.

The polarizations and dipole moments of various organic (alkyl) compounds of bromine and iodine have been redetermined by E. G. Cowley and Prof. J. R. Partington, who discuss the influence of the lengthening of the carbon chain, and of the surrounding solvent molecules. It appears that the polarizability of the polar group is a more important factor than the magnitude of the principal dipole in determining the change of moment in these series. The polarizability and size of the iodine atom exceed those of the bromine atom.

From an examination of non-flowering and flowering potato varieties, Dr. G. Cockerham has found no direct relationship between the absence of flowers and freedom from potato viruses.

The effect of colchicine (an alkaloid obtainable from meadow saffron) upon nuclei in process of division in plant cells is briefly described by B. R. Nebel. The drug slows down chromosome changes, inhibits spindle formation and prevents the anaphase stage, so that polyploid nuclei (containing a larger number of chromosomes) are formed.

The existence of the so-called volume-rectification has been found by B. K. Sen in crystals other than those having no centre of symmetry. In the course of his investigation, indications have also been found suggesting that the phenomenon of rectification is only a surface effect.

Research Items

Origin of the Long Barrow

THE problem of the origin and affinities of the British long barrow, of which the trapezoidal mound is a persistent feature, hitherto eluding search elsewhere, is discussed by Mr. Stuart Piggott in the light of evidence from Brittany in *Antiquity* of December. It had seemed clear that the long barrow was a member of the megalithic tomb complex which extends from Iberia to Orkney; and comparisons had been instituted with remains in Brittany; but it was difficult to present convincing Continental parallels for the whole specialized English long barrow type. It was, however, recently pointed out that the distribution pattern suggested a movement from Armorica to Dorset. Field and museum work in southern Brittany during the past summer have suggested Breton equivalents in a group of tombs on the plateau of Manio to the north-east of Carnac, in which appear long low mounds, peristalith and dry-walled structures. A similar group of cairns was excavated by Miln near Crucun in 1878. These also showed evidence of the quadrangular mound with enclosing wall and remains of stone structures within the area. These, it is noted, are not megalithic in the true sense. The evidence of the pottery in the grave goods points to an early date. It stands nearest of the Breton pottery to the 'undifferentiated ancestral continuum' of the Westschiekeramik postulated by Childe and equated by Mrs. Hawkes with Vouga's "neolithique ancien" and the undecorated wares of Chassey and our English Neolithic A i. It seems impossible to escape from the conclusion that this is the Breton representative of this early Neolithic culture, a further relation with the important Neolithic subgroup established at Hambury Fort in Devonshire being suggested by the occurrence in Brittany of the 'trumpet lug' found in Devon and other sites of the west of England and here regarded as a type fossil.

'Minnesota Man'

IN an analysis of the report by Dr. A. E. Jenks on 'Minnesota Man' (see *NATURE*, Oct. 2, p. 596) Dr. Albe Hrdlička criticizes the author's finding as to the antiquity and racial character of this skeleton (*American J. Phys. Anthropol.*, 22, 1937). There is, it is maintained, no certain geological evidence to indicate a Pleistocene age, while the characteristics of the skeletal remains point to a Sioux origin. As regards the geological evidence, there is a serious and irreparable uncertainty as to the original status of the ground above and immediately about the skeleton. All the circumstances point to a burial rather than a deposit after drowning. The generalizations in regard to man's coming to America in glacial times seem too categorical. The evidence is against a land-bridge between Asia and America in Pleistocene times. Mineralization of the bones has only a secondary relation to age. As regards the morphological evidence of the skeleton, in the various features enumerated as unique, unusual or primitive, Dr. Jenks is in part correct, but in part has been misled by defects in the parts, by the immature state of the skull and bones, through lack of sufficient comparative material or through over-concentration on small details. A re-examination of forty-one female Sioux skulls in the

National Museum collections leaves no uncertainty as to the Minnesota skeleton and its appurtenance. Its type is the characteristic type of the Sioux, which differs substantially from that of other North American Indians. As a Sioux, the skull and skeleton cannot possibly be assumed to be twenty, or ten, or even a few thousand years old. No Sioux sites show accumulations which would represent any such period; and on the other hand, though Minnesota was Sioux country, it could not be assumed that any type of American man could have remained in the same limited territory for thousands of years, and that without modification.

Phosphorylation and Respiration

EVIDENCE is now accumulating to the effect that phosphorylations by animal tissues depend on an intact respiratory system. This is shown very clearly in recent observations by H. Kalokar (*Enzymologia*, 2, 47; 1937) on phosphorylations by kidney cortex tissue. The accumulation of phosphoric esters, consequent upon phosphorylation, was shown after the addition to the tissue of fluoride which inhibits kidney phosphatase. It was found that such esters only accumulated under aerobic conditions; under anaerobiosis no phosphorylation could be demonstrated. The addition of cyanide (N/1000) to the system under aerobic conditions inhibited respiration and phosphorylation to the same extent. The inhibition of phosphorylation by anaerobiosis disappeared when oxygen was allowed to re-enter the system. The phosphorylated product from kidney cortex in presence of glucose, phosphate and fluoride was found to be fructose diphosphate. Similar results were found to take place with minced liver tissue.

Food of the Little Owl

"SWEEPING statements about the damage done by the Little Owl have little justification in fact" is the interesting judgment made by the committee of scientific investigators reporting on the recently completed national survey on the food of the little owl (*Athene n. noctua*) conducted by the British Trust for Ornithology during the past two years (*British Birds*, November 1937). Despite the controversy over the food of the little owl, the repeated claims by gamekeepers and others that the bird was vermin and a great destroyer of pheasant and game chicks, and several statements that it was responsible for the extermination of nightingales in districts, the committee is of the unanimous opinion that the destruction of game, poultry or wild birds is negligible, and that, except in abnormal circumstances, the owl feeds wholly on insects and small mammals. The survey was conducted with the detailed thoroughness of previous surveys, and from March to July 1937 special studies were made on little owls nesting in game-rearing districts in 11 counties. In the general survey, which was under the organization of Miss Alice Hibbert-Ware, of Girton, Cambridge, 73 experienced field naturalists sent pellets, gizzards and larder- and nest-contents from 84 counties. In all, 2,460 pellets, material from 76 nests, and 28 gizzards of little owls were examined. Insects were in 23 gizzards, rodents in 11 and birds in five.

Fossil Insects from the Permian of Kansas

SINCE the death of Dr. R. J. Tillyard, several important contributions by him have appeared in the *American Journal of Science*. It is only possible to mention two of these very briefly here. In the issue of April 1937, he deals with the only true Embiid so far found in Kansas Lower Permian rocks. This form is named *Protobia permiana* gen. et sp. nov., and is regarded as constituting the new suborder Protebriaria. This fossil has as its nearest related living form *Olatoda*. From the presence of an ovipositor and large compound eyes it is concluded that it was not a web-spinner to the extent that prevails among recent forms. The fore-tarsi, which normally contain spinning glands, are, however, missing from this fossil. In the September issue, Dr. Tillyard discusses the cockroaches or Blattaria from those same rocks. The most interesting feature here brought to light is the description given of the complete hind-wing of a Palaeozoic cockroach for the first time. The configuration of the wing in the genus *Pycnoblattina* is regarded as proving that the latter is ancestral to the archaic living termite *Mastotermes*. The conclusion is reached that the termites or Isoptera as an order were directly descended from the fossil cockroach family Spiloblattinidae.

A New Hydroid from Norway

COLLECTIONS of the bottom fauna from two localities on the west coast of Norway, where deposits of mud occurred, at a depth of from 10 to 40 metres, have revealed the presence of a minute and curious hydroid. In his description, Einar Westblad points to certain simple or primitive characters of this form: its small size, 1-1.5 mm.; its few tentacles, four normally but exceptionally three; the tetramerous arrangement of the ground plan; and the absence of perisarc (Arkiv. Zoologi, 29 B, No. 7; 1937). For the specimens, a new genus and species have been created, *Boreohydra simplex*, regarded by the author as a form intermediate between *Prothyra* and the more highly developed hydroids, falling into the same family of the Athecata as *Prothyra*. It is a curious feature of the species that it has no method of adhesion to a substratum, but lives with the lower end of the body simply embedded in the mud, after the manner of a newly settled larva of a cerianthid sea-anemone.

Drying of Plant Materials

ALTHOUGH the drying of plant materials is widely practised commercially, the underlying principles have received comparatively little investigation. The experiments on factors affecting the rate of hop drying described by A. H. Burgess (*J. Inst. Brewing*, 43; 1937) are therefore necessarily of a fundamental nature. From previous work, a formula has been developed showing the effect of atmospheric humidity, temperature, air speed and depth of loading upon the rate of drying, from which the time required for drying hops at constant temperature can be calculated. In practice, however, it is necessary to raise the temperature gradually as drying proceeds, and in the present paper it is shown how this rise influences the time required for drying, and methods are described by which the time can be computed under such conditions. Although it has hitherto been generally accepted that the rate of evaporation is independent of the temperature of the air, heated air, such as is used in hop drying, is shown to promote

evaporation by transmitting heat to the hops. Further, the actual moisture-absorptive capacity of the air, which increases as its temperature rises, also influences the rate of drying. The total rate of evaporation from a very shallow layer of hops is proportional to the 0.39 power of the air speed.

Ecology of Sooty Mould Fungi

SOOTY moulds consist of a number of different species of fungi growing together. The constituent organisms may be associated closely, or may be segregated, but their general appearance resembles a black felt of hyphae. Miss Lilian Fraser has studied "The Distribution of Sooty Mould Fungi and its Relation to Certain Aspects of their Physiology" (*Proc. Linn. Soc. N.S. Wales*, 62, Pts. 1-2, 1937). The ecology of such composite moulds naturally depends upon the existence of conditions which are suitable for all the constituent fungi. Cultural requirements of a number of the commoner species are set forth in the paper, and various characteristic associations are described. Growth is usually slow, except during periods of damp weather. The 'honey-dew' produced by many scale insects is a good medium for the growth of sooty moulds, but discourages such ubiquitous fungi as *Penicillium*. Its chief constituent is adonite, which is apparently responsible for its suitability.

Diploid and Haploid Colonies of a Yeast

FROM a commercial yeast consisting of a strain of *Saccharomyces ellipsoideus*, a single cell was isolated, and from its descendants various cell and spore cultures were derived which throw light on the life-history of this species (Winge and Lanstsen, *Comptes Rendus, Lab. Carlsberg, Serie Physiol.*, 22, No. 6). By using a microdissection technique, the four spores from an ascus were isolated and cultivated. Normally they conjugate in pairs, forming diploid colonies. Isolated spores may germinate in two ways: (1) to form colonies of rounded (torula) cells with (evidently) haploid nuclei, some of which may later conjugate to form diploid colonies of elongated cells; (2) directly on germination an internal fusion of two nuclei may take place, producing at once elongated cells which are diploid. On plaster, the round haploid cells form no spores, whereas the elongated diploid cells function at once as sporangia. The colonies derived from the four spores of an ascus show genetic segregation and probably crossing-over. The four giant-colonies from an ascus do not necessarily show segregation in pairs. In one case the resulting colonies were all different, one being like the parent colony, one with concentric furrows and marginal scallops, one with deep radiate furrows, and one smooth, conical in shape and remaining persistently haploid. Sectoring was also observed. It is thus clear that diploid cells are normally heterozygous and will show segregation in later spore generations.

Atomic Weight of Neodymium

THE considerable difference between the international atomic weight of neodymium (144.27) and that obtained by Aston with the mass-spectrograph (143.5) has led Hönigschmid to carry out a re-determination of this constant by the chemical method (*Naturwiss.*, 25, 701; 1937). Two neodymium preparations were used. X-ray spectroscopic analysis showed that they contained no other rare-earth elements in greater quantity than 0.04 per cent.

Neodymium trichloride was analysed, and as a mean of a large number of concordant results the value 144.27 was obtained for the atomic weight, in exact agreement with the international value at present accepted. The difference between the physical and chemical values is probably due (as suggested by Aston) to the existence of two heavy isotopes of neodymium of mass 148 and 150 (A. J. Dempster, *Proc. Amer. Phil. Soc.*, 75, 735; 1935), recently confirmed by Dempster (*Phys. Rev.*, [ii], 51, 289; 1937).

Action of Nitrous Acid on Amines

THE mechanism of the reaction between nitrous acid and amines is difficult to investigate owing to the instability of nitrous acid and the ease with which the initial products of the reaction undergo secondary changes. The reaction has, however, been studied by many workers, and most recently by J. C. Earl and N. G. Hills (*J. Proc. Roy. Soc. New South Wales*, 70, 322; 1937). The diazotization of aniline in methyl alcohol solution has been studied by dilatometric and conductimetric methods. The results show that the course of the initial reaction is the same for methylaniline as for aniline. The later stages of the reaction involve a rapid increase in hydrogen ion concentration. The reaction may occur between anilinium ions and nitrous acid, but an alternative explanation is that an initial reaction of which the velocity is increased by increasing hydrogen ion concentration proceeds until a critical concentration of the first reaction product is reached. This compound then decomposes, giving hydrogen ions, and causing a rapid decrease in volume and increase in conductivity.

Solvent Dewaxing

A GROUP of papers on solvent dewaxing was presented at a meeting of the Institution of Petroleum Technologists on November 9. M. Ba Thi, T. G. Hunter and A. W. Nash dealt with the subject from the phase-rule aspect, consideration being given to the use of double solvents, such as amyl alcohol/naphtha, which are completely miscible with oil at the dewaxing temperature. Representation by means of tetrahedra of simple quaternary systems of four independently variable components was described and application of these principles to equilibria in oil-wax-solvent mixtures discussed. Data deduced from such diagrams for the solvent-oil ratios employed were shown to be in agreement with experimental figures. Dr. Bruno Engel described dewaxing with chlorinated solvents, such as dichloroethane, and gave instances of distillates and residues derived from different crudes which have been dewaxed by the use of such solvents. Oils rich in asphalt and resins have been successfully treated. It has been found to be advantageous to carry out dewaxing in two or more stages, either by fractional precipitation of wax or by de-oiling the wax obtained. The cause of poor filterability and high oil retention of certain high boiling distillates was the subject of a paper by E. O. H. Kolvoort, F. R. Moser and C. G. Verver. In such cases, the wax has indefinite crystalline characteristics, suggesting the presence of branched-chain paraffins together with those of the normal type. A theory explaining how pour-point "depressors" prevent adsorption by such waxes was given. The advantages of methyl-*n*-butyl-ketone as a dewaxing solvent were indicated by O. S. Pokorny and R. K. Stratford. The authors gave data concerning wax solubility, miscibility temperature, vapour pressure,

stability, non-corrosiveness, non-toxicity, cost, etc., and concluded that the solvent should find a wide application for dewaxing purposes.

Metal-spraying

A PAPER by R. R. Sillifant, included in those of the recent Autumn Meeting of the Iron and Steel Institute, deals with the spraying of iron and steel with a wire-fed pistol. In normal circumstances the deposit consists of irregular particles flattened by the force of impact and surrounded by an oxide film which renders the deposit brittle. By using dissolved acetylene as the fuel gas in conjunction with nitrogen as the impelling medium, coupled with a suitable heat-treatment after spraying, steel deposits of high quality are obtained. Such a sprayed bar was bent cold through an angle of 90° without any sign of the dislodgement or fracture of the deposit. The technique employed is described; the heat-treatment for a deposit consisting of a steel containing 0.09 per cent of carbon being a two-hour heating at 900°C. The applications of the method in building up worn steel parts and possibly as a surface coating for cast iron are discussed.

Frictionless Torque-free Suspensions

FOR the measurement of minute forces, the torsion balance with a quartz suspension has proved invaluable. In his search for a still more sensitive instrument, Dr. F. T. Holmes of the University of Virginia has produced a magnetic suspension which he describes in the November issue of the *Review of Scientific Instruments*. A ferromagnetic needle is supported vertically with its upper end in the axis of and just below a vertical solenoid through which a current flows which is nearly sufficient to support the needle. The rest of the supporting force is provided by a smaller solenoid just below the former, and the current in it is so controlled as to make the needle stable. This is secured by providing the lower part of the needle with a cylindrical vane over the top of which a beam of light passes to fall on a photo-electric cell, the current from which operates an amplifier the output of which feeds the smaller solenoid. A downward motion of the needle admits of more light falling on the cell and the upward pull of the solenoid increases. Damping arrangements are provided. With a needle weighing 0.75 gm., a torsional couple of only 7×10^{-6} dyne cm. per radian was found and the author sees no reason why this should not be reduced considerably.

Hyperbolic or Spherical Space

DR. G. C. McVITTIE, in his recent monograph "Cosmological Theory", inferred that space is hyperbolic by an argument based on extrapolating Hubble's observations on the velocity-distance relations of the nebulae. Prof. E. Hubble himself (*Mon. Nat. Roy. Astro. Soc.*, 97, 506; 1937) has criticized this argument on the ground that the method used for extrapolation is unsatisfactory. Dr. McVittie has now shown (*Z. Astrophys.*, 14, 274; 1937) that Hubble's own methods of extrapolation imply hyperbolic space if the average mass of a nebula is taken to be 2×10^{11} times that of the sun. On the other hand, if the average mass is ten times this amount, then the magnitude of the probable errors in the observational formulae show that spherical space lies within the bounds of possibility. Of course, any argument based on extrapolation into regions of space not accessible to observation must be received with reserve.

Inland Water Survey in Great Britain

THE second annual report* (1936-37) of the Inland Water Survey under the Ministry of Health and the Scottish Office continues the story of the progress of the Survey since the date of the previous report. It points out the magnitude of the undertaking and the considerable amount of preliminary work which has been found necessary. The replies to the questionnaire circulated at the outset of investigations showed that relatively little of the varied mass of information in existence was suitable for the purposes of the Survey, and that not only were improvements necessary in the methods in vogue for gauging and recording levels in rivers and streams, but also that a large number of additional gauging stations was required. During the period under review, the efforts of the Committee and its officers have been directed towards the introduction of better methods of survey and to the examination and rearrangement of existing records suitable for publication in a form which would serve as a model for future investigations.

Emphasis is rightly laid on the importance of the functions of the new catchment boards in obtaining a full knowledge of river flows and their variations. In order to assist the catchment boards and others co-operating in the same direction, an instructional memorandum on the water survey of a river system was prepared and published in October, 1936. It is added that during the year an increasing interest has been shown in the Survey, but the comment is made that this interest tends to manifest itself only in regard to those parts of a record which are of most use to the persons or bodies concerned. This is, of course, perfectly natural; but it is obviously insufficient for the purposes of a complete survey. Thus the catchment boards show a disposition to limit their observations to periods of high discharge,

when flooding is liable to occur, and to ignore periods of relatively low discharge. But periods of low discharge are important for pollution prevention and to fishery authorities, and fundamentally so to water undertakers, so that a survey must be comprehensive in its records if it is to be of service to all classes of the community.

Underground water measurement is a branch of the work of the Survey which is being carried on with the assistance of the Geological Survey, and a tribute is paid to the late Dr. Bernard Smith, director of the Geological Survey, who took a great interest in the Inland Water Survey and acted as one of its assessors.

Assistance in hydrographical field work is being given by outside bodies and individuals; in particular, by schoolboys under the direction of their headmasters and geography masters. Their services are being utilized in the location and measurement of wells.

The examination of certain river basins in detail, begun in the previous year, has been continued, and observations of a preliminary character have been made during the twelve months in regard to the Ness Basin, the Tay, Ouse (Yorkshire), Severn, Dee (Cheshire), Irvine, Clyde and Kelvin. The results of these investigations are set out in the report and a well-merited acknowledgement is made of the pioneer work of Captain W. N. McClean in founding and directing at his own expense the organization known as River Flow Records, which has carried out discharge measurements in the Ness Basin and elsewhere during the past eight years.

The investigations made and collected from various sources are being "converted, amplified, corrected, extended and consolidated". It is announced that a selection, dealing with the results from twenty-eight gauging stations in respect of fourteen river basins in Great Britain, will shortly be published.

BRYSSON CUNNINGHAM.

* Ministry of Health and Scottish Office. Inland Water Survey Committee: Second Annual Report, 1936-37. Pp. 26. (London: H.M. Stationery Office, 1937.) 6d. net.

Research Grants of the American Academy of Arts and Sciences

INCOME from the Permanent Science Fund of the American Academy of Arts and Sciences, according to agreement and declaration of trust, shall be applied to such scientific research as shall be selected . . . in "such sciences as Mathematics, Physics, Chemistry, Astronomy, Geology and Geography, Zoology, Botany, Anthropology, Psychology, Sociology and Economy, History and Philology, Engineering, Medicine and Surgery, Agriculture, Manufacturing and Commerce, Education, and any other science of any nature or description whether or not now known or now recognized as scientific; and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants under this indenture are considered by a committee of the Academy on stated dates only. The next such meeting will be to consider applications received in proper order on blank forms furnished by the committee on March 1, 1938. Correspondence, including requests for application forms, should be addressed to the chairman of the Committee on the Permanent Science Fund, Prof. John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Grants-in-aid from this fund were voted by the Academy on November 10, 1937, as follows:

Prof. Charles Chupp, Cornell University, 400 dollars, to aid in finishing a monograph of the fungus genus *Cercospora*.

Dr. Willi M. Cohn, research lecturer, University of California, 150 dollars, to be used in printing, in the *Astrophysical Journal*, the results obtained on the polarization of the solar corona in the 1932 and 1934 eclipse expeditions.

Prof. Ada R. Hall and Helen W. Kaan, Wellesley College, 59 dollars, to assist in a histological investigation of the development of thyroid glands in rat embryos.

Prof. Robert S. Harris, Massachusetts Institute of Technology, 300 dollars, for the purchase of mothers' milk, to be used in an investigation of (a) the chemistry of the casein; (b) the antirachitic properties.

Dr. Francis R. Hunter, Rhode Island State College, 250 dollars, towards the purchase of a Barcroft-Warburg micro-respirometer, to be used in a comparative study of respiration and permeability.

Prof. Walter Landauer, Storrs Agricultural Experiment Station, 150 dollars, for the purchase of an analytical balance to be used in connexion with a quantitative study of growth in lethal embryos of creeper and Cornish fowl.

Dr. Clarence O. Little, director of the Roscoe B. Jackson Memorial Laboratory, 1,000 dollars, to be used

to study the incidence of tumours and other growth abnormalities in a species cross in mice.

Dr. Karl E. Mason, Vanderbilt University School of Medicine, 500 dollars, for technical assistance in the development and standardization of trustworthy methods for the routine assay of food substances for their vitamin E content.

Prof. Arthur F. Scott, Reed College, 500 dollars, for the purchase of apparatus to be used in determinations of the atomic weights of beryllium and bismuth.

Drs. Kurt G. Stern and Abraham White, Yale University School of Medicine, 400 dollars, to be used for the construction of equipment for the study of the homogeneity and certain physical properties of highly purified protein preparations and protein derivatives.

Dr. John H. Welah, Harvard University, 200 dollars, to enable him, during his sabbatical leave, to visit the laboratories of Prof. Koller at Kiel, and Prof. Hanström at Lund.

Prof. William F. Windle, Northwestern University Medical School, 500 dollars, for employing the services of a trained laboratory assistant in a study of neurological factors in the development of fetal respiration, and other general problems of fetal behaviour.

Foundations of Terrestrial Life: The Soil and the Green Plant*

THE ideas which I want to put forward may perhaps be indicated best by telling how and by what slow stages they grew up in my mind. A long time ago the late Prof. Gamble and I spent a very long time trying to find out how the green cells which give colour to the marine worm *Convoluta roscoffensis* get into the body of the animal, how they manage to increase and multiply there, and what is the impetus which drives them into the association. The conclusion which we reached as to the significance of the association between *Convoluta* and its green cells is nitrogen hunger. The symbiosis is only one of innumerable examples of the universal fact that the world of plants suffers, and has always suffered, from an insufficiency of nitrogen.

A good many years later, just after the Great War, the late Lord Melchett (then Sir Alfred Mond) and I spent a lot of time trying to improve the farm land surrounding Melchet Court. There was plenty of scope on soil which when it was not gravelly was clayey, and even when it wasn't was panned. Among other things, the effects of nitrogen and other fertilizers were tried on the grass land, and met with a success which was astonishing. In those days nitrogen was generally supposed to be bad for grass land. It was thus proved, however, to be wonderfully good, and that even when the poor grass land was supplied with a complete fertilizer and limed as well, the addition of more nitrogen produced more grass.

About that time, Sir Alfred Mond was taking a practical interest in the synthetic manufacture of ammonia, and there is no doubt that the results of our experiments on the value of nitrogen on grassland had something to do with his asking me

to give up an Oxford professorship and become director of agricultural research in the company which had been formed recently to develop the process at Billingham. The Research Station at Jeallot's Hill was established, and with the aid of colleagues I laid down and conducted a world-wide programme of experiments on the effects of nitrogen and other fertilizers on grass and arable land.

The next step in the development of my ideas was reached when on a visit to Ireland I was shown by one of our staff the almost incredibly swift response to nitrogen that rough, boggy, hillside grazings were making. Sedges and weeds of all kinds with scarcely any grass or clover began to disappear in a season or two, to be replaced by grasses and clovers, with the result that where before no grass grew there was soon good grazing.

The final step was reached in the course of feeding experiments with dried grass made at Jeallot's Hill. The results of the experiments showed that the winter milk of cows fed on a liberal ration of dried grass produced a butter with all the virtues of summer butter in it.

Looking back along this long, tortuous road, I find it difficult to believe that anybody could have been so slow to reach the conclusion to which it leads, or could require so much material on which to base a hypothesis which ought to have jumped to the mind long ago. The hypothesis is that the health and strength of people and their evolution, and the permanence of human societies depend on the soil and the green plant. The conclusions are that if the world has got on so well as it has with a half-starved vegetation and a hungry soil, how much better might it not get on when these deficiencies are discovered and made good.

F. KENBLE.

* The argument introduced in a series of three lectures delivered at the Royal Institution on November 30 and December 7 and 14.

Museum Study of Man and his Work

A PAPER by Mr. de La Valette at a joint meeting of the Royal Society of Arts and the India Society on December 14, on the subject of Holland's colonial museums, raised the vital issue of the clash between the new tendency in science to co-ordinate its various branches devoted to the study of mankind and his works, and the old methods of museum arrangement which kept them severely apart.

This scientific humanism, as we may term it, though it is generally referred to as ethnography, covers much of the ground formerly divided up academically between the subjects of ethnology, anthropology, archaeology, geography, history and art. It takes a group, racial or cultural, and studies it as a whole. In Holland, the makers of museums have adopted this point of view with enthusiasm, and have either altered drastically the old differently classified and over-crowded museums, or have built and endowed large new museums especially for the study and appreciation of the peoples and cultures of their overseas empire.

The Colonial Institute at Haarlem enables the Dutch people—students and ordinary citizens—to be initiated into the ancient civilizations embraced by their colonial possessions. Here man is not divorced from his inventions, his art and his accessories. He is shown, not as a 'laboratory specimen', but as a living human being whose racial features, geographic and climatic conditions and particular means of subsistence have forced him to live, dress, create—both in a religious and a material sense—in a manner peculiar to him. Films, lectures, photographs, booklets written by scholars and experts, fill out the picture and make the impact of new knowledge both sharper and deeper. The existence of this museum is almost entirely due to the acumen and enthusiastic enterprise of private individuals—bankers, colonial merchants, collectors and so forth.

Much the same policy is pursued by the Ethnographical Museum at Leyden, which is State supported

and controlled by the University of Leyden. Here is an immensely rich collection of Indonesian religious art and textiles, but although aesthetic values are brought out so far as possible by architectural means, judicious lighting and dramatic placing, yet these exhibits—the apex of a culture—are shown in their relation to the whole. They are not chunks broken off, so to speak, and existing in a vacuum.

In Great Britain the story is very different. The Victorian passion for collecting and labelling specimens has given us magnificently large, well-stocked museums, the policy and arrangement of which are still the old ones of dry scholastic classification. Objects are related in kind and time, but are divorced entirely from the men who made and used them. The only exception to this rule is the India Museum, part of the Victoria and Albert museum, which, under its new curator, Mr. K. de B. Codrington, is endeavouring to pursue this modern policy of co-ordination of all aspects of a nation's (in this case, a sub-continent's) civilization. There is serious talk, however, of this forward-looking policy being abandoned, the collection broken up, and the objects scattered, according to their ethnological, artistic or historic interest, through the various institutes of South Kensington.

Mr. de La Valette ended his talk with a strong bid not only for the continued existence of the India Museum as an entity, but also for a larger, really comprehensive India Museum on the same lines, which would combine its own collection with that of Indian and Indian-influenced objects belonging to the British Museum. This suggestion was supported by Sir Robert Witt (chairman), Lord Amulree and Sir James McKenna, among others. Sir A. Ramaswami Mudaliar made a moving plea that his great country should be studied sympathetically, and that its ancient art and culture, and its present development, should in England have a setting worthy of the Indian Empire.

Science in Radium Therapy

THE annual reports, which the Medical Research Council has now issued since 1923, enable the reader in retrospect to see how the methods of treatment of disease by means of radium have been evolved from frank experimentation to a procedure based on some, though limited, knowledge of the reactions of living tissues to radiation and supported by precision data on dosage.

The current report, No. 226 of the Special Report Series, "Medical Uses of Radium", is a summary of the work of the Council's research centres for 1936 (London: H.M. Stationery Office). The general scope of the experimental section, pp. 7-16, includes work of a purely physical and biological nature, that of the clinical section being largely concerned with the methods and results of treatment of malignant disease. A section on the treatment of simple metrorrhagia, pp. 37-38, is, however, not only of great

clinical interest, but also affords a good example of the way in which a successful form of treatment has been evolved by the method of trial and error, with still no certainty as to the essential processes set into operation by radiation. As stated in the report, 837 cases have been under observation at the Marie Curie Hospital for from one to ten years, and of these 97 per cent of the menopausal cases and 78.5 per cent of the younger patients have remained well without further treatment. Yet there is no very definite evidence as to the relative importance of the actions of the rays upon (1) uterus and (2) ovary.

By reference to this and earlier reports, the reader can quickly see the chief methods in use in the treatment of cancer of the breast, uterus, mouth, nasopharynx, larynx, oesophagus and rectum. Not only so, but for each one of these sites there are statistical

data giving the results of treatment, ranging in some cases over so much as fifteen years, and rarely so little as five. The data, taken in conjunction with those issued by the National Radium Commission, are in effect the answer to the question: What is the value of radium in the treatment of cancer? There are sites, such as the œsophagus and rectum, where the data show that a permanent improvement in the condition is not as a rule to be expected. On the other hand, a patient exhibiting an early stage of the disease in cancer of the cervix uteri is after suitable radium treatment more likely than not to be free of the disease five to six years later.

Methods change, and the tendency for the last few years has been to avoid interstitial methods and replace them by the use of radium outside the body. Teleradium has been practised by several centres in Great Britain over a period of years, and an interesting account is given of the clinical uses of a one gram unit at the Middlesex Hospital.

Reference to the experimental section shows that researches essential to our understanding of the biological actions are being undertaken by several groups, notably at the Strangeways Laboratory at Cambridge, the Imperial College of Science and Technology, the Royal Cancer Hospital, the Mount Vernon Research Centre and at the Middlesex Hospital. As stated in the introduction, with leading principles being established, the make-shift ground of empiricism gives way to a surer basis of therapy. That basis is quickly becoming a scientific one, in the sense that doses of radiation are now prescribed and dispensed in a quantitative manner; this has been brought about only by long effort, an important step being the establishment of the roentgen as an X-ray unit. The Medical Research Council, systematically and over a course of years, has aided the work of the British X-ray Unit Committee, which had much to do with fixing the value of the unit now in general use.

Cultural Successions in British Archæology

BRITISH archæology, perhaps, has profited more than any other field of archæological investigation by the recent diversion of interest from the more striking products of a culture to the building up of a culture complex as a whole. By this means it is now becoming possible to trace in greater detail and with more certainty the racial and cultural successions in Britain, and their interrelations, which went to make up the composite product appearing in these islands on the threshold of historic times. Hence the importance of such sites as Maiden Castle, St. Albans and Wheathampstead, on which more or less continuous or contiguous occupation over a comparatively long period affords an opportunity to follow the changes and modifications brought about by successive cultures.

These great sites, however, are exceptional; but an analogous opportunity, if on a somewhat lesser scale, is afforded for northern England by Eddisbury Hill, the Cheshire hill-fort, of which the recent excavation was described by Mr. W. J. Varley before the Ancient Monuments Society of Manchester on December 6. Here no less than six distinct cultural periods have been observed in the earthwork defences on the crest of the hill. A period of open occupation at the very close of the Bronze Age is represented by burial urns. This was followed by an immigration from the south, which was responsible for the largest hill-fort known in the north of England. An elaborate system of ramparts, ditches and entrances was built up during the first century B.C. This was still further enlarged under the threat of invasion by the Romans. This defensive system exceeds in complexity that of any other known Iron Age hill-fort in Britain. During the Roman occupation the rampart was dismantled and the ditches filled in. The hill lost its defensive character; and in late Roman times there is evidence of the floors of an open site occupation. The last cultural phase is early Saxon, of which relics have been discovered in a hut built over a filled-in ditch between two ramparts. Of traces of the Danish invasion none has hitherto been found; but excavation is not yet complete.

Another instance of a succession of occupations comes from Welwyn, which is all the more significant

in that it lies within the sphere of influence of the Belgic culture, which Dr. R. E. Mortimer Wheeler has described in the St. Albans area. The exploration of the Roman villa which was discovered by accident at Welwyn some five years ago points to the probability that this was a Roman farm; but further investigation shows that it had been preceded by a British, or rather a Belgic, farm.

As was pointed out by Mr. J. Ward Perkins, the excavator, in describing the site before the Society of Antiquaries on December 9, this is the first proved instance of the conversion of a pre-Roman into a Roman farm, although it would not be unreasonable to presume that this had happened with some frequency. The site is also notable for affording the rare evidence of a tower forming part of the Roman building. Such a tower might be presumed to be of frequent occurrence in Roman Britain, although actual traces of an upper story have not often been found. Here the lower part of the tower had walls of flint and brick, with coloured wall-plaster, while the upper part was of timber framing, probably filled with *pisé-de-terre*.

The result of the excavation at Welwyn is especially instructive from more than one point of view. The discovery of a pre-Roman agricultural occupation of the site links up with a number of discoveries of recent years bearing on the social and economic life of the period preceding the Roman invasion. That such discoveries have been made is to be traced in no small part to the efforts and influence of a research committee of the British Association, which directed attention to the significance of apparently unimportant and irrelevant finds on sites in Roman Britain by granting a small subsidy for many years to excavations on such sites in return for reports on the pre-Roman finds, which previously had been neglected. The growth from these small beginnings vindicates the prescience of those by whom the committee was instituted.

Further, and in the same connexion, the Welwyn excavation illustrates the advantages which may accrue from investigating the small and superficially unimportant site.

Science News a Century Ago

Quack Medicine

In a letter to the *Lancet* of December 23, 1837, "A Constant Reader" writes as follows: "There is a new system adopted by the puffers of nostrums, which, in the country, must operate very injuriously to the public. The other day travelling in the country, I met with a person who, in proof of the good performed by a quack medicine, pulled out of his pocket a handbill in which were stated the opinions of the leading journals of the metropolis, of course, highly laudatory of the nostrum in question. The plan formed to deceive the public is as follows:—An advertisement is sent to, perhaps, half a dozen of the leading journals, containing the puff intended to be republished in the handbills of the advertiser. As soon, however, as the advertisement has appeared, it is printed in the handbills, as if coming from the editor of the paper, in which it was inserted as an advertisement, and thus many ignorant persons really believe it to be the opinion of that journal."

Martin Van Marum (1750-1837)

ON December 26, 1837, the death of Martin Van Marum took place at Haarlem. He was born on March 20, 1750, at Groningen, and graduated there in medicine and philosophy. He afterwards practised medicine at Haarlem, but devoted much of his time to lecturing on physical subjects. He made a large number of experiments, especially in electricity, and devised a special form of the plate glass frictional electrical machine, which attracted a good deal of attention.

For more than forty years Van Marum was the secretary of the Dutch Society of Sciences at Haarlem. This Society had been founded in 1752 and was designed to include all branches of science and to further the search for everything necessary for the present and future prosperity of the country, both in its internal and external relations, in peace and war. Its motto was *Deo et Patria*. Its first secretary was the preacher Van der Aa, who was succeeded in 1794 by Van Marum, who held office until his death. It was probably through Van Marum that from about 1793 a more predominating place was given to physical science in its proceedings. In 1802 the Society published a volume of *Mechanical and Mathematical Transactions*, and in 1821-22 two volumes of *Philosophical Transactions*. Hooker, Lyell, Owen, Tyndall and Wheatstone were some of the foreign men of science elected to its membership.

The "Göttinger Sieben"

WHEN Queen Victoria came to the throne of England, the crown of Hanover passed to Ernst, Duke of Cumberland, the fifth son of George II. One of his first acts was to suspend the constitution of the State. This act led to a protest by seven professors of the University of Göttingen, who were dismissed then from their posts. They were afterwards referred to as the "Göttinger Sieben". They were Wilhelm Albrecht, professor of law, Friedrich Dahlmann, the historian, Heinrich Ewald, the theologian, Georg Gervinus, Jakob and Wilhelm Grimm, the philologists, and Wilhelm Ed. Weber (1804-1891), the physicist, who, with Gauss in 1833, had set up the first electric telegraph in Germany. As well as being dismissed from their posts, they were banished from the State, but not without meet-

ings of protests from other professors and the students. The streets of Göttingen had to be patrolled by soldiers, and coachmen were forbidden to supply students with carriages to enable them to accompany the professors to the borders.

Extracts from the German papers were given in *The Times* of December 27, 1837, and it is there stated that the students, not to be outdone, walked the sixteen miles to Wittenhausen where, as the exiled professors appeared with their families, they were given a rousing reception. Weber was afterwards professor of physics at Leipzig, but returned to Göttingen in 1849.

An Institution for the Advancement of Science

In its column of "Weekly Gossip", the *Athenaeum* of December 30, 1837, said: "Such of our readers as frequent Regent Street must have observed a large pile of building growing up, of late, on the west side, soon after passing Oxford Street, and communicating with one of the houses in Cavendish Square. This we are informed is about to be opened as an *Institution for the Advancement of the Arts and Practical Science* especially in connexion with Agriculture, Manufactures and other branches of Industry; combining in its results—say the projectors—many of the advantages of the *Ecole Centrale des Arts et Manufactures* in Paris. The house in Cavendish Square will contain a Reading Room, Library and accommodation for the meeting of persons feeling an interest in promoting the objects of the Institution, or desirous of acquiring knowledge of such new discoveries as may, from time to time, be made public. To it will be attached the Gallery, now building, which is to be 127 feet by 40 feet wide and well adapted, we are informed, for the exhibition of novel and useful Models and apparatus illustrative of the various branches of Science and their application to the Arts; with a Laboratory, Experiment Rooms, a Theatre for Lectures, Consultation Rooms for the use of inventors, patentees, persons wishing to make experiments and persons seeking information on any point of science."

University Events

BIRMINGHAM.—The degree of D.Sc. in industrial fermentation has been conferred on J. L. Shimwell for numerous papers, published in the *Journal of the Institution of Brewing*, on bacteriological subjects associated with the brewing and fermentation industry.

CAMBRIDGE.—A grant of £100 a year for five years is recommended to be paid from the Chest to the fund for the upkeep of Wicken Fen.

The degree of Sc.D. has been conferred on W. G. Palmer of St. John's College.

LONDON.—The title of reader in civil engineering in the University has been conferred on Dr. A. L. Higgins in respect of the post held by him at Queen Mary College.

The title of emeritus professor of chemistry in the University has been conferred on Prof. F. G. Donnan on his retirement from the University chair of chemistry at University College.

The degree of D.Sc. in botany has been awarded to Miss Katherine Warrington, of Rothamsted Experimental Station, and that of D.Sc. in physiology to Miss Katherine Tansley, of University College.

Societies and Academies

Dublin

Royal Irish Academy, November 8.

K. G. EMILJUS and J. SAYERS: Negative ions in discharge tubes. Rules for the effects of negative ions of molecular dimensions on conductivity and structure in the electric discharge have been formulated. A statistical theory of ion equilibrium in the plasma has been developed, and a source of O described.

H. SCHMITZ: Irish species of the dipterous family, Phoridae. The paper includes all previous Irish records for the flies of this family and in addition the results of six months (January-June 1937) intensive work at the group by the author and Fr. P. O'Kelly, S.J. Their combined efforts have increased our knowledge of the Irish Phoridae to the extent that there are now records for 117 species where previously we had only ten. Nine species new to science are described and new names proposed for hitherto wrongly identified species, necessary after re-examination of the types of Haliday's species in the National Museum, Dublin.

V. C. A. FERRARO: Functions of quaternions. A function of a quaternion is defined as one which possesses a differential coefficient independent of the differential quaternion. Two cases may be distinguished according as the differential is a pre- or post-factor. The most-general type of such a function is arrived at, and suggestions as to other definitions of a function are discussed.

Paris

Academy of Sciences, November 8 (C.R., 205, 825-884).

SERGE BERNSTEIN: The best approximation of non-regular functions.

KENTARO YANO: The equations of geodesics in a variety with projective connexion.

RAPHAËL SALÉM: Diophantine approximations and trigonometrical series.

ALFRED LINDARD: The generalization of a theorem of Privaloff.

FERNAND AIMOND: The equilibrium of convex surfaces.

RENÉ SWYNGEDAUF: The slipping of a transmission with unequal pulleys.

EMILE SEVIN: The action of the sources of stellar energy.

JEAN-LOUIS DESTOUCHES: The unity of theoretical physics.

LUIGI BULL and PIERRE GIRARD: The influence of electric and magnetic fields on the electric spark in air at atmospheric pressure. The effect of an electric field is constant, the spark is always curved with the convexity towards the anode. A magnetic field has generally no effect, but exceptionally one spark in a series shows curvature.

HUBERT FORESTIER and RICHARD LILLE: The influence of magnetic transformations on the velocity of formation of ferrite.

GEORGES DUCHÈNE: Modifications of the phosphorescence of a semi-conducting zinc sulphide under the influence of an electric current.

MME. MARIE FREYMANN: Comparison of the absorption spectra of the amines in the states of liquid and vapour in the near infra-red.

HORIA HULUBEI: New researches on the element 87 (Ml). Discussion of some objections raised to the conclusions on an earlier communication. The lines are admittedly feeble, due to the small proportion of the element present, but the results given in the present paper strengthen the assumption of the existence of the element 87 (moldavium).

WILFRIED HELLER and Mlle. GERMAINE QUINFF: The isothermal and reversible variation of the absorption in thixotropic salts.

RENÉ FREYMANN and Jules GUÉRON: Absorption spectra, in the near infra-red, of systems constituted by gaseous hydrochloric acid and an oxygenated organic solvent.

AUGUSTIN BOUTARIO and Mlle. SUZANNE THÉVENET: Variations of the viscosity of colloidal solutions of arsenic sulphide as a function of the time and under the influence of electrolytes.

MME. RAMART-LUCAS: The structure of coloured substances in the visible part of the spectrum according to their absorption spectrum.

ANTOINE WILLERMAT: Researches on the dissociable anthracene oxides: the influence of fatty groups in the meso position.

LOUIS DUNOYER: Optical illusions produced by a rotating light (in a lighthouse).

EDMOND ROTHÉ and ELIE PETERSCHMITT: The mode of production of earthquakes. The distribution of compressions and expansions.

PIERRE LEBAGE: The exchange of the seeds of *Lepidium sativum* between media at different temperatures. Studies on the duration of acquired precocity in plants grown in different climates.

PAUL BERTRAND: Remarks on the comparative ontogeny of living and fossil phanerogams. The correct interpretation of the organization of seedlings of phanerogams gives a means of reconstituting with sufficient accuracy the organization of seedlings of all fossil phanerogams, provided that there is a good transverse section of the stem and some indications on the structure of the root.

LOUIS BLARINGHEM: Remarks on the preceding communication.

JEAN BRAUVHÈRE: The granular structure of the chloroplasts: the stroma.

Mlle. LISE EMBRIQUE: Experimental rickets in the guinea pig.

ANDRÉ LWOFF and HISATAKE DURI: Thiazol, a growth factor for *Polytoma ocellatum*. The importance of the constituents of aneurine for the leucophyte flagellates.

Amsterdam

Royal Academy (Proc., 40, No. 8, October 1937).

F. A. VERNING MEINERTZ: (1) Second order disturbance terms in pendulum observations at sea. A discussion of Brown's correction terms and their possible experimental determination. (2) Determination of the earth's plasticity from the post-glacial uplift of Scandinavia: isostatic adjustment.

J. CLAY and G. VAN KLINFF: Conductivity of pure gases at high pressures. Neon and xenon become conducting even in the absence of an external ionizing agent at certain pressures between 60 and 80 atm.

J. G. VAN DER CORPUT: Weyl's method in the theory of numbers.

R. WEITZENBÖCK: Trivectors.

E. COHEN and W. A. T. COHEN-DE MEESTER: Daniel Gabriel Fahrenheit (2). A further contribution to the history of Fahrenheit.

H. BRENDKAMP: Carson's integral equation.

HWA-CHUNG LEE: Differential geometry of constant transformations.

J. HAANTJES: Conformal representations of an n -dimensional Euclidean space with a non-definite fundamental form on itself.

J. M. VAN DER ZANDEN: Polymerides of methyl-chavicol.

A. W. H. VAN HEEK: Chemical processes in the spexis of *Sauromatum* (3).

H. W. V. WILLEMS: Relation between the optical properties and the chemical composition of glaucophane.

G. C. HIRSCH: Outlines of a theory of the Golgi bodies (2). The Golgi bodies in time.

G. STAHNY: *Parerythropodium maris-tenebrosi* n.sp., a new alcyonarian from the coast of north-west Africa.

Vienna

Academy of Sciences, October 21.

H. BRENDORF and MELITTA MITLACHER: Stationary air currents in closed vessels. It is found that the needle of a short-circuited electrometer moves with a period of one day. On certain days, a short-period motion is superposed on the diurnal motion. The short-period motion is due to fluctuations in the barometric pressure causing air to stream in and out of the case, while the diurnal motion is due to small temperature changes in the case of the electrometer setting up slowly varying, quasi-stationary air currents. The diurnal variation of these air currents may give rise to errors in large ionization chambers.

G. STETTER and F. PRANKE: Resonance effect in the disintegration of aluminium by α -rays.

K. JEHK: Stress in a lap weld with chamfered seam.

F. WISELEY, A. MUNSTER and S. WANG: Catalytic hydrogenation of saturated lactones.

October 28.

W. J. MÜLLER and R. GRUBER: Comparative study of the reactivity of lignites and their coals. The results given by different methods of measurement are compared.

E. BARONI and A. FINK: Concentration of D_2O in natural ice (4).

K. BRAUNER: Curvature property of manifolds of class 1.

F. WERNER: Fauna of the Peloponnesus, the islands of Cythera and Euboea and the islets of the Saronic Gulf.

K. ZALISKY: Mammals of Lower Austria, with particular reference to the Gölseental.

November 4.

R. INZINGER: Curve invariants of cyclic series.

S. MEYER: Age of the sun and the decay constant of actino-uranium.

E. CLAR: Stratigraphy of the Schwarzeck breccia in the Radstädter Tauern.

H. STROUBAL: Greek millipeds collected by Dr. F. Werner in 1937.

J. SCHNEIDER: Discovery of a female Boii skeleton at Vill near Innsbruck.

A. ERDÉLYI: Non-uniform strings with a parabolic distribution of density.

L. LÄMMERMAYER: Amount and nature of the growth of wood at and above the forest boundary.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR ASSISTANT CHIEF (male) at the Royal Ordnance Factory, Irvine—The Under-Secretary of State (O.S.), The War Office, London, S.W.1 (January 8) (Quote Appt/60).

TECHNICAL OFFICER (radio development) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (January 8) (Ref. No. 526).

ONE BACTERIOLOGIST AND ONE NATURALIST in the Laboratories of the Freshwater Biological Association of the British Empire at Wray Castle, Ambleside, Westmorland—The Director (January 31).

LIVERY PROFESSOR OF COAL GAS AND FUEL INDUSTRIES in the University of Leeds—The Registrar (February 5).

ASSISTANT LECTURER IN HORTICULTURE in Buckinghamshire—The Agricultural Organizer, County Office, Aylesbury.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Report of the National Forest Park Committee (Browdonia), 1937. Pp. 5+1 plate. (London: H.M. Stationery Office.) 6d. net. [1911]

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1936; with Report and Notes of the Director. Pp. xx+40. (Blackburn: Stonyhurst College Observatory.) [1911]

Technical Publications of the International Tin Research and Development Council. Series A, No. 66: Measurement of the Thickness of Tin Coatings on Steel by a Magneto and Electromagnetic Method. By Dr. B. Chalmers, W. H. Hoare and W. H. Tait. Pp. 9. Free. Series B, No. 6: The Wetting of Metals by Metals with particular reference to Tinning and Soldering. By M. J. Daniels and D. J. Macnaughtan. Pp. 11. Free. (London: International Tin Research and Development Council.) [1911]

Report by the Food Council to the President of the Board of Trade on Costs and Profits of Retail Milk Distribution in Great Britain. Pp. 36. (London: H.M. Stationery Office.) 6d. net. [1911]

Royal Commission on Awards to Inventors. Final Report. (Cmd 5594.) Pp. 8. (London: H.M. Stationery Office.) 2d. net. [1911]

University of London: University College. Calendar, Session 1937-1938. Pp. lxxx+14+588+24. (London: Taylor and Francis, Ltd.) [1911]

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 90. Studies on the Family Acrididae (Orthoptera) of Venezuela. By H. Radcliffe Roberts. Pp. 245-268. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 8: Lepidoptera; Rhopalocera. By Ezra T. Cresson, Jr. Pp. 269-334. Third Preliminary Report on the Results of the Second Dolan Expedition to West China and Tibet; Four New Birds from Tibet. By Ernest Schaller. Pp. 335-336. (Philadelphia: Academy of Natural Sciences.) [1911]

Union of South Africa: Department of Mines: Geological Survey. Memoir No. 33: The Geology of the Country around Bethlehem and Kestell; with Special Reference to Oil Indications. By O. R. Van Riden. Pp. 60. (Pretoria: Government Printer.) 7s. 6d., including Map. [1911]

The University and the National Life: Three Addresses to Victorian Political Organizations. By Dr. E. H. Priestley. Pp. 48+9 plates. (Melbourne: Melbourne University Press.) [1911]

Annals of the Royal Botanic Garden, Calcutta. Vol. 14; Part 1: An Account of the Genus *Dioscorea* in the East. Part 1: The Species which Twine to the Left. By D. Prain and I. H. Burkill. Pp. xii+vi+36 plates. (Calcutta: Government Printing Office.) 75 rupees; £5 12s. 6d. [1911]

Smithsonian Miscellaneous Collections. Vol. 96, No. 6. Growth of *Avena Coleoptile* and first Internode in Different Wave-length Bands of the Visible Spectrum. By Earl S. Johnston. (Publication 3444.) Pp. 19. (Washington, D.C.: Government Printing Office) [1911]

Catalogues, etc.

Klassische Philologie, Teil 1. (Antiquariatskatalog Nr. 716.) Pp. 240. Geschenksverzeichnis aus allen Gebieten der Unterhaltung und des Wissens. (Böcher-Anzeige No. 170.) Pp. 150. Mittelalter: Geschichte, Kulturgeschichte, Rechts- und Wirtschaftsgeschichte, Kirchengeschichte. (Antiquariatskatalog Nr. 718.) Pp. 272. (Leipzig: Gustav Fock, G.m.b.H.) [1911]

Catalogus Dissertationum, Philologicarum Classicarum. Editio III. Bibliographische Schriften zu den griechischen und lateinischen Schriftstellern, enthaltend die Literatur aus den Jahren 1911-1936. Pp. 176. (Leipzig: Gustav Fock, G.m.b.H.) 1.50 gold marks.

Dulcan's Autumn 1937 Botanical Catalogue, with a few Miscellaneous Natural History Books in addition. (No. 266.) Pp. 45. (London: Dulcan and Co., Ltd.) [1911]

A Short Catalogue of Books relating to Africa. (Catalogue N.8. No. 25.) Pp. 23. Books of Early Science, Medicine, etc. (Catalogue N.8. No. 26.) Pp. 42. Dawson's Periodica (English and Foreign). (Catalogue N.8. No. 27.) Pp. 56. (London: Wm. Dawson and Sons, Ltd.) [1911]

English Books before 1700. (Catalogue No. 619.) Pp. 72. (London: Francis Edwards, Ltd.) [1911]